

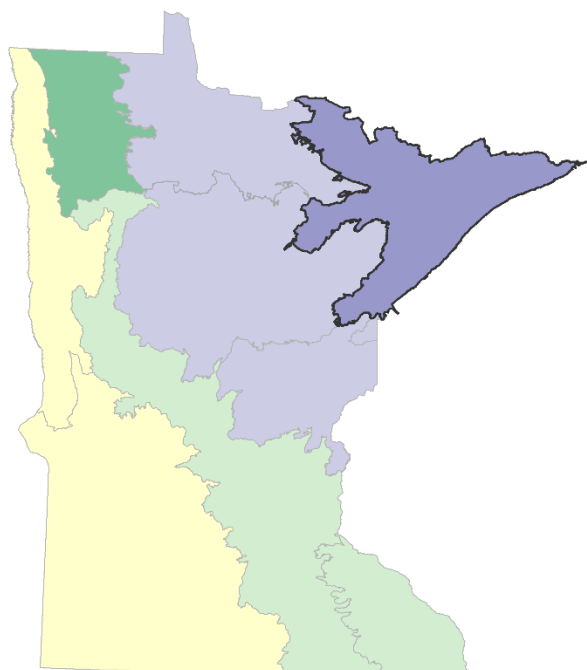
---

# Northern Superior Uplands

## Section Forest Resources Management Plan Narrative Guidance

March 2026

---





500 Lafayette Road

St. Paul, MN 55155-4040

888-646-6367 or 651-296-6157

[mndnr.gov](http://mndnr.gov)

The Minnesota DNR prohibits discrimination in its programs and services based on race, color, creed, religion, national origin, sex, marital or familial status, disability, public assistance status, age, sexual orientation, and local human rights commission activity. Individuals with a disability who need a reasonable accommodation to access or participate in DNR programs and services, including those who would like to request this document in an alternative format, should contact the DNR ADA Title II Coordinator at [info.dnr@state.mn.us](mailto:info.dnr@state.mn.us) or 651-296-6157. We welcome calls from Telecommunications Relay Service (TRS) users. For assistance in other languages, please call 651-296-6157 or 888-MINNDNR (646-6367). Discrimination inquiries should be sent to Minnesota DNR, 500 Lafayette Road, St. Paul, MN 55155-4049.

©2022, State of Minnesota, Department of Natural Resources

---

## Table of Contents

List of Abbreviations .....	5
Executive Summary.....	6
Guiding Principles for the SFRMP process.....	6
Planning Outcomes and Summary .....	6
Chapter 1: Introduction .....	8
State Lands Foundational to Forest Management .....	8
Layers of DNR Forest Management Direction and Guidance.....	10
Section Forest Resource Management Plans .....	12
SFRMP Implementation.....	13
Scope of this Section Forest Resource Management Plan .....	14
Forest Planning Efforts Related to the NSU SFRMP .....	18
Planning Area Description .....	18
A Note on Data Limitations .....	19
Chapter 2: SFRMP Vegetation Management Issues .....	20
Issue Definition .....	20
Issues .....	21
Chapter 3: Forest Types and Management Direction.....	36
Introduction.....	36
3.1 Forest Composition and Within-stand Diversity .....	38
Cover Types .....	42
3.2 Harvest Levels.....	68
3.3 Biological Diversity, Young and Old Forest, and Spatial Distribution .....	70
3.4 Wildlife Habitat.....	76
3.5 Riparian and Aquatic Areas .....	77
3.6 Timber Productivity .....	78
3.7 Forest Pests, Pathogens, and Non-native Invasive Species.....	79
3.8 Climate Change.....	80
3.9 Visual Quality .....	81
3.10 Access to State Land .....	81

3.11 Cultural Resources .....	82
3.12 Natural Disturbance Events .....	82
3.13 Management Opportunity Areas .....	83
Appendix A: Summary of Issues and General Direction Statements.....	85
Summary of Issue Statements .....	86
Summary of General Direction Statements .....	88
Appendix B: Management Opportunity Areas .....	90
Deer Management Areas .....	90
Landscape Management Opportunity Area .....	92
Moose Management Opportunity Areas .....	93
Old Forest Management Complexes .....	94
Open Landscape Management Area .....	96
Patches .....	97
Ruffed Grouse Management Area .....	99
Pilot Management Opportunity Areas .....	101
Appendix C. Modeled Management Regimes .....	103
Even-Aged Management Rotation Age and Reserves Tables .....	104
Uneven-Aged Management Regimes.....	108
Thinning Regimes .....	112
Appendix D: Planned Acre and Volume Summary Tables .....	116
Glossary.....	117

## List of Abbreviations

---

<b>Abbreviation</b>	<b>Description</b>
APA	Annual plan addition
Con-Con	Consolidated-conservation land
DFC	Desired future condition
DNR	Department of Natural Resources
ECS	Ecological classification system
ELB	Eastern larch beetle
ETS	Endangered, threatened, and special concern species
EWR	Ecological and Water Resources Division
FAW	Fish and Wildlife Division
FIA	Forest inventory and analysis
FIM	Forest inventory module
FRIT	Forest resources issues team
FSC	Forest Stewardship Council
GDS	General direction statement
GIS	Geographic information system
HCVF	High conservation value forest
MBS	Minnesota Biological Survey
MFRC	Minnesota Forest Resources Council
MOA	Management opportunity area
NHIS	Natural heritage information system
NPC	Native plant community
NSU	Northern Superior Uplands
OFMC	Old forest management complex
RAN	Region area number
RGMA	Ruffed grouse management area
RMZ	Riparian management zone
RSA	Representative sample area
SFI	Sustainable Forestry Initiative
SFRMP	Section Forest Resource Management Plan
SGCN	Species in greatest conservation need
SI	Site index
SMZ	Special management zone
SNA	Scientific and natural area
STH(A)	Sustainable Timber Harvest (Analysis)
WMA	Wildlife management area

See the [Glossary](#) for definitions of terms used in this document.

# Executive Summary

---

This Section Forest Resource Management Plan (SFRMP) narrative provides guidance for vegetation management on state forest lands administered by the Minnesota Department of Natural Resources (DNR) divisions of Forestry and Fish and Wildlife in the [Northern Superior Uplands \(NSU\) Ecological Section](#). The primary audience for this document is land managers within the DNR; however, the plan also informs stakeholders and the interested public about DNR forest resource management in the NSU Section. This SFRMP replaces the narrative guidance in three plans that formerly covered the Northern Superior Uplands Section: the Border Lakes Subsection Forest Resource Management Plan, the North Shore Highlands, Toimi Uplands, and Laurentian Uplands Subsection Forest Resource Management Plan, and the Nashwauk Uplands portion of the North 4 Subsection Forest Resource Management Plan.

DNR forest management is shaped by a wide range of statutes, policies, plans, and site-level guidance. Section Forest Resource Management Plans, which include both strategic and operational components, play a key role in this broader network of direction and guidance, and are developed and implemented accordingly. For example, all SFRMP components are developed to meet statutory requirements and DNR policies, and considering other information such as wildlife management area (WMA) unit plans. Likewise, DNR forest managers account for DNR policies, procedures, and other relevant plans, such as WMA unit plans, alongside SFRMP guidance when deciding if and how to manage specific forest stands.

This SFRMP narrative informs implementation of the 10-year stand exam list and documents management opportunity areas (MOAs), which are areas on DNR-administered lands that offer good opportunities to maintain or create spatial patterns to address natural resource values that are difficult to achieve through individual stand management. It is intended to inform management for approximately the next 10 years or until replaced.

## Guiding Principles for the SFRMP process

- Provide guidance for forest management activities that address ecological protection, timber production, fish and wildlife habitat, and cultural and recreational values at the landscape scale.
- Provide guidance to managers and foresters implementing the SFRMP strategic direction and stand exam list.
- Ensure recommendations for vegetation management adhere to DNR directions, guidelines, and policies.
- Use the expertise of interdisciplinary team members across DNR divisions to identify issues, direction, and strategies for vegetation management on state-administered land in the NSU Section.
- Consider and incorporate tribal and public input in the planning process.

## Planning Outcomes and Summary

- This plan calls for increasing within-stand compositional and structural diversity appropriate to native plant communities to address habitat objectives and increase resilience to climate change.

- The plan provides that young and older forest for all cover types will continue to be represented on DNR-administered land, with amounts determined through this plan period's strategic direction. This plan recommends strategies aimed at providing older forest characteristics within stands, especially in management opportunity areas such as old forest management complexes.
- The plan includes strategies for managing riparian areas to retain their integrity and provide habitat for fish, wildlife, and plant species, including increasing longer-lived species and conifers, increasing forest age, and applying Minnesota Forest Resource Council Voluntary Site-Level Forest Management Guidelines in riparian areas.
- As part of this planning process, management opportunity areas in the Section that were included in the 10-year stand exam list development process were reviewed. Management guidance was developed for these opportunity areas, which contribute toward meeting goals for providing habitat and ecosystem functions that require management at broader scales than individual stands.
- Forest cover type conversion goals in this plan emphasize decreasing the aspen cover type by approximately 2.4% and increasing acres of red pine, white cedar, white spruce, northern hardwoods, white pine, and other cover types. These goals are intended to increase resilience to climate change, provide wildlife habitat, and develop cover types on suitable NPCs. Aspen will continue to be the most abundant cover type in the Section.
- Additional topics addressed in the plan include limiting damage from insects, disease, and non-native species; producing forest conditions that support a range of wildlife habitats; managing for endangered, threatened, and rare species; managing areas of high and outstanding biodiversity significance; minimizing forest management impacts on visual quality; protecting cultural resources; considering climate change mitigation and adaptation needs and opportunities; and evaluating and responding to disturbance events (e.g., fire and wind).

# Chapter 1: Introduction

---

State statutes, including the Sustainable Forest Resources Act ([Minnesota Statute 89A](#)), provide direction for forest management conducted by the Minnesota Department of Natural Resources (DNR). Accordingly, it is the state's policy to "pursue the sustainable management, use, and protection of the state's forest resources to achieve the state's economic, environmental, and social goals," with sustainability defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." In addition, the DNR's mission is to work with Minnesotans to conserve and manage the state's natural resources, provide outdoor recreation opportunities, and provide for commercial uses of natural resources in a way that creates a sustainable quality of life. State-owned, DNR-administered lands and associated resources are foundational to the DNR's ability to execute its mission for the benefit of all Minnesotans.

## State Lands Foundational to Forest Management

The DNR manages 5.6 million surface acres of state-owned land throughout Minnesota and 12 million acres of state-owned mineral rights that significantly contribute to Minnesota's quality of life and economic opportunity. These lands and resources support natural resource-based economies, provide tourism and recreation opportunities, protect rare resources, provide habitat for fish and wildlife, and provide important ecological services like clean air and water.

### State Trust Lands

The DNR manages school trust (2.5 million acres statewide) and university trust lands (25,840 acres statewide) on behalf of their respective beneficiaries - Minnesota's public schools and the University of Minnesota. The Permanent School Fund and Permanent University Fund are trusts established in the Minnesota State Constitution and designated as perpetual sources of income for the named beneficiaries. The funds consist of two parts: the physical lands granted to the state by the federal government and the dollars in the fund that are generated from those lands. The department manages the physical lands as a trustee. This trustee obligation imposes fiduciary responsibilities on the Department to manage the trust fund lands in the best interests of the beneficiaries to fund Minnesota's public schools and the University of Minnesota.

**School trust lands** are managed to maximize long-term economic return consistent with sound natural resource conservation and management principles ([Minn. Stat. 127A.31](#)). See the department's Operational Order 121: Management of School Trust Lands for more information about how we operationalize this constitutional and statutory directive. Investment income is distributed to the state's public school districts annually to fund operations. There are approximately 500,300 acres of school trust lands in the NSU Section.

**University trust lands** are managed to generate revenue for the permanent university fund. Investment income is distributed to the University of Minnesota annually, which is used to fund professorial chairs, scholarships for students from the Iron Range, mineral and mineral-related research, a mining-related degree program offered through the University at the Mesabi Range Community and Technical Program, and scholarships for students to attend that program. There are approximately 11,400 acres of university trust lands in the NSU Section.

## State Non-trust Lands

The DNR manages non-trust lands according to their applicable statutory purposes. These lands primarily include Volstead lands (31,500 acres) and acquired lands (1.49 million acres).

**Land & Water Conservation Fund** (“LAWCON Lands”) The purpose of LAWCON is to provide public outdoor recreation opportunities. Forest management, including timber harvesting, is allowed to preserve the natural attributes of the forest and promote outdoor recreation. However, harvesting timber chiefly to meet a commercial demand is not allowed. The state can use its discretion in managing LAWCON lands, provided the management is solely for outdoor recreation. These requirements are codified in 36 CFR Part 59.3.

**Former Minnesota Power Lands** have been acquired through various means by the DNR. These lands are now part of the Riverlands State Forest.

**Volstead lands** were purchased from the federal government with funds appropriated by the Minnesota Legislature. These lands carried unpaid county liens for drainage ditches intended to make the land suitable for farming but were unsuccessful. Income generated from DNR natural resource management on these lands is split evenly with the county in which the lands are located. The granting authority for Volstead lands is under the Act of Congress, May 20, 1908 (“Volstead Act”) and the Act of Congress, May 1, 1958. Also, see [Laws of MN 1961, Ch. 472](#), as amended by [Laws of MN 1963, Ch. 390](#). There are approximately 50 acres of Volstead lands in the NSU Section.

**Acquired lands** were gifted from private owners or organizations or governmental entities, purchased to meet specific management or habitat needs, or otherwise conveyed to the state. The DNR manages these lands according to the statutory authority under which they were acquired. There are approximately 149,000 acres of acquired lands in the NSU Section.

## Recreation Unit

This guidance in this SFRMP narrative applies to lands of the various statuses listed above in recreation units that have different statutory purposes.

**Wildlife Management Areas (WMAs)** are managed in accordance with MN Statutes section [86A.05](#). Specifically, WMA lands are developed and managed “...for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses.” WMAs may include school trust lands, which are managed to maximize long-term economic return to the Permanent School Fund while also incorporating WMA goals.

**Aquatic Management Areas (AMAs)** are managed according to MN Statutes section 86A.05 “to protect, develop, and manage lakes, rivers, streams, and adjacent wetlands and lands that are critical for fish and other aquatic life, for water quality, and for their intrinsic biological value.”

**State forest lands** are managed according to MN Statutes [chapter 89](#) under the principles of multiple use and sustained yield to provide multiple forest benefits over time, including wildlife habitat, biodiversity, wood supply and healthy natural resource economies, carbon storage and sequestration, forest health, recreation, and water quality and quantity.

## Layers of DNR Forest Management Direction and Guidance

Multiple layers of laws, policies, guidelines, and plans direct and inform forest management on DNR-administered lands. Together, they shape the DNR’s mission, vision, goals, objectives, and strategies for forest management, with the aim of optimizing the balance of multiple forest values and their corresponding benefits sustainably over time. Because requirements differ across recreational units and land statuses managed by the DNR, the “optimal balance” of forest benefits varies depending on the authorized purpose of those lands.

Within this network of forest management direction and guidance, DNR forest management objectives are informed by data and analysis and are predicated on:

- Minnesota statutes that lay out the purpose and management goals of the units of the Outdoor Recreation System and forest management goals and policies (see above). For example, DNR’s forest management on WMAs and aquatic management areas (AMAs), is conducted to advance fish and wildlife habitat, and forest management on state forest lands provides for multiple use and sustained yield.
  - Key state statutes include Outdoor Recreation System Classification and Purposes (Minn Stat. 86A.05); State Forests, Tree Planting, Forest Roads (Minn. Stat. Ch. 89); Sustainable Forest Resources Act (Minn. Stat. 89A.02); Permanent School Fund (Minn. Stat. 127A.30—127A.353); Wildlife Management Areas (Minn. Stat. 86A.05, subd. 8).
- The multiple forest values (i.e., wildlife habitat, biodiversity, wood supply and healthy natural resource economies, climate mitigation and adaptation, forest health, recreation, and water quality and quantity) toward which the DNR manages, with the relative emphasis among these values depending on the recreation unit and land status.
- The long-term, landscape-level desired future forest conditions (DFFCs) described in SFRMPs that DNR is seeking to achieve through forest management.

Additional direction clarifies how the DNR will advance forest management objectives, including:

- The Interdisciplinary Forest Management Coordination Framework, which governs how DNR disciplines work together to meet requirements and advance goals through forest management, including operational procedures such as the dispute resolution process and the Procedure: *Forest Habitat Management on Lands Administered by the Fish & Wildlife Division*.
- All policies, guidelines, and short-term direction included in the DNR’s Interdisciplinary Forest Management Policy System.
- Minnesota’s Forest Resources Council’s Voluntary Site-Level Forest Management Guidelines, which the DNR uses as best management practices (BMPs) for all forest management work.
- The spatial 10-year Stand Exam List, which identifies the forest stands to consider for management (see the [Development of the DNR 10-year Stand Exam List report](#) for more details).
- Annual stand exam lists derived from the 10-year Stand Exam List.
- Strategies in SFRMPs and WMA plans.

- Other applicable division guidance, procedures, and manuals such as the Division of Fish and Wildlife directive on forest management on WMAs and AMAs/FMAs.

Together, these laws, policies, guidelines, procedures, and plans ensure the DNR manages forests sustainably; adheres to its mission; and meets its statutory, forest certification, contractual, and fiduciary obligations.

Section Forest Resource Management Plans are a key layer that interacts with others in DNR's broader network of forest management direction and guidance. They are developed to comply with all requirements, including applicable state and federal laws and DNR policies. Additional information from sources such as WMA unit plans, which provide fish and wildlife habitat management guidance within WMAs, are also considered when developing SFRMPs. Likewise, when implementing SFRMP direction and guidance, DNR forest managers comply with all other requirements, including DNR policies and procedures, consider additional relevant guidance, and consult WMA plans when working within WMAs.

## Examples of the layers of direction and guidance for forest management on DNR-administered lands

Laws and statewide strategic plans	Policies and procedures	Landscape and sub-landscape plans and direction	Site-level guidance and information
Sustainable Forest Resources Act (MS 89A) Forest Resource Management (MS 89) School Trust Lands (MS 84, subd. 18) State Outdoor Recreation Act (MS 86A.05) State Forests Wildlife Management Areas Federal Endangered Species Act DNR Strategic Conservation Agenda State Forest Action Plan State Wildlife Action Plan	Operational orders School trust lands Invasive species Climate adaptation and mitigation Interdisciplinary forest management policy system Rare species and native plant communities (NPCs) Bald eagle nests High conservation value forest (HCVF) Bat habitat conservation plan (HCP) policy Old growth forest Department and division policies, directives, procedures, guidelines and manuals	SFRMP WMA plans Minnesota Forest Resources Council (MFRC) landscape plans Sub-landscape direction (e.g., HCVF direction documents) Beltrami Island LUP Comprehensive Conservation Plan	MFRC site-level guidelines NPC field guides and silvicultural strategies Silvicultural case studies

## Section Forest Resource Management Plans

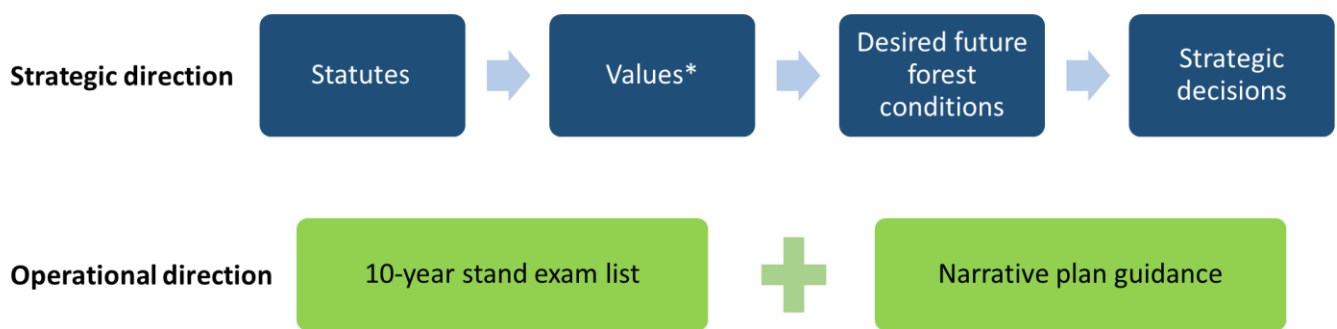
Section Forest Resource Management Plans guide forest management activities on state-administered forest lands, primarily in state forests and WMAs, at the ecological section scale. SFRMPs have both strategic and operational components designed to advance long-term (50+ year) landscape scale goals over 10-year planning periods.

SFRMP strategic direction includes desired future forest conditions designed to sustainably supply a balance of forest benefits - wildlife habitat, biodiversity, wood supply and healthy natural resource economies, carbon storage and sequestration, forest health, recreation, and water quality and quantity - over the long-term at the landscape scale according to the statutory purpose and other requirements associated with the different lands the DNR manages.

SFRMP operational direction includes information regarding which forest stands DNR forest managers will visit for potential management (stand exam lists) and narrative guidance for what to consider when deciding if and how to manage a specific forest stand. Implementation of stand exam lists and the guidance in this SFRMP narrative is conducted in the context of the broader network of DNR forest management direction (see above), which includes policies, procedures, and other plans that may influence forest management decisions for a particular stand. For example, the guidance in this SFRMP narrative is implemented in the context of policies for how to coordinate among DNR disciplines, procedures for how to administer the stand exam list and conduct forest management on Fish and Wildlife-administered lands, and state or federal requirements based on the recreation unit, land status, and resources on the ground.

## SFRMP Components

SFRMP desired future conditions (DFCs) and strategic decisions meet statutory requirements and are informed by values. SFRMP operational direction includes the 10-year stand exam list and narrative guidance for advancing long-term landscape objectives through site-level decisions.



\*wildlife habitat, biodiversity, wood supply and healthy natural resource economies, climate adaptation and mitigation, forest health, recreation, and water quality and quantity

## SFRMP Implementation

As this SFRMP is implemented, DNR staff visit and evaluate stands in the NSU Section on the stand exam list for potential management. After receiving comments from internal staff, tribes, and the public, DNR staff conduct stand examinations. These stand examinations can have several different outcomes. Some stand exams result in postponing management to another planning period for biodiversity, habitat, or silvicultural reasons (e.g., the stand is not ready to harvest). Sometimes, the forest inventory requires correction, and the site is not ready to harvest. In other cases, a treatment other than timber harvest is deemed most appropriate to meet the stand goals. And in still other cases, timber harvest is appropriate. Timber harvest can take many forms, including regenerating an entire site, applying an intermediate treatment such as thinning to improve tree growth, selectively cutting trees to adjust forest composition and structure, or addressing a forest health issue. DNR forest managers incorporate many sources of information and direction into these management decisions, including:

- Current site conditions
- Comments from DNR foresters, wildlife biologists, ecologists, and archaeologists; tribal natural resources staff; and the public
- Specific considerations regarding:
  - recreation unit classification (e.g., WMA, state forest)
  - land status (e.g., school trust, acquired, consolidated conservation)
  - resources on the site (e.g., rare native plant communities, federal or state endangered or threatened species, High Conservation Value Forest, water features, wildlife habitat components, legacy trees, bald eagle nests, recreational trails, roads, etc.)
- Best practices outlined in Minnesota Forest Resource Council Voluntary Site-Level Guidelines
- Narrative SFRMP guidance, including MOA goals and strategies
- WMA unit plan goals and strategies

DNR staff then develop site-specific prescriptions for stands that are identified for timber harvest that achieve landscape- and site-level forest management goals.

## Scope of this Section Forest Resource Management Plan

This SFRMP directs vegetation management on DNR-administered forest lands in the Northern Superior Uplands (NSU) Ecological Section, which contains the Border Lakes, Nashwauk Uplands, Laurentian Uplands, Toimi Uplands, and North Shore Highlands Subsections ([Map 1.1](#)). A detailed explanation of the DNR’s ecological classification system (ECS), including sections and subsections, is available on the [DNR ECS webpage](#). Vegetation management includes actions that affect the composition and structure of forest lands, such as timber harvesting, thinning, prescribed burning, biomass harvest, and reforestation. SFRMP planning considers the condition and management of forest lands in other ownerships but only proposes forest management direction and actions for DNR-administered lands.

This plan considers only a portion of DNR-administered forest lands in the NSU Section and uses cover type to classify vegetation for management on those lands (the cover type of a stand is generally determined by the predominant tree species or vegetation type in that stand). The following terms describe subsets of DNR-administered lands and how they relate to the SFRMPs:

- “Forest land” includes lands in the DNR forest stand inventory, including cover types from aspen to stagnant conifers, muskeg, upland and lowland grass and brush, and other wetlands.
- “Managed acres” refers to a subset of forest lands that excludes areas such as old growth forests, state parks, and scientific and natural areas (SNAs) where we do not develop plans for using timber harvest as a tool to achieve our goals. Managed acres also exclude inoperable stands. SFRMP guidance applies to managed forest acres.
- “Timberland” refers to managed acres for which timber harvest is a feasible management tool. Timberland includes cover types capable of producing merchantable timber and excludes very slow-growing trees (e.g., stagnant lowland conifers or offsite aspen). Timberland is the pool of acres that was used to develop stand exam lists for this planning period.

This SFRMP provides guidance for managed acres in the NSU Ecological Section.

Not all forest management planning is addressed in this SFRMP, however. Examples of management planning activities that are beyond the scope of SFRMPs include comprehensive road access plans, state park land management planning, old growth forest designation, scientific and natural area (SNA) establishment, wilderness designation, establishment of wildlife population goals, cumulative effects analysis at the watershed level, fire management, and recreation facilities/systems planning (e.g., hunter walking trails, forest recreation areas, or off-highway vehicle trails planning).

### **Desired Outcomes of the SFRMP Planning Effort**

This SFRMP provides goals and direction for resource managers in the NSU Section, including:

- **Desired Future Condition (DFC) Goals:**
  - These are long-term (50+ years) and short-term (10 years) changes in vegetation structure and composition.
  - DFCs are achieved through management activities, including no action, that will best move the forest landscape toward the goals for state forest lands.
    - Strategic planning decisions include the [estimated amount of timber volume necessary to offer during FY2019-2028](#) to advance DFCs over that period.
  - DFCs, including cover type goals, are developed from existing long-term SFRMP goals, [assessment information](#), and identified issues.
- **Guidance to staff on stand exam list implementation**
  - General direction statements and strategies in Chapter 3 guide staff on what to consider when making forest stand management decisions while completing stand exams.
  - Products of this SFRMP planning process include implementation training and a field guide for DNR staff so they understand how to apply SFRMP guidance during stand exams.
- **Guidance and prioritization of Management Opportunity Areas (MOAs)**
  - MOAs identify good opportunities to address particular values on DNR-administered lands that can be difficult to achieve at the stand level. See Appendix B for more information on MOAs.
  - MOAs include old forest management complexes (OFMCs), ruffed grouse management areas, older forest patch MOAs, open landscape priority areas, and deer yards, among others.
  - Management guidance documents developed for MOAs through SFRMP are included as appendices in this plan.

### **Staff Involved in Developing SFRMPs**

While the Division of Forestry is the lead division for developing and maintaining SFRMPs, the development process is interdisciplinary. Planners and personnel from the DNR Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources contribute to the development of SFRMP components, with oversight from forest resource issues teams (FRITs). Regional and Executive FRITs are comprised of the regional director and managers of the three divisions and division directors, respectively. The northeast (Region 2) FRIT sponsored the

NSU planning effort. Additional staff, such as Geographic Information System (GIS) or administrative specialists, support SFRMP planning as needed.

### **Tribal and Public Involvement Opportunities**

Tribal and public involvement in SFRMP development occurs through a comment period on the draft plan. Tribal comment periods occur before public comment periods.

Additional input opportunities may arise if plan revisions are proposed during plan implementation.

### **Narrative SFRMP Development Process Overview**

Development of this narrative SFRMP guidance occurred in several steps (Table 1.1). In Step 1, DNR staff prepared information to assess the current forest resource conditions in the Section and prepared for the planning process. In Step 2, the SFRMP team updated the issues and the general directions, strategies, and cover type recommendations to address the issues. In Step 3, the plan was shared first with tribal natural resource agencies and then with the public (Step 4). Finally, in step 5, the plan is finalized and distributed.

The NSU SFRMP process started in 2014, and steps 1, 2, and parts of step 3 (Table 1.1) were subsequently completed. In 2016, the NSU SFRMP process was paused while the SFRMP strategic direction was evaluated and updated. Planning for the NSU SFRMP resumed in 2019 to complete this plan in alignment with the updated strategic direction. Other aspects of SFRMP related to management opportunity areas, cover type conversions, and goals for within-stand diversity, among others, were determined through the process to produce this narrative plan document.

**Table 1.1. SFRMP process summary.**

Steps	SFRMP Process Description
<p><b>Step 1</b></p>	<p><b>Initiating the Planning Process</b></p> <ul style="list-style-type: none"> <li>• Form an interdisciplinary team for the Section.</li> <li>• Assemble baseline assessment information.</li> <li>• Prepare draft SFRMP template.</li> <li>• Establish a web page on the DNR website.</li> <li>• Update the mailing list of public/stakeholders.</li> </ul>
<p><b>Step 2</b></p>	<p><b>Develop Draft Plan</b></p> <ul style="list-style-type: none"> <li>• Review and update the list of issues to be addressed in the plan.</li> <li>• Update general direction statements (GDSs) in response to the final list of issues.</li> <li>• Review and update strategies and desired future condition (DFC) goals consistent with the general direction statements and policy.</li> <li>• Prioritize, develop, and revise Management Opportunity Area guidance documents.</li> </ul>
<p><b>Step 3</b></p>	<p><b>Tribal Input</b></p> <ul style="list-style-type: none"> <li>• Make the draft plan available for tribal input.</li> <li>• Review comments received, respond to them, and incorporate them into the draft plan as appropriate.</li> </ul>
<p><b>Step 4</b></p>	<p><b>Public Input</b></p> <ul style="list-style-type: none"> <li>• Make the draft plan available for public input.</li> <li>• Review comments received, respond to them, and incorporate them into the draft plan as appropriate.</li> </ul>
<p><b>Step 5</b></p>	<p><b>Final Plan</b></p> <ul style="list-style-type: none"> <li>• Present a summary of comments, responses, and plan revisions for the Commissioner’s approval.</li> <li>• Commissioner approves final plan.</li> <li>• Distribute the final plan.</li> <li>• Provide plan implementation training to DNR staff involved in forest management and coordination.</li> </ul>
<p><b>Step 6</b></p>	<p><b>Monitoring</b></p> <ul style="list-style-type: none"> <li>• After implementation, plans are periodically monitored to assess their implementation and effectiveness.</li> </ul>

# Forest Planning Efforts Related to the NSU SFRMP

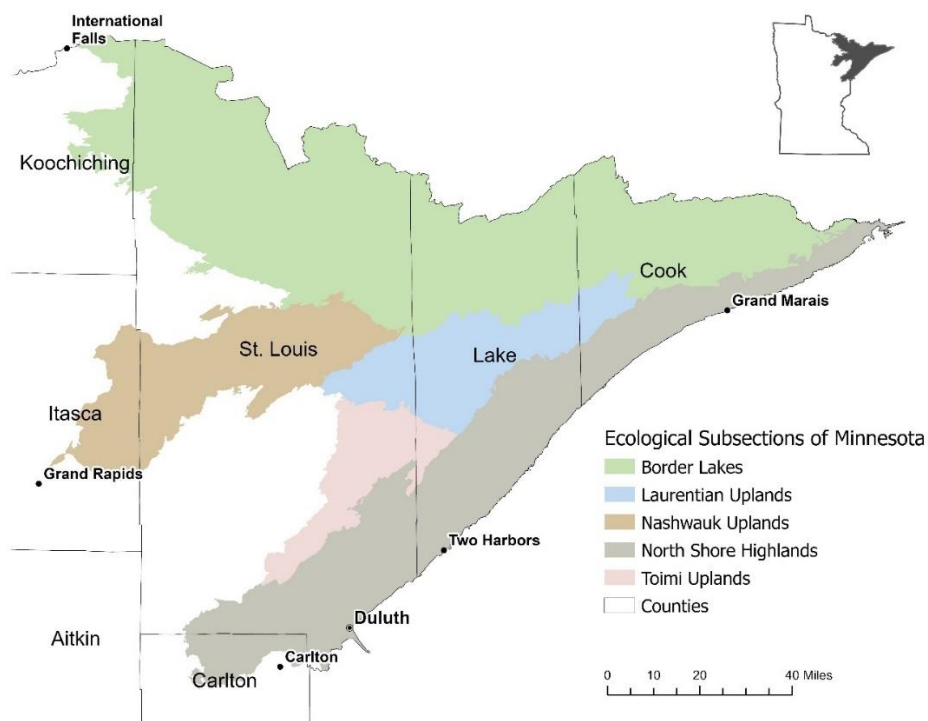
## MFRC Regional Landscape Planning

In developing this SFRMP, the team considered the recommended desired outcomes, goals, and strategies developed for the northeast landscape region under the direction of the Minnesota Forest Resources Council (MFRC) Landscape Program. By aligning with the MFRC plans, the management guidance for DNR-administered lands in this SFRMP incorporates recommendations that were developed with a broader landscape perspective across all ownerships. Having aligned goals and strategies assists in cooperation across ownerships in this larger landscape area.

## Planning Area Description

The total land area of the NSU Section includes approximately 6 million acres, including all or parts of the following counties: Koochiching, Itasca, Carlton, St. Louis, Lake, and Cook (Map 1.1). Recreation, mining, forestry, and tourism are major economic activities in this Section. Lowland and upland forests (conifer and deciduous), peatlands, and marsh systems are the dominant land cover classes in the NSU. Much of the land in the Section (64 %) is in public ownership, with the state owning approximately 981,000 acres (approximately 634,775 acres of the state-administered land is timber land that will be managed in this plan). Other major landowners in the Section include private landowners, tribes, counties, industry, and the federal government. For more detailed land descriptions, refer to chapters one through three of the NSU SFRMP Preliminary Issues and Assessment document on the [NSU SFRMP webpage](#).

**Map 1.1: Location of Northern Superior Uplands Section and included subsections**



**Table 1.2: Generalized forest cover type composition in the subsection(s) total acres**

Cover Type Group	Border Lakes	Laurentian Uplands	Nashwauk Uplands	North Shore Highlands	Toimi Uplands	Total
Aspen, birch, and balm-of-Gilead	125,656	14,059	30,148	75,873	12,276	258,012
Other upland hardwoods (maple, basswood, oak)	2,060	217	1,502	17,802	631	22,212
Lowland hardwoods (ash, elm, and silver maple)	7,838	336	2,599	7,531	492	18,796
Pine (red pine, white pine, and jack pine)	56,980	6,883	9,567	8,596	3,131	85,157
White spruce, balsam fir, and upland black spruce	16,108	6,634	3,528	19,430	3,355	49,055
Lowland conifers (black spruce, tamarack, and white cedar)	50,022	21,230	9,542	30,597	3,962	115,353
Stagnant conifers (black spruce, tamarack, and white cedar)	15,621	16,973	8,841	9,811	1,607	52,853
Other	36,605	14,260	20,584	31,755	5,650	108,854
<b>Totals</b>	<b>310,890</b>	<b>80,592</b>	<b>86,311</b>	<b>201,395</b>	<b>31,104</b>	<b>710,292</b>

## A Note on Data Limitations

Due to updates to the forest inventory and other data sources during the planning process, there may be slight differences in acreages between various tables and figures in this planning document. These differences do not affect the recommendations in this plan. Acreage goals in this plan should be viewed as desired trends, not exact targets.

# Chapter 2: SFRMP Vegetation Management Issues

---

## Issue Definition

In this plan, “issues” refers to natural resource-related concerns that are directly affected by, or directly affect, vegetation management decisions on lands administered by the DNR Divisions of Forestry and Fish and Wildlife. Relevant issues are defined by current, anticipated, or desired forest vegetation conditions and trends, threats to forest vegetation, and vegetation management opportunities. The issues described in this chapter are broad, complex, and often interacting. Future direction in Chapter 3 of this SFRMP document seeks to balance addressing these issues while following Department policies and direction and state and federal laws.

Some issues relevant to DNR-administered forest lands are outside the scope of the SFRMP process. For example, SFRMPs do not address recreation trail system issues or planning. However, aesthetic concerns along existing recreational trail corridors can be considered when determining forest management guidance in SFRMPs. As another example, SFRMPs establish vegetation goals associated with wildlife habitat but not goals for wildlife population levels.

All of the issues listed in this chapter are important to the management of DNR-administered land; however, the extent to which issues can be addressed through the SFRMP varies. Some issues raised in this chapter are primarily addressed through other planning processes but are included here due to their influence on the desired future conditions, general direction, and strategies given in this plan. For example, several decisions about forest management on DNR-administered land related to the issues listed below were addressed or determined through developing the strategic direction and the 10-year stand exam list, including:

- amount, type, and distribution of old and young forest
- desired age class distributions
- timber harvest levels
- landscape patterns of harvested stands

Issues in this plan are addressed through management depending on the opportunities available, given a variety of factors, including current natural resource conditions, managing to address various forest values, state and federal statutes, and Department direction and policy.

## How SFRMP Issues Were Identified

The SFRMP teams used assessment information<sup>1</sup>, DNR policies and guidelines, local knowledge, existing plans, and external input to identify the final issues relevant to the scope of this plan. The SFRMP team began with a common set of issues developed from previous SFRMPs. These SFRMP issues were refined and supplemented based on section-specific conditions, considerations, and public comments.

---

<sup>1</sup> Minn. DNR July 2014 Preliminary Issues and Assessment, Subsection Forest Resource Management Plan.

# Issues

## A. Forest Age and Growth Stages

Some aspects of this issue category, including the distribution of forest ages across DNR-administered lands, are addressed through the strategic direction and the 10-year stand exam list. They are still included here because they are also relevant to implementing the strategic direction and 10-year stand exam list through SFRMP guidance.

### A1. Representing growth stages and forest types across the landscape, given age class distribution goals

**Why is this issue important?** Adequate representation of all age classes and growth stages provides:

- a supply of habitat types that supports many species
- greater potential to provide a sustainable yield of timber
- ecological values, including healthier, diverse forests that are more resilient to insect and disease outbreaks and the negative effects of climate change

**What are the likely consequences of not addressing this issue?**

- increased risk of epidemic insect and disease outbreaks
- decreased population abundance of species with age-specific habitat requirements
- long-term loss of forest productivity
- decreased forest diversity
- boom and bust supply of forest products and habitats

### A2. Managing for older forest and old forest qualities on the landscape.

Mature to old forest is represented on DNR-administered land in various ways. Examples include stands that exceed the standard rotation age for their cover type, old forest characteristics like large old trees and snags within younger stands, and designated old growth forests, which are high-quality representations of forests in later successional stages.

**Why is this issue important?** Older forest provides the following benefits:

- later successional growth stages associated with animal, plant, and fungi species' habitats
- development of late-successional native plant community (NPC) growth stages
- stable hydrology and groundwater in older forests
- overall structural and species diversity on the forest landscape
- growth of large trees for sawing into lumber
- traditional uses associated with older forests

The cost of retaining older forests in the management pool includes reduced timber quantity for some types of forest products, lower merchantability, challenges with regeneration for some forest types, forest health and wildlife risks, and lower productivity compared to forests at or below the standard DNR rotation age.

**What are the likely consequences of not addressing this issue?** reduced presence of species with old forest-specific habitat associations, resulting in decreased biodiversity

- reduced recreational and economic opportunities associated with the loss of old forest conditions
- reduced ecological services associated with old forest conditions, such as maintaining water quality, natural disturbance regimes, and biodiversity
- lower potential for some large-diameter forest products (sawtimber, cabin logs, etc.)

### A3. Managing for young, early successional forest.

This plan defines young, early successional forests as the 0-30 age class of aspen, balm-of-Gilead, birch, and jack pine cover types.

**Why is this issue important?** Young, early successional forest provides:

- vegetation conditions that support associated plant and animal (game and non-game) species
- cover from predation and/or food supply for species that depend on dense young forest
- edges between young and more mature forests that some species depend on
- future timber production in these forest types

**What are the likely consequences of not addressing this issue?**

- reduced populations of important game species, particularly ruffed grouse, deer, moose, and American woodcock
- reduced populations of associated non-game species, particularly songbirds
- reduced social, economic, and ecological value of these species
- reduced value of traditional use of the natural resources associated with young forests (e.g., berry picking)

## B. Forest Composition, Structure, Spatial Arrangement, Growth Stages, and Native Plant Communities

B1. Addressing biodiversity, forest health, and productivity of native plant communities through management of forest composition, structure, representation of growth stages, within-stand diversity, and spatial arrangement of vegetative types.

**Why is this issue important?** Current conditions deviate significantly from historical ecological diversity pre-European settlement in many ways. Although a return to historical patterns of diversity across the ecological Section from a particular period in time is not a goal of the DNR or this SFRMP, historical conditions can be a useful reference for evaluating conditions today in the context of forest management. Compared to Minnesota forest land pre-European settlement:

- forest composition and structure have been simplified
- white pine, white spruce, tamarack, and upland white cedar have declined, while aspen has increased
- within-stand diversity has decreased

- non-native invasive species have increased
- more of the forest is in younger age classes and less in older age classes
- patch size has decreased, and fragmentation has increased
- connectivity of vegetation patches used by wildlife has decreased

**What are the likely consequences of not addressing this issue?**

- reduction of species associated with specific declining habitat types
- increase in non-native invasive species
- increase in populations of desirable species to the point where they reach undesirable levels
- reduced biodiversity
- reduction of ecologically intact landscapes
- reduced ability to produce a diversity of forest products (e.g., sawtimber, aesthetics, non-timber forest products, recreation, and tourism)
- reduced ability to respond to climate change

Planning efforts intend to produce a more regulated age class structure, which may differ from historical patterns.

**B2. Determining which tree species to increase or manage within forest communities in the Section with respect to various natural resource objectives and projected environmental change.**

**Why is this issue important?**

- Past harvests, insect infestations, disease, drought, and browsing by wildlife have resulted in changes in forest age structure and composition. The consequences of this include:
  - reduced regenerative capacity for tree species due to factors such as lack of large, downed trees, insects and disease, and a lack of seed trees
  - change in mycorrhizal relationships necessary for healthy soils and trees
  - changes to the composition and structure necessary to sustain associated species
- Climate change is expected to impact which cover types will grow well on sites and will inform which cover types are most appropriate for future vegetation management decisions.

**What are the likely consequences of not addressing this issue?**

Changes to:

- native tree species diversity within forest communities
- native plant community composition, structure, and function
- associated wildlife and warming of cold-water trout streams
- the social, economic, and ecological values provided by these species

### B3. Maintaining or enhancing imperiled and highly imperiled native plant communities in the Section.

**Why is this issue important?** Certain rare native plant communities are of particular concern in the Section because of one or more of the following factors:

- global or statewide rarity
- limited occurrence in the Section
- known association with rare species
- significant changes in composition as compared to historical conditions

Examples of these types of communities in the NSU Section are FDn43a, MHn45b&c, and FDn32e (see the DNR NPC website and DNR field guides to native plant communities for more information).

#### **What are the likely consequences of not addressing this issue?**

- fewer examples of high-quality, intact native plant communities used as controls to compare and monitor the effects of management
- continued forest stand and landscape simplification
- reduced habitat for native and rare species, some of which may be threatened or endangered
- reduced overall forest biodiversity, sustainability, and resiliency

### B4. Retaining characteristics of natural stand-replacement disturbance events while applying intensive management of forest communities.

#### **Why is this issue important?**

- Intensive management is important for successfully regenerating certain species, controlling insect or disease problems, and managing wildlife habitat.
- Intensive management of forest communities can result in forest simplification and fragmentation of native plant communities at the stand and landscape scale.
- Even in fire-dependent systems, where natural disturbance events (e.g., wind and fire) are relatively historically frequent, the resulting forest mosaic includes undisturbed vegetation and many legacies or refugia for species in the regenerating stand.
- Intensive management can include ground-disturbing activities such as rock-raking and herbicide application that can potentially reduce plant species and structural diversity, disrupt the soil profile, compact the soil, reduce native herbaceous species diversity, and increase non-native invasive plants or aggressive native plants.

#### **What are the likely consequences of not addressing this issue?**

- proliferation of forest pests and diseases across the landscape
- increased fire risk if the accumulation of dead woody materials is not managed
- increased simplification of forest stands and landscape communities
- fragmentation of native plant communities and forest cover types
- reduced diversity of forest species associated with natural disturbances

B5. Using management to better reflect natural landscape patterns (the size and configuration of growth stages and types resulting from broad-scale natural disturbances) in the Section.

**Why is this issue important?**

- Large blocks of forest provide an opportunity to create contiguous habitat of uniform age and structure in patches of various sizes and ages.
- Large patches and older growth stages are much less frequent in managed forest landscapes than they were pre-European settlement. This change has resulted in:
  - fragmentation and simplification of forest ecosystems at the landscape scale
  - change in the spatial arrangement of vegetation patches used by plants and animals

**What are the likely consequences of not addressing this issue?**

- increasing isolation of wildlife and plant populations
- reduced species abundance
- reduced resilience of forest ecosystems to disturbance events and climate change
- increases of certain populations to undesirable levels, resulting in negative impacts on forest communities

B6. Reducing forest fragmentation to maintain connectivity among habitat types.

**Why is this issue important?** There is less fragmentation in this section than in other parts of the state. However, harvesting and other factors such as road and trail construction, residential development, and ongoing sales of large tracts of land by private corporations have resulted in:

- reduced forest patch size
- altered forest composition, structure, and age
- increased forest fragmentation and simplification

**What are the likely consequences of not addressing this issue?**

- continued reduction in forest patch size
- decreased interior forest habitat, and increased edge disturbance, which can promote invasive species
- reduced biodiversity and the ability of the forest to produce a range of forest products
- reduced habitat connectivity and ecologically intact landscapes

## C. Harvest Levels for Timber and Non-Timber Forest Products

Decisions concerning the amount of timber volume to offer for sale to accomplish the disturbance needed to develop the DNR's desired forest age class distributions and species mixes over time, consistent with the specific management objectives of different forest lands administered by the DNR, are part of the strategic direction for this planning period. Other aspects of management related to harvest levels, such as providing guidance related to annual plan additions or habitat, are within the scope of the SFRMP.

C1. Contributing to sustainable forest management that meets the department's direction to continue to develop the desired forest age class distributions and species mixes over time by offering timber volume for sale, considering all forest resources and the objectives of the different forest lands administered by the DNR.

**Why is this issue important?**

- Some cover types in the Section have pronounced age class imbalances, which, if not corrected, decreases our opportunity to provide a consistent supply of other forest resource benefits over time.
- Timber harvest sustainably provides forest products from a renewable resource that Minnesotans use every day, including:
  - Building materials for homes, businesses, and other buildings, including lumber, cabin logs, flooring, paneling, building timbers, and engineered wood products
  - Pulp, paper, and paper products used for printing documents, packaging, and numerous other applications
  - Dissolved wood products used to create clothing and other products
  - Utility poles that facilitate the transmission of the electricity our society depends on
- Sustainable timber harvest supports the state's economy.
  - Forest management directly produces thousands of jobs, billions of dollars in revenue, and millions of dollars in state and local taxes.
  - Forest management supports healthy forests that promote recreation, a \$10 billion dollar industry in Minnesota.
  - Forest management that sustains healthy forests promotes ecosystem benefits, such as clean water, that support the state's economy overall.
- Forest management on school trust land must provide economic benefit to the Permanent School Fund.
- Managing forests sustainably is a requirement for maintaining the DNR's forest certification.

**What are the likely consequences of not addressing this issue?**

- inability to provide a consistent harvest level over time, which affects the DNR's ability to manage state forest lands for a sustained yield, decreases economic stability in the forest products sector, and may jeopardize our ability to rely on timber harvest as an important forest management tool
- reduced diversity in vegetation types throughout the Section
- reduction of certain animal species in the Section due to reductions of associated vegetation conditions
- changes to soils and hydrology in wet forests
- reduced revenue for the Permanent School Fund

C2. Managing non-timber forest products.

Demand for some non-timber forest products (e.g., balsam boughs and decorative trees) has been light but is increasing for others.

**Why is this issue important?** Non-timber forest products (e.g., balsam boughs and decorative trees):

- provide diversification for local economies and support traditional harvest activities (e.g., maple syrup tapping)
- are particularly important in areas where employment opportunities are limited
- support local individuals, families, and cottage industries in an expanding worldwide market

**What are the likely consequences of not addressing this issue?**

- unsustainable harvest of these resources
- negative effects on local cottage industries and economics
- reduction in traditional use of non-forest products
- change in forest composition or structure due to harvest activities
- inadvertent harvest of rare species

## **D. Biological Diversity**

**D1. Maintaining or enhancing biodiversity and native plant community composition, structure, and function through stand management within larger areas of biodiversity significance.**

**Why is this issue important?** Larger areas with biodiversity significance provide:

- reference areas to improve our understanding of ecosystems and help us evaluate the effects of vegetation management
- opportunities for large patch management to address landscape-level goals
- the maintenance, enhancement, or restoration of high-quality examples of native plant communities
- potential for addressing biodiversity-related goals of the DNR and other landowners
- ecosystem services that support human health, safety, and welfare

**What are the likely consequences of not addressing this issue?**

- reduction in species richness
- concerns about biodiversity and ecosystem function
- fewer opportunities for maintaining or restoring ecological patch relationships
- reduced ecosystem resilience in a changing climate
- impact on native plant community characteristics and components

**D2. Retaining or restoring within-stand structural complexity (e.g., vertical structure, stem size and density, coarse woody debris, and pit and mound micro-topography) when stands are harvested before reaching older growth stages in which these characteristics would normally develop.**

**Why is this issue important?**

- Within-stand structural complexity supports a variety of plant and animal species and promotes the regeneration of some tree species.

- Current practices tend to reduce within-stand structural complexity and diversity.

#### **What are the likely consequences of not addressing this issue?**

- changes to the composition and vertical structure necessary to sustain native plant and animal species
- fewer regeneration sites for some species
- reduced native tree species diversity within forest communities
- reduced native plant community composition, structure, and function
- changes to associated wildlife populations
- decreases in soil complexity and health

### **E. Rare Features**

#### **E1. Protecting rare plants and animals (including species in greatest conservation need), their habitats, and other rare features in the Section.**

##### **Why is this issue important?**

- Protecting rare features on state lands is a key component of ensuring species, community, and forest-level biodiversity in the Section.
- DNR department-wide direction acknowledges the DNR's role in advocating for the maintenance and protection of habitat for rare features throughout the state, regardless of ownership.
- The DNR is obligated to protect endangered, threatened, and special concern (ETS) species and their habitats.
- The DNR is required by third-party certification (forest certification) to ensure that any management within high conservation value forest (HCVF) sites enhances or maintains the high conservation value(s) associated with the site.

##### **What are the likely consequences of not addressing this issue?**

- rare species extirpation at the local and state level
- rare species declines, leading to listing status changes
- rare species habitat degradation
- reduced diversity at the species (genetic), community, and/or landscape level

### **F. Wildlife**

#### **F1. Addressing the needs of game and nongame species through vegetation management.**

##### **Why is this issue important?**

- Forest management changes the habitat for game and nongame wildlife species.
- Forest wildlife is important to society and depends on healthy forest ecosystems.

- Legal mandates, stakeholders' expectations, and DNR internal policies require the ecological integrity of the forest to be maintained and enhanced. Practical reasons to maintain ecological integrity related to wildlife include:
  - economic vitality of forest and tourism industries
  - maintenance of recreation opportunities for the public
  - health of wildlife species and populations
- Reduced availability of important habitat types is a concern for some species, including listed and special concern species (e.g., larger diameter aspen for fisher/marten cavity needs, effective winter conifer cover for wintering deer)

**What are the likely consequences of not addressing this issue?**

- changes to wildlife (game and nongame) habitat
- changes to forest bird habitat can make forest insect and disease control more difficult
- fewer populations associated with declining habitat types
- economic losses resulting from a decline in recreational activity associated with wildlife
- social losses because of a decline in the enjoyment of cultural values associated with wildlife
- additional species listed as ETS-affecting future management options

**G. Watersheds, including Riparian and Aquatic Areas**

**G1. Addressing the impacts of vegetation management on surface waters (wetlands, streams, and lakes).**

**Why is this issue important?**

- Management of riparian areas can influence water quality, water temperature, erosion rates, and deposition of woody debris in lakes and streams, as well as the diversity of wildlife and plant species found in a watershed.
- Management activities may result in impacts on permanent wetlands adjacent to upland stands. For example, young forests in the adjacent landscape can lead to faster and increased water runoff.
- Well-managed riparian areas are critical to protecting, maintaining, or enhancing aquatic habitat types, corridors, and connectivity for plant and animal species, aesthetics, recreation, water quality, and forest products.
- While Minnesota Forest Resource Council's (MFRC's) *Voluntary Site-Level Guidelines* serve as the DNR standard for protections/mitigations related to surface waters, applying site-level guidelines without considering site-specific and landscape conditions may not be adequate to protect surface waters.

**What are the likely consequences of not addressing this issue?**

- degradation of communities associated with wetlands, streams, and lakes
- reduced abundance of associated wildlife and aquatic species
- negative impacts on other values, including water quality and recreation opportunities

## G2. Addressing cumulative impacts to aquatic resources of vegetation management on a watershed or sub-watershed level.

A description of this issue is included here because of its relevance to forest management. However, because we do not currently have the data or scientific methodology to fully evaluate cumulative impacts across ownership and time, this plan does not include specific future direction related to cumulative impacts on aquatic resources. Instead, this plan and DNR forest management focus on addressing water quality issues and impacts on aquatic resources through applying MFRC site-level guidelines and guidance for site-level decisions.

### **Why is this issue important?**

- Vegetation management activities and the amount of forest cover on the landscape affect watershed and sub-watershed hydrology.
- Land can have a significant impact on the type of vegetation and vegetation management distributed across the Section.

## H. Timber Productivity

### H1. Maintaining or increasing timber productivity on state lands.

#### **Why is this issue important?**

- Minnesota's forests provide a range of environmental and economic services. Healthy trees provide many ecosystem benefits, from habitat to carbon sequestration.
- Timber sales are the means by which the DNR accomplishes much of the vegetation management activities covered under this SFRMP.
- A robust forest industry is a critical component of our ability to manage forests.

#### **What are the likely consequences of not addressing this issue?**

- reduction in timber products available in the Section
- reduced ability to sustainably provide forest products over time
- reduced revenues to the Permanent School Fund
- fewer forest product businesses throughout the state due to a reduction in forest product quality and availability
- reduced availability of commercial timber harvest as a tool for managing forests due to a decline in the forest products industry

## I. Disturbance Impacts on Forest Ecosystems

### 11. Addressing disturbances, such as harmful forest insects, disease, and herbivory, on forest ecosystems.

#### Why is this issue important?

- Insects and diseases can reduce timber production and lumber quality and increase fire hazards.
- They can promote a diversity of tree species and forest structure and generate dead wood, which provides important habitat components and soil nutrients.
- Widespread pest outbreaks outside their natural range cause high levels of tree mortality. They can have significant ecological and economic consequences.
- Aggressive control attempts may result in an imbalance in native insect populations.
- Inadequate control may negatively affect the forest's timber volume, aesthetics, and recreational enjoyment.
- Undesirable increases in certain wildlife populations can have adverse impacts, including browsing and grazing by wildlife (herbivory).

#### What are the likely consequences of not addressing this issue?

- degradation of forest products or regeneration due to forest insects, disease outbreaks, or herbivory
- change in important ecosystems or ecosystem processes
- increased occurrence of non-native invasive species
- negative impacts on native plant communities
- reduction in carbon storage and sequestration in forests

### 12. Addressing non-native invasive species threats and invasions.

#### Why is this issue important?

- Non-native invasives have the potential to displace native species, carry or cause diseases, or disrupt natural community functions.
- We lack effective or practical methods to control invasive species at a landscape scale.
- There are some examples of effective controls at the site level, such as beetles controlling purple loosestrife.
- It is the DNR's policy, through the Invasive Species Operational Order, to prevent or limit the introduction of invasive species onto DNR-administered lands and waters and limit their spread and impact on high-value resources.
- Invasive species can result in economic loss, including loss of timber through increased competition and increased damage and control costs.
- Many non-native and invasive species lack effective or practical control methods.
- Increased use of public lands results in a greater risk of transporting invasive species of all kinds.

### **What are the likely consequences of not addressing this issue?**

- permanent changes to native plant and animal communities through invasion or displacement
- degradation of soil and water resources, with cascading detrimental impacts on food sources, habitat, and populations.
- negative economic impacts, including increased control costs, decreased timber revenue, and decreased property values

### I3. [Considering catastrophic natural disturbances in vegetation management decisions.](#)

#### **Why is this issue important?**

- Catastrophic natural disturbance events, such as wind and fire, may destroy or damage forest resources, reducing opportunities for commercial timber harvest.
- They may also affect this plan's short-term goals and long-term desired future condition (DFC) goals.
- The timing and location of catastrophic events are difficult to predict.

#### **What are the likely consequences of not addressing this issue?**

- less marketable timber available for sale
- increase in fire danger in the vicinity of a catastrophic event
- disruption of opportunities to implement plan goals

## **J. Climate Change**

### J1. [Managing vegetation to prepare for and respond to the effects of climate change.](#)

#### **Why is this issue important?**

- Minnesota is one of the fastest-warming states in the U.S., and temperatures are projected to continue increasing through the end of this century.
- Effects of climate change may include:
  - changes in the frequency and intensity of precipitation events
  - changes in the distribution and survival of plant and animal species
  - increased reproductive capability and survival of some non-native invasive species, insect pests, and pathogens that affect forests and wildlife
  - effects on tree species, such as balsam fir, white spruce, and balsam poplar, due to soil warming and decreased soil moisture (based on [Northern Institute of Applied Climate Science \(NIACS\) projections for the NSU in 2021](#); refer to the latest information for specific species projections)
  - expansion of habitat for some tree species, such as American basswood, eastern white pine, eastern hemlock, and northern red oak (see NIACS projections referenced above or the latest information for specific species projections)
- Forests with lower species and structural diversity are projected to be less resilient to climate change impacts.

- Future management decisions on cover type species appropriate for certain sites will be impacted by climate change.
- Carbon sequestration by forests and wetlands may be affected.

**What are the likely consequences of not addressing this issue?**

- acceleration and exacerbation of climate change effects on forest communities
- less opportunity to begin directing management toward mitigating climate change effects on the most vulnerable species and native plant communities
- fewer management opportunities if changes in species populations and ranges are not addressed
- reduced timber production and access to winter management sites
- reduced ecosystem resilience
- reduced habitat for native wildlife and plants

**K. Visual Quality**

**K1. Minimizing the effects of vegetation management activities on visual quality.**

**Why is this issue important?**

- Scenic beauty, or visual quality, is a primary reason people choose to spend their recreation and vacation time in or near forested areas.
- Visual quality is an important consideration for vegetation management activities conducted adjacent to recreational trails, lakes, waterways, or near public roads and highways.

**What are the likely consequences of not addressing this issue?**

- a negative experience for the vacationing and recreating public in forested areas of the state
- negative public perception of DNR forest management activities
- increased regulations for vegetation management activities
- reduced vegetation management opportunities due to public opposition

**L. Access to State Land**

**L1. Providing access to stands identified for management.**

**Why is this issue important?**

- Access routes provide access for vegetation management activities, insect and disease control, fire response, and recreation.

**What are the likely consequences of not addressing this issue?**

If not managed properly, forest road development, construction, and maintenance can result in negative impacts, including:

- permanent land disturbance
- forest fragmentation and loss of timberland acres
- increased spread of non-native invasive species and undesirable native plants and animals
- potential conflicts with adjacent private landowners
- potential for user-developed trails
- degradation of water quality, changes to hydrology, and destruction of fish habitat
- increased soil compaction
- negative effects on rare species and rare species habitats

## M. Cultural Resources

### M1. Protecting cultural resources during vegetation management activities on state-administered lands.

A cultural resource is an archaeological site, cemetery, historic structure, historic area, or traditional use area of spiritual, traditional, scientific, or educational value. Examples include the archaeological remains of a 2,000-year-old American Indian village, an abandoned logging camp, a portage trail, a cemetery, food-gathering sites such as wild rice harvesting and maple sugaring camps, or a pioneer homestead.

#### Why is this issue important?

- Cultural resources are scarce, nonrenewable features that provide physical links to our past.
- They often possess spiritual, traditional, scientific, and educational values and should be treated as assets.
- In addition to federal and state laws that protect certain types of cultural resources, the *Voluntary Site-Level Forest Management Guidelines* provide information and recommendations to assist private and public land managers in taking responsible actions when cultural resources are encountered.

#### What are the likely consequences of not addressing this issue?

- Loss of opportunities for Minnesotans to connect with their cultural heritage.
- Permanent loss of or damage to a cultural resource may violate federal or state law.

## N. Balancing Vegetation Management Needs with Legal Requirements

### N1. Including various state and federal legal requirements in the SFRMP planning process.

**Why is this issue important?** Vegetation management is directed by administrative land status and other relevant statutes and laws. Some examples include:

- The Minnesota State Constitution and state statute require the DNR to manage school trust lands for the maximum long-term economic benefit of the Permanent School Fund, using sound natural resource conservation and management principles.
- Acquired WMA lands are managed primarily for wildlife habitat.
- The DNR must comply with federal and state endangered species acts.

**What are the likely consequences of not addressing this issue?**

- failure to follow mandates and legislative intent may be a violation of federal or state law
- corrective action requests from third-party certifiers or loss of the DNR's forest certification due to failure to comply with legal requirements
- loss of the DNR's authority to manage certain lands

# Chapter 3: Forest Types and Management Direction

---

## Introduction

Managing sustainably requires that we address the issues identified in Chapter 2 to balance multiple forest benefits. Sustainably managed forests support wildlife habitat, biodiversity, wood supply and healthy natural resource economies, carbon storage, forest health, recreation, and water quality and quantity. The “optimal balance” of these forest benefits varies across the different lands managed by the DNR. This chapter provides future direction to forest managers that aims to balance the issues identified in this plan while adhering to DNR policy.

Interdisciplinary DNR staff members helped refine general direction statement (GDS) strategies in response to the list of issues in Chapter 2 and defined desired future condition (DFC) goals where appropriate (see below for definitions of GDSs and DFCs). An issue may be addressed through one or more GDSs, and some GDSs address multiple issues. Goals and strategies for state-administered forest lands in this plan are consistent with the MFRC northeast regional landscape committee's desired outcomes, long-term goals, and strategies for forest lands and ecosystem types in the northeast landscape region.

Management opportunity areas (MOAs) were reviewed and adopted as part of developing this plan. Management opportunity areas provide opportunities to address values such as biodiversity, rare features, diversity of native plant community growth stages, and wildlife needs through vegetation management at a scale smaller than the landscape but larger than individual stands. See [Section 3.13](#) and [Appendix B](#) for more information on MOAs.

## General Direction Statements (GDS)

- follow direction provided in state statutes and rules, and DNR policies, guidelines, and management direction
- incorporate DNR specialists’ expert knowledge in their fields
- make recommendations for forest change, such as increasing, decreasing, maintaining, or protecting a condition, output, or quality
- are grouped under 12 forest resource management categories. Some categories have several GDSs to address the associated issues, while others have only one
- strategies in each GDS are suggested ways to achieve the general direction

## Desired Future Conditions (DFC)

- are short (10 years) and long-term (50+ years) goals for the desired condition of DNR-administered forest lands in the Section
- were identified where we currently can measure and quantify progress
- examples include cover type acres, age class distributions, and amounts of young and old forest
- 50-year DFCs in relation to cover type conversion are presented to aid in the understanding of current goals and do not necessarily represent the goals of future planning periods

## Role of Department Guidance Documents, Policy, and Management Recommendations

In addition to DFCs, general direction statements, and strategies identified in this SFRMP, a vast array of planning documents, guidelines, policies, objectives, and initiatives direct vegetation management on state-administered land. DNR employees must consider all these directives when making individual site-level decisions. The DNR's internal policy system, which uses a variety of directional documents to communicate expectations to DNR staff on a range of land management issues, provides as they apply to individual site-level decisions.

### Questions that should always be considered when implementing this plan include:

- Is treatment consistent with current DNR policies and guidelines?
- Does the treatment align with the management objectives and requirements associated with the land status (e.g., if the treatment is on acquired WMA acres, is it primarily for habitat improvement? If the treatment is on school trust lands, does the prescription adhere to the DNR School Trust Lands policy?)
- Does the design meet MFRC *Voluntary Site-Level Guidelines*?
- Is the decision appropriate to the NPC? Is it consistent with the ECS silvicultural interpretation?
- Is the stand a good candidate for advancing SFRMP conversion goals?
- Do planned actions account for species in greatest conservation need and ETS species?
- If appropriate, have climate change adaptation strategies been implemented?
- If a forest health issue is present, have current guidelines or forest health specialists been consulted?
- Do management decisions align with local annual goals derived from the strategic direction and 10-year stand exam list?
- Is the site in a MOA? If yes, is treatment consistent with MOA guidance documents?
- Is the site within an area with a WMA plan or other operational plan? If yes, have you considered and incorporated applicable direction from those plans?
- Has the management objective been documented prior to treatment?

The strategies for achieving GDSs throughout the rest of this chapter provide guidance beyond these overarching considerations to achieve SFRMP landscape goals.

## 3.1 Forest Composition and Within-stand Diversity

Broadly, the goals for forest composition and within-stand diversity in this section of the plan are to maintain cover type diversity on the landscape, convert cover types, and increase within-stand diversity where appropriate. This section concludes with a description of each cover type.

### GDS 1A: Maintain diversity of cover types.

#### GDS-1A Strategies

- Retain cover types appropriate to native plant communities (NPCs).
  - For NPC-appropriate species, including suitability projections under climate change, refer to the [NPC Silviculture Strategies for forest stand prescriptions](#) webpage.
  - To learn more about NPCs typically found in this Section and their silviculture interpretations, refer to the *Field Guide to Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province* and the [DNR website](#).
- Convert cover types where appropriate (Table 3.1).
  - Determine sites and species appropriate for conversion during site visits and native plant community evaluations.
- Consider cultural use and significance when determining conversions for a specific site (e.g., maintain some species for cultural reasons even if not projected to do well in climate change models).
- Incorporate strategies to help increase resilience to climate change.
  - Increase the component of species that are projected to increase due to climate change.
- When conversion is desirable, options available include:
  - Allow some stands to convert through succession with or without harvest.
  - Artificially convert some stands through mechanical site preparation, prescribed burning, planting, or seeding.
  - Selectively harvest some stands to facilitate movement toward the desired cover type and within-stand composition.

**Table 3.1: Current cover type acres and goals for the first decade and 50-year planning period. Conversion goals decided by the SFRMP team are given where appropriate (see the Cover Types section below for more information on how the team determined conversion goals).**

Cover Type	Current Cover Type Acres	Conversion Acres (first plan decade)*	Conversion Acres (50-year DFC)**	Final Cover type Acres
Aspen/balm-of-Gilead	198,270	-4,856	-24,280	173,990
Birch	29,394	-735	-3,675	25,719
White cedar	32,865	957	4785	37,650
Jack pine	24,349	274	1370	25,719
White spruce	22,511	530	2650	25,161
Red (Norway) pine	33,772	2326	11,630	45,402
Northern hardwoods	13,407	647	3235	16,642
Black Spruce - upland	6,150	150	750	6800
White pine	9,302	654	3270	12,572
Oak	435	54	286	721

\*Conversion acres are desired trends, not exact targets. These goals may not be fully achieved due to various factors, including funding.

\*\*50-year DFCs here and under specific cover types are presented to aid in the understanding of cover type conversions. They do not necessarily represent additional conversions in future planning periods.

### **GDS-1B: Manage within stands to reflect the composition, structure, and function of native plant communities.**

#### GDS-1B Strategies

- Continue to use the *Field Guide to the Native Plant Communities of Minnesota: the Laurentian Mixed Forest Province* and associated ECS silvicultural interpretations to classify stands to NPC and inform silvicultural prescriptions.
- Retain components of various growth stages in stands.
- Utilize the most up-to-date available climate change projection information to inform decisions on species to reserve, regenerate, or introduce into stands.
  - Consider projected species habitat increase or decline as climate change progresses (e.g., [MN Forest Ecosystem Vulnerability Assessment and Synthesis](#), the [Climate Change Field Guide for Northern Minnesota Forests: Site-level Considerations and Adaptation](#), and the [Northern Institute of Applied Climate Science \(NIACS\) projections for the NSU](#)).
- Retain biological legacies through implementing site-level guidelines.

## GDS-1C: Maintain or increase species, age, and structural diversity within some stands.

### GDS-1C Strategies

- Provide a variety of structural diversity characteristics, considering the following:
  - sizes (diameter and height), abundance, and distribution of overstory trees
  - understory vegetation
  - arrangement (scattered or clumped) of vegetation in the stand
  - distribution, size, and decay class of snags and coarse woody debris
- Use selective harvesting to encourage diversity of species, ages, and stand structures. Selective harvesting is a silvicultural tool that can reserve species, age classes, and structural components while harvesting part of the stand.
- Meet or exceed the MFRC *Voluntary Site-Level Guidelines* designed to maintain a stand's diversity of species, age, and structure.
- Retain tree species, stand structure, and ground layer diversity within stands when prescribing timber stand improvement rather than managing for one species.
- Take advantage of opportunities to diversify stands when prescribing intermediate treatments.
- Maintain the amount of older forest as directed by the Department.
- Use harvest systems or methods that protect advanced regeneration. Retain conditions that favor regeneration and understory initiation.
  - When it is desirable to protect the existing seedlings and saplings in a stand, timber sale regulations should specify outcomes to protect these regenerating trees. In some cases, portions of the stand may be delineated to protect regeneration by restricting harvest activity in those areas. To enhance the seedling recruitment of some species, a partial canopy may be retained to meet the needed moisture and light requirements of the seedlings.
- Identify some stands where succession is allowed to occur to encourage the development of within-stand diversity. The movement to the next successional stage may be achieved with or without harvest.
- Increase and/or maintain species within appropriate cover types, including white pine, white spruce, upland cedar, upland tamarack, upland black spruce, yellow birch, and oak. Silvicultural practices that may increase the presence of these target species include planting, inter-planting, and artificial or natural seeding.
- Manage planted and seeded stands to represent the array of NPCs and variations within NPCs. This may be accomplished by:
  - accepting lower stocking levels of planted species in younger planted stands if other desirable species are present to create a fully stocked stand
  - planting or seeding mixed species appropriate to the site
  - using intermediate harvests to enhance age, species, and structural diversity
  - using the least intensive site preparation necessary to successfully regenerate the site while favoring retention of the existing ground-layer plant species

- Some plant communities can naturally exhibit low species diversity. Low species diversity can be natural and has occurred historically in peatlands and in association with large-scale disturbances, particularly fire.
- Encourage fruit and mast-producing species.

## Cover Types

The following cover type management guidance provides a summary of current conditions and future management direction for each of the major cover types, including strategies based on site index for some cover types within the NSU Section. However, this section does not provide a comprehensive discussion of these cover types, and field staff should rely on current management direction and policy.

Some cover types include conversion goals (desired trends, not exact targets), which the SFRMP team developed considering:

- documented and modeled native plant communities
- historical forest composition, disturbance regimes, and range of natural variation
- wildlife habitat associations
- forest insects and diseases
- increased availability of certain forest products (e.g., sawtimber)
- projected tree suitability under projected long-term climate change conditions
- recreational values

The following cover type information contains basic information for cover types within the NSU Section. General silvicultural information can be found on the [DNR's silviculture webpage](#). Additional silvicultural options may be considered on a site-level basis to meet goals, including but not limited to site-specific goals such as MOAs, species-specific guidelines, and conversion goals. Follow current departmental policy when deciding upon silvicultural options.

Broadly, management strategies for cover types fall into two categories: even-aged management and uneven-aged management (Table 3.2). Even-aged managed cover types are managed with the goal of moving toward balanced age class distributions, with relatively equal acres in each 10-year age class through the standard DNR rotation age for a cover type. Some stands within these cover types are thinned periodically to enhance individual tree growth, forest health, and within-stand diversity. Uneven-aged managed cover types are not managed for balanced age class distributions but to enhance within-stand diversity and composition and improve wood quality.

These broad management strategies were used during modeling to develop the DNR's 10-year stand exam list. It is important to remember that model assumptions, including standard types of management by cover type, are simplified assumptions for average management on the average stand in the average year. These simplified assumptions are necessary for the model, which cannot work with the nuance of site-level variation. In reality, sites may differ in their objectives and characteristics. For more information, see the DNR's [Development of the 10-year Stand Exam List](#) report.

**Table 3.2 General management strategies by cover type. Actual prescriptions may vary depending on the results of field examinations and stand management objectives. For example, on lands administered by the Division of Fish and Wildlife, alternative strategies may be used to support fish or wildlife habitat values.**

Cover Type	Thin	Even-Aged	Uneven-Aged	Cover Type	Thin	Even-Aged	Uneven-Aged
Ash/lowland hardwoods			✓	Jack pine		✓	
Aspen/balm of Gilead		✓		Norway (red) pine	✓	✓	
Birch		✓		Tamarack		✓	
Northern hardwoods	✓		✓	White cedar			✓
Oak	✓	✓	✓	White spruce natural			✓
Balsam fir		✓		White spruce-planted	✓	✓	
Black spruce-lowland		✓		White pine-natural			✓
Black spruce-upland		✓		White pine-planted	✓	✓	✓ (FAW)

## Ash/Lowland Hardwoods

The ash and lowland hardwoods (Ash/LH) cover types are combined into one management category because they are commonly associated with one another and managed under the same management prescriptions. Ash and lowland hardwood cover types occur along water features or in depressions where the water table is generally within reach of plant roots.

**Current Acres:** 16,646 acres in the NSU Section (approximately 2.9% of the state-managed forest acres in the Section)

### Future Direction and Goals

- Increase within-stand diversity.
- Increase resilience of sites to emerald ash borer (EAB).
- Maintain forested conditions of ash sites in the wake of EAB.

### Strategies

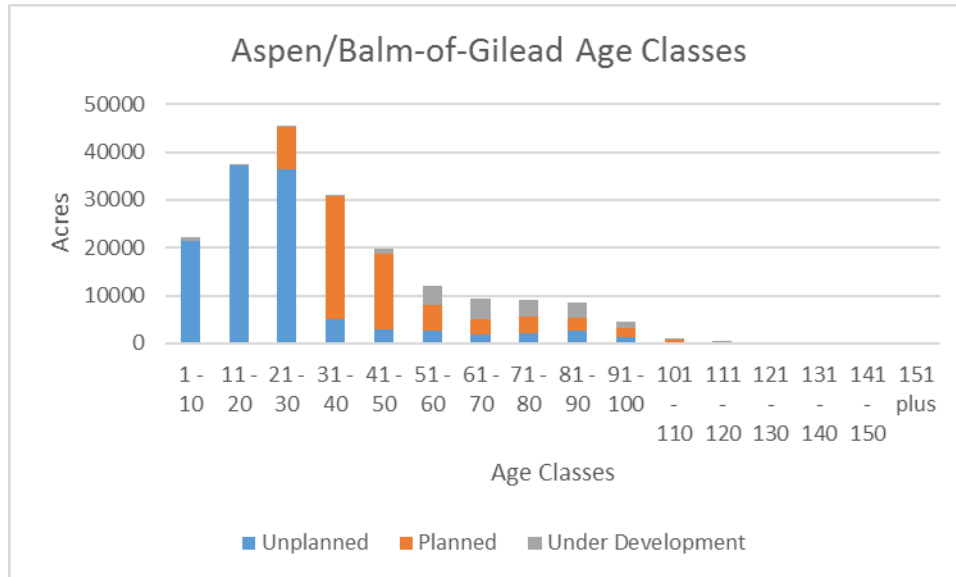
- Follow Department and divisional guidance on managing ash to address the threat of emerald ash borer, including:
  - maintain an ash component in all stands, but reduce the size and number of ash
  - promote non-ash species

### Special Concerns

- Emerald ash borer (EAB) is a threat to the retention of ash species.
- Reductions in the amount of wet forest due to swamping out as ash trees die, resulting in conversion to non-forested cover types.

## Aspen/Balm-of-Gilead

Aspen and balm-of-Gilead (A/BG) cover types are combined because they are commonly associated with each other and managed similarly. Aspen/BG-dominated native plant communities in the NSU are typically mesic to wet-mesic forests with a mixture of hardwood species and some conifers in the canopy and understory.



**Current Acres:** 200,508 acres in the NSU Section (approximately 34.9% of the state-managed forest acres in the Section)

### Future Direction and Goals

- 10-year DFC: 193,414 acres (2.5% decrease)
- 50-year DFC: 173,990 acres (12.5% decrease)
- Move toward balanced age class distribution up to rotation age, and include policy-directed amounts above rotation age.
- Increase within-stand diversity.

### Strategies

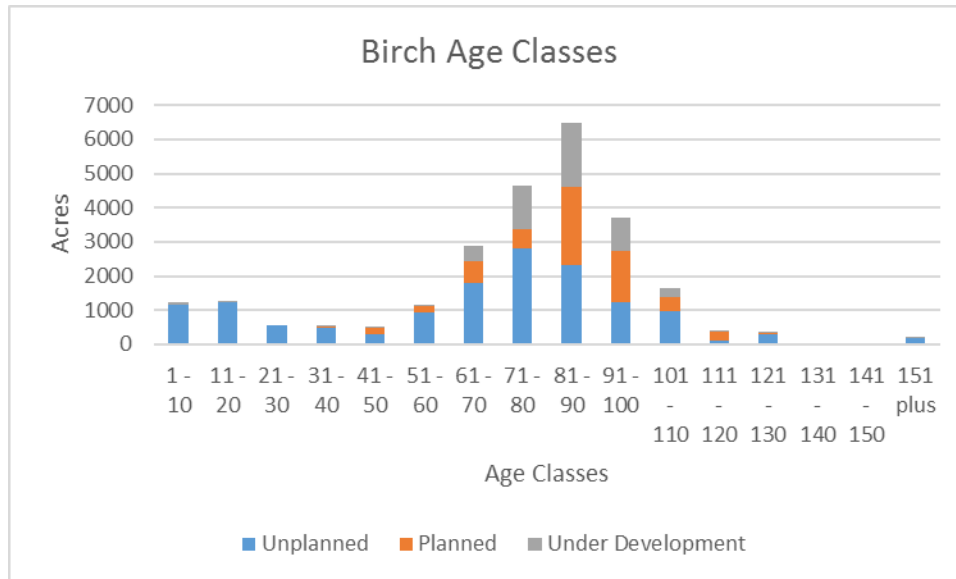
- Clearcut with reserve is the common prescription if desiring to regenerate aspen.
- Convert approximately 4,856 acres (24,280 acres over five plan periods) utilizing NPC-suitable species.
  - Convert 2.5% aspen to other cover types in this planning period to increase cover type diversity and increase other cover types projected to gain habitat as the climate changes.
  - Determine sites and species appropriate for conversion by field visits and based on the NPC.
- Maintain the diversity of species where they occur in aspen stands.
- Increase northern hardwood species, including birch and oak, or conifers, including white pine, white spruce, red pine, and upland white cedar, within aspen/BG stands as appropriate to NPC.

## Special Concerns

- Conversion is challenging due to aggressive suckering. Alternative prescriptions may be utilized to allow conversion.
- Insect and disease concerns include:
  - stem decay and butt rot in wounded trees
  - white trunk rot as aspen ages
  - decline following tent caterpillar defoliation in stressed stands
  - *Hypoxylon* cankers and *Saperda* stem borer mortality in low-density stands or stand edges
  - preferred host for gypsy moth
- Long distances to markets may challenge management efforts for some stands.

## Birch

The birch (Bi) cover type includes paper birch and, to a limited extent, yellow birch in NSU. Birch is often found with some conifers in the canopy and understory. It is often mixed with other hardwood species. Birch can be found on mesic to dry sites.



**Current Acres:** 29,394 acres in the NSU Section (approximately 4.5% of the state-managed forest acres in the Section)

### Future Direction and Goals

- 10-year DFC: 28,659 acres (2.5% decrease)
- 50-year DFC: 25,719 acres (12.5% decrease)
- Move toward balanced age class distribution to the extent possible.
- Increase within-stand diversity.

### Strategies

- Natural succession is converting more birch than the DFC goal. Hence, conversion through management is generally unnecessary, and maintaining birch stands is appropriate for most sites.
- Generally, a clearcut method is used to regenerate paper birch.
- Various methods can be used to regenerate yellow birch; however, seeds require decaying coniferous nurse logs or exposed mineral soil to sprout.
- Look for opportunities to convert the A/BG cover type to the Bi cover type where the site is appropriate.
- Increase northern hardwood species, including birch and oak, or conifers, including white pine, white spruce, red pine, and upland white cedar within stands where they already occur or in appropriate NPCs.

### Special Concerns

- Balancing Bi age classes may not be attainable due to the small number of cover type acres and marketability concerns.

## Northern Hardwoods

Northern hardwood (NH) dominated plant communities in the NSU usually occur on upland sites with moist soils in settings protected from fire. Natural, mature NH stands are comprised of mixed species.

**Current Acres:** 13,675 acres in the NSU Section (approximately 2.4% of the state-managed forest acres in the Section)

### Future Direction and Goals

- 10-year DFC: 14,054 acres (5% increase)
- 50-year DFC: 16,642 acres (25% increase)
- Move toward a regulated size-class structure within stands.
- Improve timber quality.

### Strategies

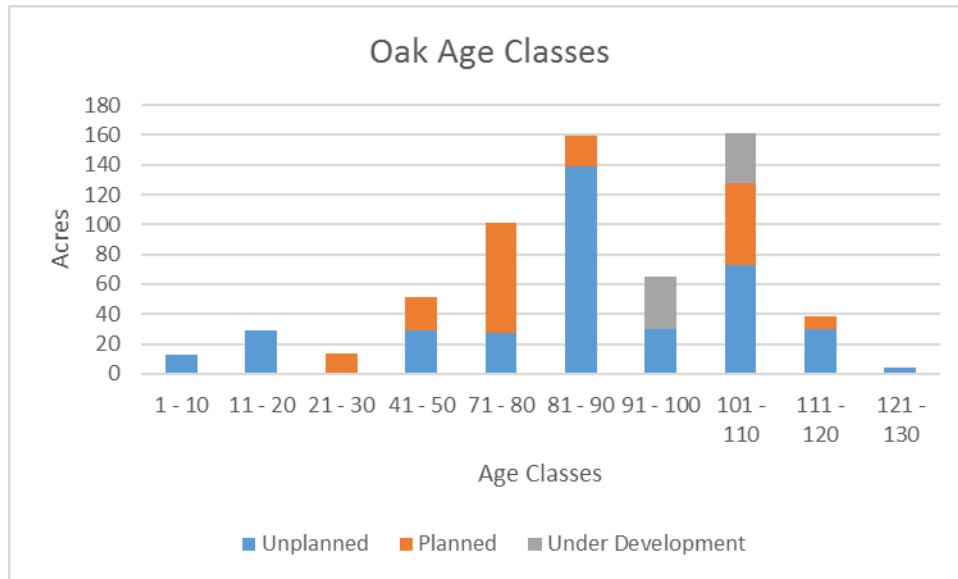
- Generally, uneven-aged and gap management is used to regenerate NH and manage species composition.
- Convert approximately 647 acres (3,235 acres total over five plan periods) of the aspen/balm of Gilead/birch cover type to the NH cover type.
  - Gradually convert from aspen-dominated stands to more diverse stands with additional hardwood trees.
- Increase diversity of species within stands where opportunities exist
- Increase oak and maintain birch and basswood in mixed stands where appropriate

### Special Concerns

- If left to naturally succeed, shade-tolerant species such as maple and basswood will increase in abundance at the expense of shade-intolerant species such as birch and oak.
- Considering climate change and market forces, some aspen stands may gradually convert to more NH-dominated stands.

## Oak

The oak cover type includes all oak species. Natural, mature oak stands range from nearly pure oak to mixed stands. Oak species are commonly found as a component of other cover types, such as aspen, birch, northern hardwoods, and lowland hardwoods (bur oak).



**Current Acres:** 435 acres in the NSU Section (approximately 0.08% of the state-managed forest acres in the Section)

### Future Direction and Goals

- 10-year DFC: 509 acres (11.5% increase)
- 50-year DFC: 721 acres (57.5% increase)
- Move toward a desired balance among age classes.
- Maintain age and species composition within stands.
- Increase oak cover type where appropriate for climate change adaptation.

### Strategies

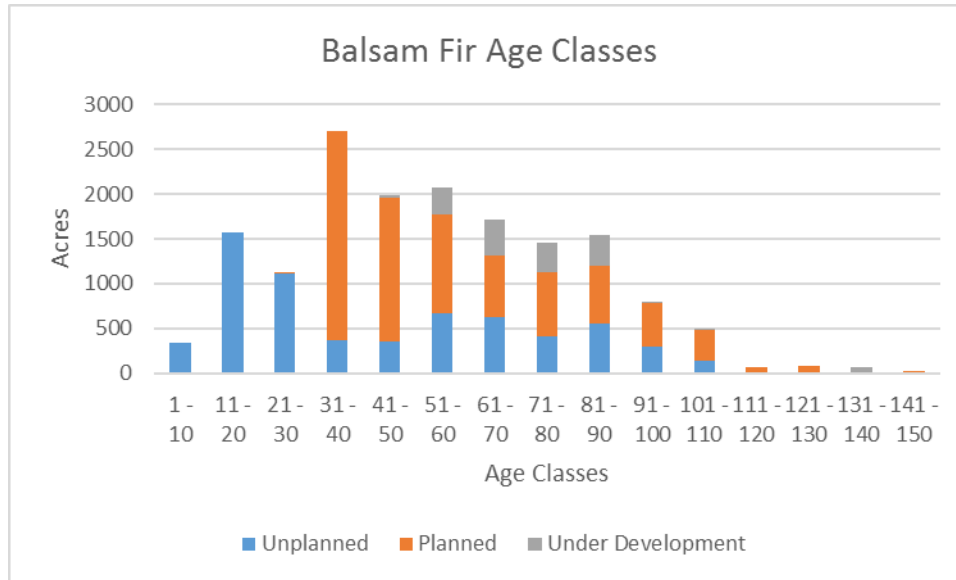
- Use appropriate regeneration method depending on advanced regeneration:
  - if there is enough advanced regeneration, use a clearcut method
  - if there is insufficient advanced regeneration, typically use shelterwood harvests
  - group selection is a silvicultural strategy that may be considered
- Increase oak components in aspen and NH cover types.

### Special Concerns

- If allowed to succeed, shade-tolerant species such as maples will increase abundance in oak stands.
- Some aspen stands may gradually include a greater oak component as a result of climate change and market forces.
- Regeneration may require browse protection.

## Balsam Fir

Natural, mature balsam fir (BF) stands are typically mixed stands. Balsam fir is best suited to wet-mesic sites where adequate soil moisture is available throughout the growing season.



**Current Acres:** 16,034 acres in the NSU Section (approximately 2.8% of the state-managed forest acres in the Section)

### Future Direction and Goals

- The desired within-stand composition is mixed forests, including long-lived conifers and upland hardwoods appropriate to NPC.
- Move toward a balanced age class distribution.
- Manage balsam fir as a component of other mixed species cover types.

### Strategies

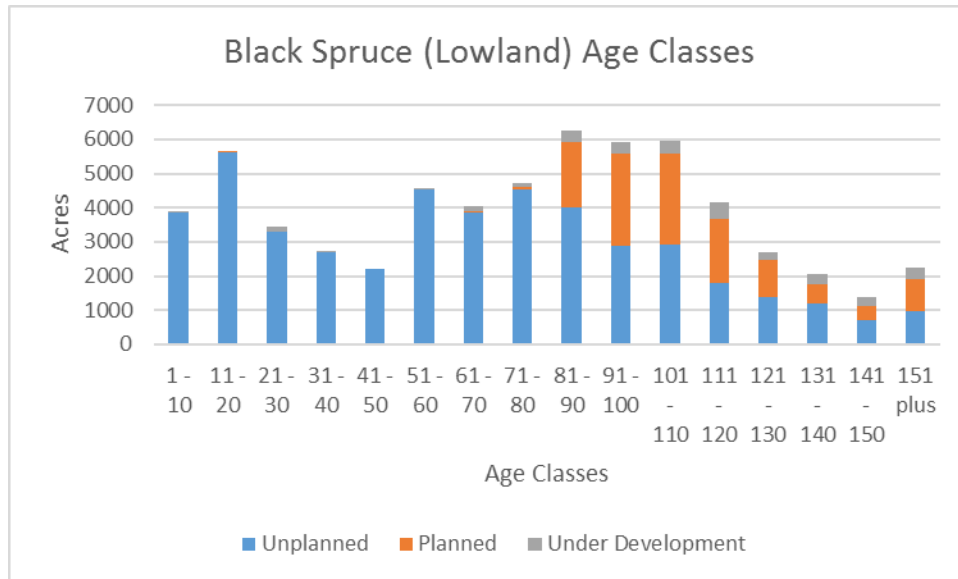
- Manage BF generally as even-aged for pulpwood and bolts.
- Some BF stands may be managed unevenly for a variety of purposes.
- Use intermediate treatments to control species composition and speed up stand development.
  - The best results from release treatments are in young, vigorous stands (approximately 6-10 feet tall).

### Special Concerns

- Spruce budworm
  - Emphasize regeneration of WS rather than BF in the understory.
  - Increase the abundance of non-host tree species such as pines and hardwoods.

## Black Spruce (Lowland)

The black spruce (lowland) (BSL) cover type is generally managed as an even-aged cover type for pulpwood while providing forest wildlife habitat and biodiversity. Natural, mature BSL stands range from pure or nearly pure stands to mixed stands, including secondary species such as tamarack, balsam fir, cedar, and birch.



**Current Acres:** 61,786 acres in the NSU Section (approximately 10.7% of the state-managed forest acres in the Section)

### Future Direction and Goals

- Move toward a balanced age class distribution.
- Maintain species diversity within BSL stands.

### Strategies

- Maintain secondary component species such as tamarack, white cedar, balsam fir, and paper birch. This can be accomplished through:
  - reserving seed trees, islands, or clumps of mature trees and advanced regeneration
  - harvesting to promote the sprouting of deciduous species
- Utilize natural or artificial seeding to regenerate BSL stands after harvest.

### Special Concerns

- BSL grows slowly and may have reduced vigor in some NPCs, especially on sites compacted by harvest operations.
- Concerns over climate change impact the season of operability, limiting management opportunities to a shorter period of frozen ground conditions to reduce rutting and compaction concerns.
- In wetter lowland sites, large black spruce clearcuts may result in raised hydrology and seeding regeneration failure (swamping out).
- Eastern dwarf mistletoe. Strategies generally used to limit spread to regenerating stands:

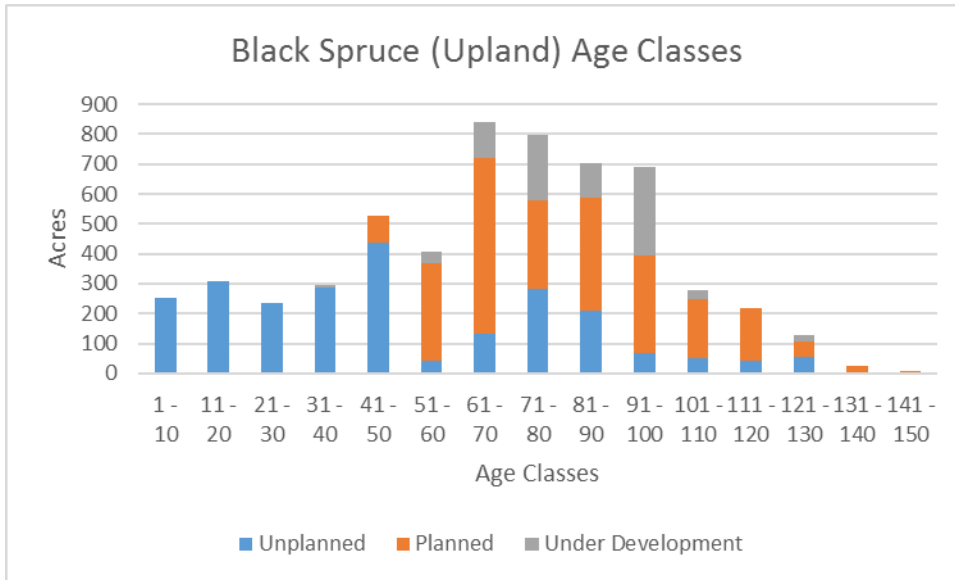
- Remove all live black spruce greater than 5 feet tall in clear cuts.
- Distribute slash for prescribed burns evenly across the site.
- Design timber sale boundaries to include a 2-chain (132-foot) buffer of non-infected black spruce around mistletoe pockets.
- Consider alternative goals and reserves in dwarf mistletoe mitigation decisions.

To reduce dwarf mistletoe infection in newly regenerating stands:

- Use prescribed fire or winter shearing to remove all residual infected trees if they are not removed during timber harvest.
- Regenerate densely stocked stands of black spruce to slow spread and reduce damage.
- BSL may experience reduced habitat under some projected climate change scenarios.

## Black Spruce (Upland)

Upland black spruce (BSU) stands are typically mixed with other conifers (often co-dominant with jack pine), aspen, and birch. BSU stands are found on nutrient-poor, dry to mesic sites.



**Current Acres:** 6,150 acres in the NSU Section (approximately 1% of the state-managed forest acres in the Section)

### Future Direction and Goals

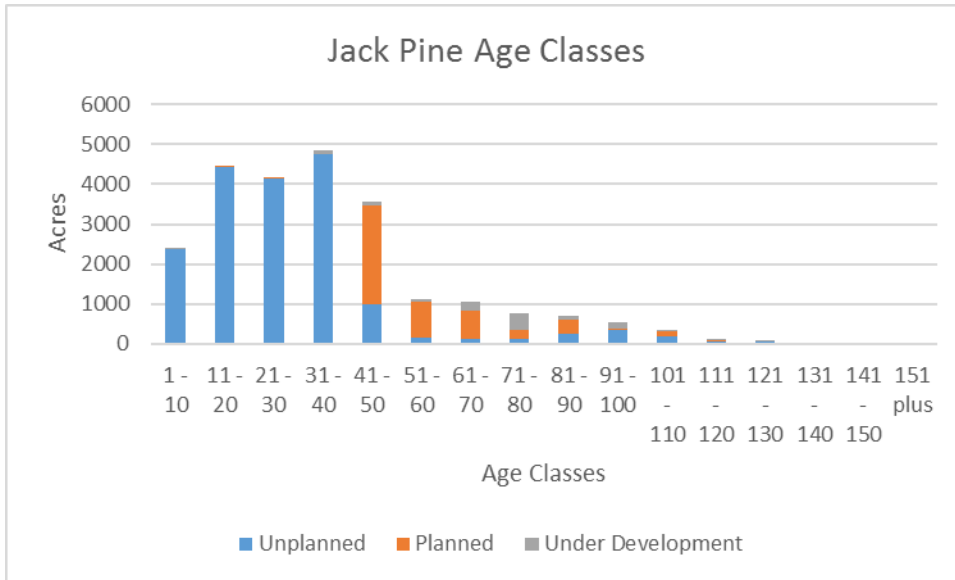
- 10-year DFC: 6,300 acres (2.5% increase)
- 50-year DFC: 6,800 acres (12.5% increase)
- Maintain acres of BSU and increase upland black spruce abundance in other cover types.

### Strategies

- Use small-gap strategies to perpetuate advanced regeneration of BSU, take advantage of seed trees, and reduce aspen competition.
- Perpetuate and increase black spruce when found in JP stands by creating a seedbed for reserved upland black spruce expansion.

## Jack Pine

The jack pine (JP) cover type is generally managed even-aged for pulpwood and bolts and to support wildlife habitat and biodiversity.



**Current Acres:** 24,195 acres in the NSU Section (approximately 4.2% of the state-managed forest acres in the Section)

### Future Direction and Goals

- 10-year DFC: 24,623 acres (1.1% increase)
- 50-year DFC: 25,719 acres (5.5% increase)
- Move toward a more balanced age class structure.
- The desired within-stand composition is relatively pure jack pine in younger growth stages. As forest stands mature, other species may increase depending on NPC.

### Strategies

- Convert approximately 274 acres (1,370 acres over five plan periods total) of A/BG/Bi cover types to the JP cover type in appropriate sites, including FDn12, FDn22, and FDn33.
- Perpetuate and increase black spruce when found in JP stands by creating a seedbed for reserved upland black spruce expansion. Sites classified as FDn32 may be suitable.

### Special Concerns

Due to jack pine budworm outbreaks, older stands are at high risk for significant mortality. Outbreaks occur at 6-12-year intervals and usually last 3-4 years in a location. Suggestions to address jack pine budworm include:

- Maintain age class diversity to minimize mortality.
- Salvage budworm-killed trees. Pre-salvage if intended products include dimensional lumber.
- Minimize “edge” when designing timber sales to decrease the severity of budworm impact.

- Regenerate jack pine from local seed sources to preserve the natural diversity of drought-tolerant populations.
- Reductions in jack pine habitat are expected under some projected climate change scenarios.

## Red (Norway) Pine

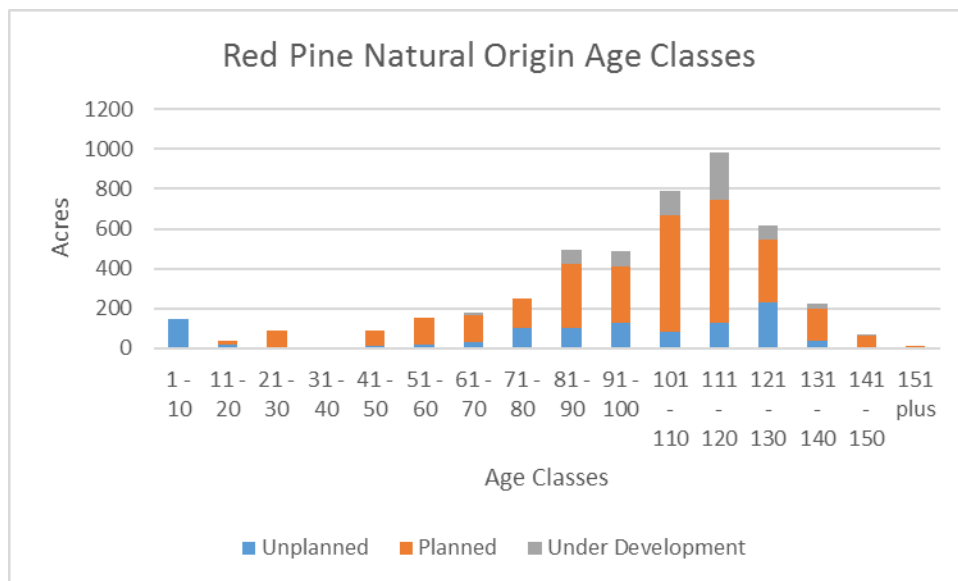
Red pine (RP) on DNR-administered timberlands is treated as two distinct cover types. Planted stands are managed using an economic rotation age (ERA). Natural origin stands are managed using a longer rotation age to reflect more of the natural variation in the lifespan of red pine trees, with a final harvest followed by a regeneration strategy mimicking the creation of a natural origin stand.

### Special Concerns

- Shoot blight-Follow current DNR guidance
- Bark Beetles-Follow current DNR guidance

## Red (Norway) Pine – Natural Origin

Red pine-dominated NPCs in the NSU Section are typically dry to mesic forests ranging from nearly pure stands to mixtures with conifers and hardwood species, especially aspen and birch. Currently, natural origin red pine stands have been identified in five different native plant community classes, within which nine discrete NPC types and subtypes can be described.



**Current Acres:** 4,629 acres in the NSU Section (13.3% of total red pine acres; planted and natural origin red pine together represent approximately 6.1% of the state-managed forest acres in the Section)

### Future Direction and Goals

- Move toward a more balanced age class structure.
- The desired structure within red pine ranges from predominantly single-canopied, even-aged stands to multi-canopied, mixed-aged stands with red pine, other conifers, and deciduous species as co-dominants.

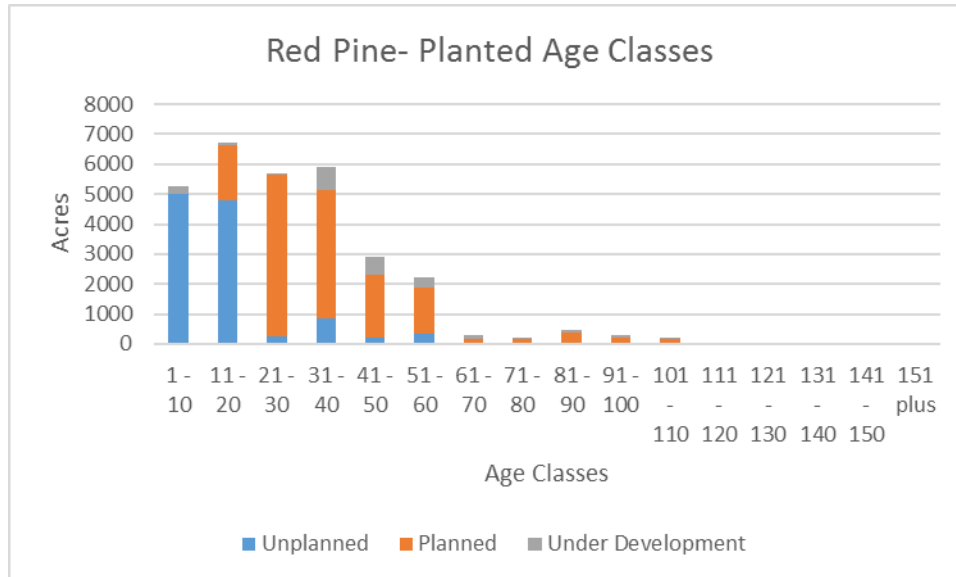
### Strategies

- Follow current department guidance for red pine management.

- Thinning in natural origin stands should maintain or increase within-stand diversity, retaining red pine as the main cover type, by the following methods:
  - Reserve individual trees or patches of other species appropriate to the site, where possible.
  - Creating or maintaining variable densities within stands when thinning.
  - Protect advanced regeneration of desirable understory species, where possible.
  - Higher stand densities (basal area) are recommended along stand edges exposed to wind and along high-visual-quality corridors, such as major roads and lakes.
  - Underplanting tolerant species where seed sources or advanced regeneration for these are lacking. For species suggestions, refer to the *Field Guide to Native Plant Communities of Minnesota* and NPC silviculture interpretations.
  - Incorporating variable density thinning or other techniques to meet biodiversity or habitat objectives. For example, thin 20 percent of the stand to 60 BA, 60 percent to 90 BA, and skip thinning in 20 percent to encourage within-stand diversity.
  - Large gaps (~3 ac) may be produced during early thinnings in mixed red pine/jack pine stands to encourage jack pine seeding, thereby ensuring that the species is not eliminated from the stand during later thinnings or due to early mortality.
- Consider the following recommendations when regenerating red pine:
  - Use natural regeneration in natural origin stands when opportunities arise.
  - Scarify to encourage natural seeding of red pine and other species.
  - Maintaining within-stand diversity during site preparation and herbicide use.
  - Prescribed surface fire in mature red pine stands can effectively manage shrub competition, reduce thick duff layers, and prepare mineral seedbeds. Summer fires conducted over several growing seasons are most effective at controlling dense shrub competition and exposing mineral soil.
  - Account for the risk of *Diplodia* tip blight and canker (*Sphaeropsis sapinea*) and shoot blight (*Sirococcus conigens*) infection on sites where taller infected red pine or jack pine are left on or next to sites being regenerated to red pine.
- Consider the potential impacts of bark beetles during intermediate harvest in red pine.

## Red (Norway) Pine – Planted

Red pine plantations are typically dominated by planted red pine but often include white pine, jack pine, birch, and aspen components.



**Current Acres:** 30,190 acres in the NSU Section (86.7% of total red pine acres; planted and natural origin red pine together represent approximately 6.1% of the state-managed forest acres in the Section)

### Future Direction and Goals

- Move toward a more balanced age class structure for classes between 0 years and economic rotation age.
- Manage for poles and high-value sawtimber products.
- Increase biological diversity and wildlife habitat.
- Diversify stands as they age.
- Increase within-stand structure to maintain or improve wildlife habitat and biodiversity.

### Strategies

- Convert approximately 2,326 acres (11,630 acres over five plan periods total) of A/BG/Bi types to the RP cover type.
- Manage predominantly as an even-aged cover type.
- Use thinning to increase future tree growth, quality, and vigor and to obtain the desired composition of the stand. Recommendations are:
  - Utilize normal rotation stand thinnings in merchantable stands at approximately 10-year intervals, depending on site quality.
  - Older stands may have longer intervals between thinnings to compensate for slower growth rates and facilitate desirable understory species' growth.
- To regenerate RP, use clearcut or clearcut with reserves. Use the following considerations:

- When site prepping and using herbicide, attempt to maintain within-stand diversity.
- Scarify to encourage natural seeding of red pine and other species.
- Scarify and artificially seed red pine and/or other species.
- Prescribed surface fire in mature red pine stands can effectively manage shrub competition, reduce thick duff layers, and prepare mineral seedbeds. Summer fires conducted over several growing seasons are most effective at controlling dense shrub competition and exposing mineral soil. This may be done before harvesting to prepare seedbeds unless charred bark on harvested trees poses a problem (“Red Pine Handbook”).
- Consider the risk of *Diplodia* tip blight and canker (*Sphaeropsis sapinea*) and shoot blight (*Sirococcus conigens*) infection on sites where taller infected red pine or jack pine are left on or next to sites being regenerated to red pine.
- Use shelterwood when converting to white pine.
- Reserve biological legacies such as large, healthy, live trees, decadent trees, snags, logs, and other coarse woody debris.
- Manage some stands for large-diameter, high-quality products (e.g., the size of poles needed to support the electrical grid has increased to 40’ tall poles that are 14” in diameter).

## Stagnant Spruce

Stagnant spruce (Sx) is not considered a commercial cover type; however, some harvest occurs for decorative spruce tops. Treetops from 1 ½ to 6 feet long are cut from selected trees, which grow new tops from lateral branches over time. Harvest level varies with tree size and quality and industry product specifications. In most stands, selective harvest ranges from 5-10 percent to as high as 20 percent of trees. Harvesting in higher quality stands has occurred periodically on a 10 to 15-year cycle.

This cover type is mostly composed of lowland black spruce or a mix of black spruce and other lowland conifers growing on very poor sites with organic soils saturated throughout the year and low nutrient levels. Stagnant spruce has a site index of less than 23, meaning that when trees are 50 years old, they are 22 feet tall or less.

Balancing the Sx age class distribution is not a goal of this plan.

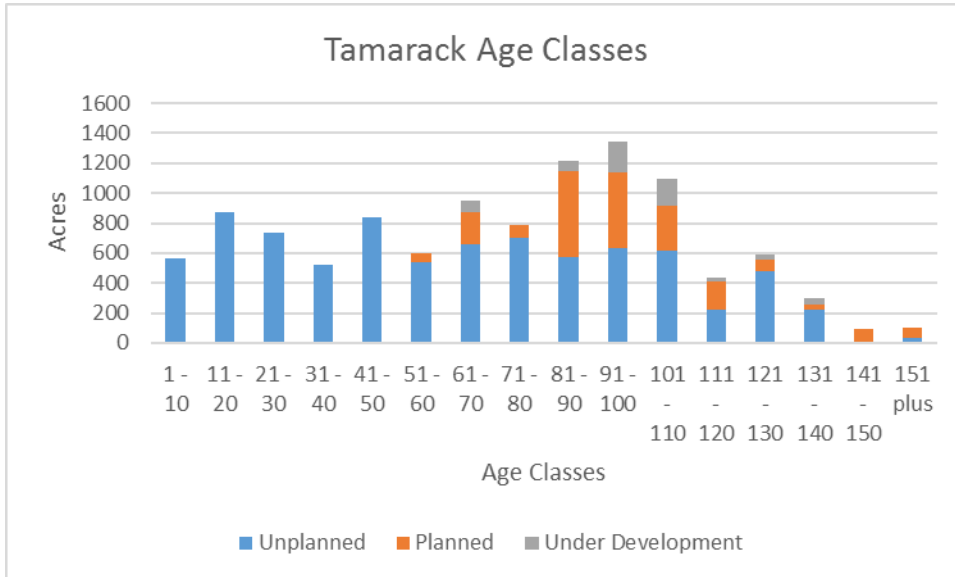
**Current Acres:** 30,357 acres in the NSU Section (approximately 5.3% of the state-managed forest acres in the Section)

### Special Concerns

- Peatland forests are characterized by saturated ground cover that is sensitive to rutting and compression by equipment. Consider low-impact equipment.

## Tamarack

Natural, mature tamarack (T) stands range from pure or nearly pure stands to mixed stands. Secondary species in the cover type include black spruce, balsam fir, cedar, and birch. Typical tamarack-dominated NPCs include APn81. The T cover type is managed primarily by even-aged methods for pulpwood while providing forest wildlife habitat and biodiversity.



**Current Acres:** 11,050 acres in the NSU Section (approximately 1.9% of the state-managed forest acres in the Section)

### Future Direction and Goals

- Move toward a balanced age class distribution
- Maintain T acres on the landscape and increase upland tamarack

### Strategies

- Harvest, leaving seed trees, in advance of eastern larch beetle (ELB). Leaving approximately ten tamarack per acre is recommended for successful seeding.
- Increase tamarack within other cover types and on upland sites as appropriate
- Maintain secondary component species of T stands where possible by:
  - reserving seed trees, reserve islands, clumps of mature trees, or advanced regeneration
  - artificial seeding may be an option for species such as black spruce and cedar

### Special Concerns

- Eastern larch beetle (ELB)
  - Consider pre-salvage or salvage harvest when stands are currently infested or are dying due to infestation.
  - Consider retaining a minimum of 5-10 live tamarack per acre as seed trees.
  - Where opportunities exist, regenerate high site index stands ahead of ELB infestation.

## White Cedar

White cedar (WC) is long-lived and is the climax species in many NPCs in which it occurs. Natural, mature WC stands range from pure to mixed stands. White cedar occurs on a wide range of site conditions but grows best on sites with the following characteristics:

### Lowland

- well-decomposed peat derived from woody plants or sedges
- pH of 6.5 – 7.8
- good water movement
- groundwater high in minerals

### Upland

- constant soil moisture supply
- somewhat poor to well-drained soils
- good aeration
- medium to fine textures high in calcium

White cedar is managed as an uneven-aged cover type. Balancing WC's age class distribution is not a goal of this plan.

**Current Acres:** 32,066 acres in the NSU Section (approximately 5.6% of the state-managed forest acres in the Section)

### Future Direction and Goals

- 10-year DFC: 33,822 acres (3% increase)
- 50-year DFC: 37,650 acres (15% increase)
- Increase the abundance of white cedar as a component of other cover types.
- Emphasize WC in deer wintering areas.

### Strategies

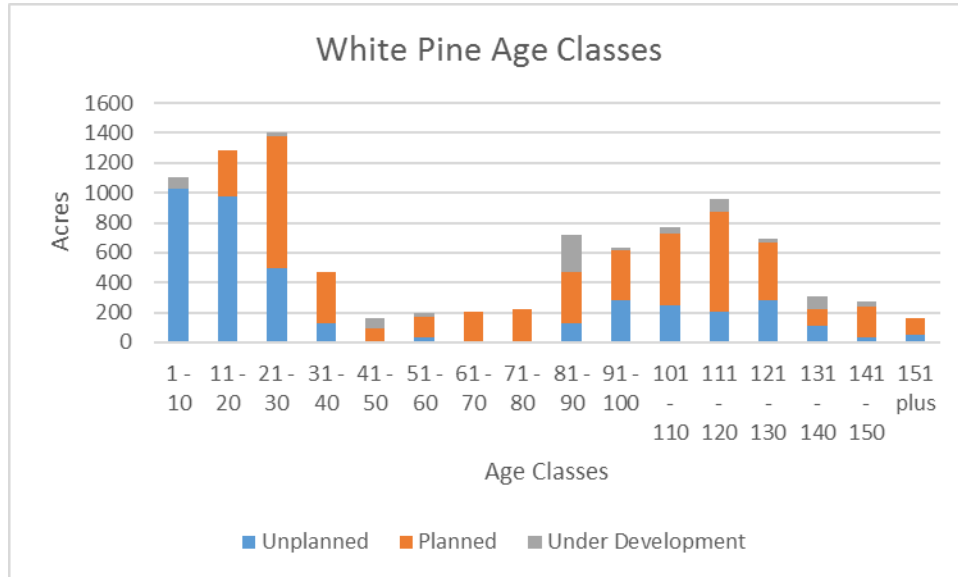
- Maintain or increase the acreage of WC stands used as thermal cover areas by deer.
- Maintain or increase white cedar as a component of other forest cover types.
- Manage stands as multi-age and mixed-species stands.
- Consider increasing the amount of strip and patch cuts in WC stands to increase age class diversity.
- Protect regeneration from browsing.

### Special Concerns

- Browsing by deer, mice, and snowshoe hares may limit the ability to increase or maintain WC stands.

## White Pine

White pine (WP) occurs as pure stands and as a component of many other upland cover types in the NSU Section. In this plan, a stand belongs to the WP cover type if it contains greater than 33% white pine by volume or basal area.



**Current Acres:** 9,570 acres in the NSU (approximately 1.7% of the state-managed forest acres in the Section)

### Future Direction and Goals

- 10-year DFC: 9,956 acres (7% increase)
- 50-year DFC: 12,572 acres (35% increase)
- Maintain age and species composition within stands.
- Move toward a balanced age class distribution.

### Strategies

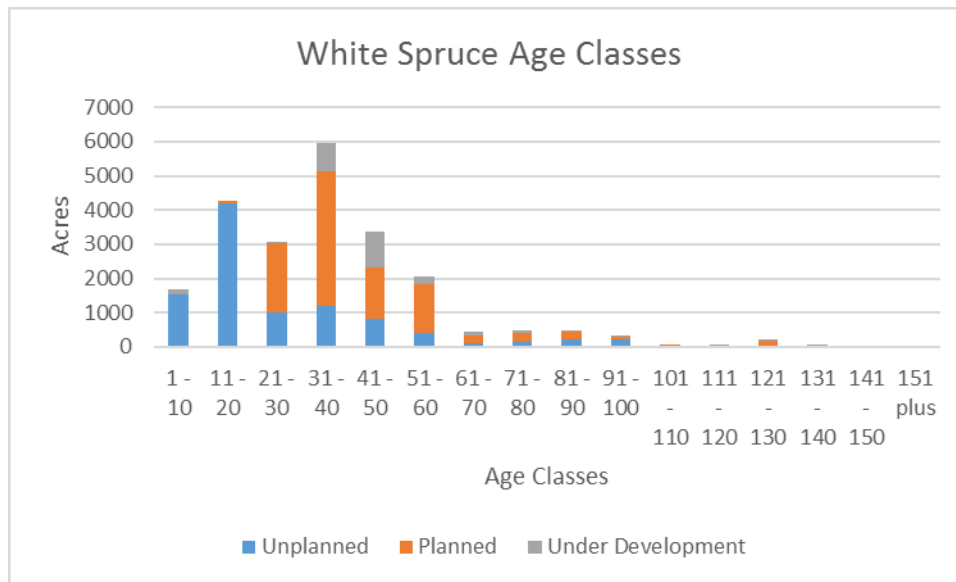
- Manage white pine stands to maximize the understory's potential for white pine regeneration.
  - White pine abundance can be encouraged by selective thinning in appropriate stands.
- Convert approximately 654 acres (3,270 acres over five plan periods total) of A/BG/Bi cover types to the WP cover type.
  - Assess the suitability of stands that include white pine for the capacity to convert to the WP cover type considering NPC and the DNR's [NPC Silviculture Strategies for forest stand prescriptions](#) webpage.
- Increase the amount of white pine occurring as a component in mixed stands appropriate to NPC.
- To decrease the risk of white pine blister rust, establish white pines under an overstory to prevent dew formation on needles. Tend seedlings and saplings once established using pathological pruning.

### Special Concerns

- Recruitment is often difficult due to deer browsing in some areas.
- White pine blister rust has affected tree growth and regeneration in northern Minnesota.
  - Seedlings and saplings often die, especially if planted in open plantations.

## White Spruce

White spruce (WS) stands vary from planted monotypic stands of nearly pure white spruce to natural origin stands that include other canopy tree species. White spruce occurs as mixed stands in the FD and MH native plant communities and is considered an excellent competitor in FDn43 and MHn44 NPCs. Natural origin white spruce is managed as an uneven-aged cover type, while plantation white spruce is managed as an even-aged cover type.



**Current Acres:** 22,527 acres in the NSU Section (approximately 3.9% of the state-managed forest acres in the Section)

### Future Direction and Goals

- 10-year DFC: 23,041 acres (2.5% increase)
- 50-year DFC: 25,161 acres (12.5% increase)
- Increase species and structural diversity in planted WS stands.
- Move toward a balanced age class distribution for WS.

### Strategies

- Convert approximately 530 acres (2,650 acres over five plan periods total) of A/BG/Bi cover types to WS/BF cover types in appropriate sites.
- Manage natural origin WS as multi-age and mixed-species stands. Recommendations include:
  - Retain some super canopy trees in patches or clumps at each treatment.
  - Encourage multi-layered understory development.
  - Emphasize regenerating white spruce in the understory.
  - Use single-tree and group selection harvest methods for stands that are already multi-aged.
  - Use shelterwood, seed tree with reserves, or group selection harvest methods for even-aged stands to move the stand toward becoming multi-aged.

- Manage planted WS as normal rotation stands on an even-aged basis for pulpwood, bolts, and sawtimber products when appropriate.
  - After final harvest, convert plantation WS stands to mixed species, structurally diverse stands using NPC information to select the most appropriate species.
- When regenerating WS stands, reduce balsam fir, the preferred spruce budworm host. Increase the abundance of non-host tree species such as pines and hardwoods.
- Plant WS seedlings under a light overstory of aspen or aspen/birch to discourage insect pests that cause seedling mortality and impact height growth.
- Avoid damaging shallow roots of white spruce during thinning. Consider the following strategies:
  - Thin only when the ground is frozen and snow is present.
  - Conduct the first thinning before the plantation is 30 years old.
  - Consider forgoing intermediate treatments in lieu of final harvest, as WS may decline due to multiple stand entries.

#### Special Concerns

- Spruce budworm and yellow-headed spruce sawfly. Reserve trees may mitigate impacts from sawflies by providing partial overstory shade. See the strategies above concerning spruce budworm.
- Needlecast diseases and other insects (e.g., spruce weevil, spruce beetle, etc.)
- Thinning damage to the shallow root system of WS (see strategies above)

## Upland Brush

Upland brush is a non-commercial cover type dominated by deciduous brush species. Without management intervention, upland brush types generally will not regenerate into a commercial timber stand for many decades. Upland brush is often created after a stand-level disturbance, age-related decline of a formerly commercial species, insect or disease outbreaks, browse pressure, or significant failure in regeneration in a plantation.

Upland brush types have high value as forage and cover for moose; promoting upland brush may be considered to enhance the habitat for moose and other species.

### Future Direction and Goals:

- Manage upland brush to provide habitat for moose and associated species.

### Strategies:

- Delineate inclusions of upland brush cover types larger than 5 acres within the moose range.
- Identify stands to be considered for upland brush management.
- Mowing, shearing, prescribed burning, or other methods may be considered to manage upland brush sites.

### Special Concerns:

- While most of the implementation of strategies in the plan are completed by the Division of Forestry, upland brush is largely to be maintained by the Division of Fish and Wildlife.

## 3.2 Harvest Levels

### **GDS-2A: Provide a sustainable supply of timber.**

Providing a sustainable supply of timber is one of the forest benefits for which state forests are managed, and an ancillary benefit of habitat management on acquired DNR WMA and Aquatic Management Area (AMA) lands. The DNR uses timber harvest to create the disturbance needed to create a mix of forest age classes that provide broad social, economic, and environmental benefits in perpetuity. The DNR uses timber volume to track that disturbance because it is the most efficient and effective metric currently available to evaluate our progress. The amount of timber volume the DNR plans to offer annually in this plan period was determined considering the results of STHA modeling and the following factors, among others:

- statutory requirements for specific land statuses (e.g., school trust lands, WMAs, state forests)
- age class imbalances for even-aged-managed cover types
- acres over rotation age
- representation of young and old forest
- varying goals based on administration or land status
- wildlife habitat and biodiversity
- supply of timber
- criteria for uneven-aged management and thinning
- forest growth and sustainability
- forest health concerns
- expected future market and stand conditions
- incorporating intermediate treatments to achieve goals in conjunction with harvests

Considering these factors, the DNR determined how much timber volume to offer on average annually to achieve the disturbance needed to sustain a balance of multiple values and forest benefits over time and to meet the objectives for different forest lands administered by the DNR.

The statewide 10-year stand exam list was developed to implement the strategic direction for this plan period. See [the DNR 10-year stand exam list report](#) for more information. Note that the DNR plans to visit more stand acres that contain more volume than necessary, based on model estimates, to ensure that the DNR will offer as much volume annually as planned. Thus, the estimated volume from planned stand exam acres is not equivalent to the volume harvested and removed from the landscape.

After site visits and interdisciplinary coordination, DNR staff determine whether forest stands on the stand exam list should have timber appraised and offered for sale, their inventory corrected, or treatment deferred to later in the planning period or to another planning period.

#### **GDS-2A**      **Strategies**

In addition to the statewide 10-year stand exam list, the following strategies aim to contribute to providing a sustainable timber supply over time:

- Emphasize treating stands older than normal rotation age and visiting the oldest stands first.
- Consider SFRMP goals when proposing annual plan additions (APAs) and follow APA policy when assessing how APAs (and deferred acres) interact with planned acres to achieve planned volumes.
  - Annual plan additions are stands or portions of stands that make sense to treat immediately (e.g., to address insects and diseases, operational considerations, or to adhere to policy) and are not on the stand exam list.
- Consider potential biomass harvest consistent with MFRC guidelines.
  - Biomass could be available as tops and limbs from timber harvests.
  - Non-commercial forests and brushlands may have the potential for biomass harvest.

### **GDS-2B: Manage the availability of non-timber forest products.**

Non-timber forest products include decorative materials, foods, herbs, medicinal materials, and specialty items.

Special product permits or informal timber sales are issued at the field level for a number of non-timber forest products, which may be restricted depending on the administration. Some non-timber forest products are included in treaty rights.

The following strategies will be used to protect the long-term availability of these forest resources.

#### **GDS-2B**      **Strategies**

- Identify known traditional gathering areas of special forest products when managing forest resources.
- Supervise and enforce special product permit regulations to ensure resource sustainability.
- Consider managing or using some forest stands for non-timber forest products.
- Be aware of known locations of important wildlife habitats, rare native plant communities, or rare species before issuing special product permits.
- Maintain non-timber forest products projected to be negatively impacted by climate change.

### 3.3 Biological Diversity, Young and Old Forest, and Spatial Distribution

Biological diversity, forest composition, and spatial distribution of forest patches are influenced by many factors, including:

**Soils and hydrology:** Nutrient and water availability are fundamental to determining species making up a native plant community. Demand for these resources and the ability of each tree species to compete alters the forest's makeup.

**Natural disturbance:** In conjunction with insects and disease, windthrow and wildfire were once the primary natural disturbance factors affecting forest stands. Alteration of the type and frequency of fires since European settlement has helped to shape the current forest.

**Past timber harvesting and land management practices:** In the early 20th century, timber harvesting practices and large wildfires in some portions of Minnesota caused much of the long-lived coniferous forest to be replaced by early successional species. The scale and intensity of timber harvest and wildfires had profound and long-lasting effects on seed sources, soil fertility, and subsequent re-vegetation.

**Natural succession:** As some 20th-century forests have matured beyond the maximum age for early successional tree species, there have been moderate declines in cover type acres of quaking aspen, balm-of-Gilead, and paper birch and corresponding increases in cover type acres dominated by mid- and late-successional tree species such as northern hardwoods and long-lived conifers.

**Current forest management practices:** Recent state forest management plans, and forest management plans in general throughout Minnesota, have been targeting a percentage of early successional cover types for conversion to later-successional cover types and mixed-forest stands.

**Wildlife browse:** Some species (e.g., deer, hare, porcupine, beaver, and other rodents) can affect the health of trees or regeneration success. Some species of trees (e.g., white pine, white cedar, and oaks) and other forest plants may require protection from browse damage to thrive/survive.

**Invasive species:** Invasive plants, animals, and diseases have established their presence and continue to emerge as significant factors affecting forest vegetation and biological processes. Among other effects, invasive species can disrupt natural succession, hinder regeneration, or displace native trees and plants.

**Climate Change:** Various climate change projections suggest that over time, some common tree species will decline (e.g., balsam poplar, balsam fir, white spruce<sup>2</sup>). However, habitat for some species is projected to increase (e.g., American basswood, northern red oak, eastern white pine). Forests with lower species and structural diversity are predicted to be less resilient to climate change impacts. In addition, fragmented landscapes will provide less opportunity for desired native species to migrate in response to climate change.

---

<sup>2</sup> Projections are from the [NIACS Climate Change Projections for Individual Tree Species: Northern Superior Uplands \(Ecological Section 212L\)](#).

### **GDS-3A: Ensure older forest stands and older forest characteristics within stands are distributed across the landscape.**

Conditions ranging from stands over standard DNR rotation age for a cover type (“older forest”) to stands designated as old growth represent mature to old forest on the landscape. These conditions are created or maintained in many ways on DNR-administered land and on other ownerships in the NSU landscape, including:

- Designation of old growth forests.
- Incorporating older forest values in the forest management strategic direction and stand exam list development:
  - Older forest across ownerships is accounted for during DNR planning (see below).
  - Model results show that, at the current level of volume offered, older forest will be retained, and for many forest types, will continue to accumulate.
  - Management regimes on Division of Fish and Wildlife-administered lands and in some management opportunity areas are designed to promote older forest.
  - The strategic direction ensures that at least 2.5% of the aspen cover type on DNR-managed forest lands is 60 years old or older statewide.
  - Some forest stands on DNR-administered lands that are not in the management pool (e.g., state parks and SNAs, inoperable stands, most representative sample areas (RSAs), and stagnant conifers) provide additional older forest.
- On average, approximately 30% of acres on DNR annual stand exam lists don’t result in timber sales. A portion of these represent or will become older forests.
- Application of site-level guidelines to riparian management zones.
- Management for High Conservation Values.
- Conversions from shorter to longer-lived species (e.g., aspen to pine).

In addition, the DNR uses an adaptive approach to monitor and manage forest age classes, including older forest, across ownerships at a landscape level:

1. The Section Forest Resource Management Plan (SFRMP) original desired percentage of older forest is applied as a benchmark across all ownerships.
2. Forest age class distributions across all ownerships and on DNR-administered timberlands are periodically monitored.
3. If necessary, DNR forest age class management may be adjusted in response to changing conditions across all ownerships.

**Table 3.3: Subsection Old Forest Benchmarks across all ownerships**

Subsection % Old Forest Benchmark\*

Cover Type	North Shore Highlands	Border Lakes	Toimi Uplands	Laurentian Highlands	Nashwauk Uplands
Aspen	11	11	11	11	12
Birch	14	14	14	14	12
Jack Pine/BSU	9	9	9	9	12
Balsam Fir	9	9	9	9	9
BSL High SI	10	10	10	10	15
BSL Medium SI	10	10	10	10	13

\*Numbers reflect effective older forest (over standard rotation age) goals from previous SFRMPs as applied in old forest adequacy analysis.

\* Due to varying confidence levels and coverage of data in the NSU Section, precise comparisons of all forest benchmarks were difficult to derive. The department strives to monitor and improve the data available to analyze the current status.

### GDS-3A Strategies

- If the DNR identifies discrepancies between current and benchmark percentages of old forest across ownerships, communicate the issue through appropriate channels. (This is done during monitoring and assessment.)
- Allow some stands to naturally succeed to long-lived cover types, with or without harvest.
- Maintain designated old-growth stands.
- Manage Old Forest Management Complexes (OFMCs) according to DNR policy.
- Use silvicultural treatments that retain old forest components in some stands.
- Consider the old forest's contribution to habitat and biodiversity when deciding to add and offer unplanned wood for harvest.

### **GDS-3B: Maintain or enhance vegetation conditions associated with known occurrences of species in greatest conservation need.**

Species in greatest conservation need (SGCN) are native animals whose populations are rare, declining, or vulnerable to decline and are below levels necessary to ensure their long-term health and stability. Key Habitats are habitats that are most important to the greatest number of SGCN. For more information, refer to Minnesota’s Wildlife Action Plan and the [Rare Species Guide](#) on the DNR website.

### GDS-3B Strategies

- Apply SGCN data and Wildlife Action Plan guidance in vegetation management.
- Incorporate new SGCN locations and data into coordination and management as they are collected.
- Manage applicable MOAs consistent with their association with SGCN.
- Maintain or enhance SGCN habitats using our interdisciplinary forest management processes.
- Consider climate change adaptation strategies in the [Wildlife Action Plan](#).

**GDS-3C: Maintain existing large patches and increase average patch size on state lands over time with consideration of natural spatial patterns. Identify ways to increase average patch size over time.**

Providing a diverse distribution of patch sizes and ages for wildlife and other values has long been an SFRMP goal. Patches are made up of one or more adjoining stands that are relatively homogenous in structure, primarily in height and density, and are similar in vegetation cover and age. Patches may be formally recognized as patch management opportunity areas (MOAs), but patches of forest vegetation can also be created, maintained, or enhanced outside of MOAs through stand exam list development and decisions made during stand management.

In this plan, patches:

- are categorized as old, intermediate, and young within cover types or groups of cover types
- range in size from small (less than 40 acres) to large (greater than 640 acres)
- may have smaller areas within them that are not in the same patch category as the main patch, such as inclusions, residual islands, legacy patches, corridors, and buffers

The primary goal of this plan is to set the stage in the short term (10 years) to improve the distribution of patch sizes and age classes across the landscape over the long term (50 years). The strategies below provide general guidance for working toward these goals.

**GDS-3C Strategies**

- Review and incorporate MOA guidance documents in management activities.
- Maintain existing large patches.
- Group harvest activities to maintain or create new large patches.
- Increase the “age window” for harvesting adjacent stands to maintain or create new large patches (harvesting at younger or older ages than normal).
- Increase the size of clearcuts while retaining adequate residuals.
- When possible, cooperate with other landowners in patch management to maintain existing large patches and increase the average patch size across forest land of multiple ownerships.

**GDS-3D: Maintain or enhance vegetation conditions associated with existing biodiversity significance factors in MBS sites of high and outstanding biodiversity significance.**

Minnesota Biological Survey (MBS) sites of biodiversity significance contain intact native plant communities, populations, or concentrations of rare species, critical animal habitat, or functional landscapes.

MBS sites are ranked as having outstanding (O), high (H), or moderate (M) biodiversity significance or as being below (B) the MBS minimum biodiversity threshold for statewide significance based on the following factors:

- rare species occurrences (element occurrences)
- native plant community quality, rarity, and size

- landscape context and presence/absence of landscape-level functions

More information about MBS, including background, definitions, and maps of sites of biodiversity significance, is available on the [DNR website](#).

### GDS-3D Strategies

Forest management activities such as timber harvesting, site preparation, access route construction and maintenance, and tree planting will occur on Forestry- and Fish and Wildlife-administered lands within MBS sites following the guidance and directions contained in this plan, as well as completed WMA unit plans, where applicable. Forest management activities in those MBS sites determined to be of greatest concern or importance for SFRMP will emphasize the following strategies to help minimize the loss of the factors on which the MBS sites were ranked.

- Implement measures to maintain or minimize the loss of characteristics that contributed to identifying MBS Sites of high and outstanding significance.
- Consider the broader context and significance of the MBS site as a whole when assigning management objectives and designing silvicultural prescriptions.
- Emulate the within-stand composition, structure, and function of NPC growth stages when managing stands in outstanding and high MBS sites.
- Increase the use of prescribed fire as a silvicultural technique in managing fire-dependent NPCs.
- Locate roads and trails to minimize fragmentation of high and outstanding MBS sites.
- MBS categories were considered when identifying [High Conservation Value Forests \(HCVF\)](#). Account for current DNR policy on HCVF when making management decisions.
- DNR personnel across divisions should inform other landowners of the significance of MBS sites, their biodiversity objectives, and management options for addressing them as opportunities arise.

### **GDS-3E: Protect, maintain, or enhance endangered, threatened, and special concern species and their habitats in the Section.**

*Minnesota's List of Endangered, Threatened, and Special Concern Species* (ETS list) identifies plants and animals at risk of disappearing from Minnesota. Special regulations apply to endangered and threatened species. Species listed as special concern are not statutorily protected but are considered in management decisions. Up-to-date information on the state ETS list can be found on the DNR's [ETS website](#). Vegetation management decisions will comply with federal laws, including the Endangered Species Act, state laws, and department-listed species direction.

The DNR has a leadership role in administering and applying MN rare species statutes and associated rules. Information on rare species in MN is available at the [rare species guide website](#).

### GDS-3E Strategies

- Provide DNR staff access to the Natural Heritage Information System (NHIS).
- Incorporate new rare features inventory information as it becomes available.

- Consult the rare features database (NHIS) when planning management activities.
- Coordinate with division partners to avoid impacts on state-protected species and species of special concern.
- In stand management decisions, account for rare species in the context of current Department guidance.
- Coordinate with division partners and refer to resources such as the [NIACS Adaptation Menu for Terrestrial Wildlife Management](#) to mitigate the effects of climate change on ETS species.

### **GDS-3F: Protect, maintain, or enhance rare native plant communities in the Section.**

Minnesota’s NPCs are ranked based on NatureServe’s Conservation Status Rank system (S-Rank), indicating the relative rarity or endangerment of the NPC statewide. These ranks are:

- S1 – critically imperiled
- S2 – imperiled
- S3 – rare or uncommon
- S4 – widespread, abundant, and apparently secure, but with cause for long-term concern
- S5 – demonstrably widespread, abundant, and secure

More information on status ranks, including a complete list of S-Ranks by NPC, is available on the [DNR native plant community classification webpage](#).

In addition to conservation status ranks, NPC condition ranks indicate the ecological integrity of NPC occurrences. NPC condition is ranked on a continuum from A through D, with an A rank indicating an excellent-quality NPC and a D rank indicating a poor-quality NPC.

#### **GDS-3F Strategies**

- Coordinate with EWR staff to determine treatments that will protect, maintain, or enhance occurrences of rare NPCs.
- Look for appropriate opportunities to maintain or improve the condition rank of rare NPCs during management.
- Maintain high-quality rare NPCs for their value as refugia and biological legacies into the future.

### **GDS-3G: Represent native plant community class growth stages on state lands.**

Growth stages are successional stages within a native plant community class that develop over time following an initial stand-establishing disturbance. Plant and animal species utilize various growth stages in different ways.

This SFRMP document does not establish acreage goals for growth stages by ecosystem type or native plant community. However, DNR staff members are encouraged to apply the following strategies to maintain/increase the representation of NPC growth stages on state lands.

## GDS-3G Strategies

- Look for opportunities to maintain and/or develop characteristics of under-represented growth stages.
- Account for the contribution of inoperable stands and reserved areas (e.g., old growth, SNAs, state parks) in providing representations of growth stages when developing prescriptions.

### **GDS-3H: Ensure young, early successional forest is distributed across the landscape over time.**

The 0-30 year age group of aspen, balm-of-Gilead, birch, and jack pine cover types represents upland young, early successional forest in this plan. The goal of balancing age class distributions in even-aged managed cover types determines the amount of young forest sustained over time. Young, early successional tree species are also present in other cover types.

In this planning period, sufficient young forest is being created and maintained in the NSU Section during the course of this ten-year planning effort through the implementation of the strategic direction and the 10-year stand exam list. Management opportunity areas that are a part of this plan provide further direction for managing some young, early successional forest for wildlife species (e.g., ruffed grouse management areas). Management opportunity areas are summarized, with links for their management guidance documents, in [Appendix B](#).

## **3.4 Wildlife Habitat**

### **GDS-4: Provide a variety of vegetation conditions and habitat components at multiple scales simultaneously to support wildlife species found in the Section.**

Game and nongame wildlife populations reflect the biological health of the forest and are important to society for their inherent values. Both natural events and forest vegetation management have the potential to positively or negatively affect wildlife species, as well as provide a variety of habitats for short- and long-distance migrants. A range of vegetation conditions and components of species' habitats are provided in the NSU Section through a variety of mechanisms:

- **Some species associated with older forest** are provided for in statutory preserves, old growth stands and old forest complexes, inoperable or unmerchantable stands, management regimes that allow older rotation ages and greater reserve amounts on Fish & Wildlife-administered land, stands that are not harvested at rotation age for a variety of reasons, and on other ownerships (see GDS-3A for additional examples).
- **Species associated with younger forest** are provided for on state lands and other ownerships in timberlands that are regenerating after harvest.
- **Structural elements within stands that many species depend on** are provided through the application of MFRC site-level guidelines and strategies in this plan.
- **Some individual species' needs** are addressed through state and federal laws and department policies and guidelines.

Providing diverse forest characteristics and forest stand age classes will help support wildlife species with different habitat requirements. Strategies throughout this plan promote and preserve wildlife habitat, including guidance related to:

- Increasing tree species and structural diversity within stands
- Ensuring there is older and younger forest habitat across the landscape
- Providing a range of NPC growth stages
- Protecting rare native plant communities; endangered, threatened, and special concern species; species in greatest conservation need; riparian areas, and high and outstanding sites of biodiversity significance

#### GDS-4 Strategies

Below are additional strategies for managing forests to support wildlife in the NSU Section:

- Manage to retain the integrity of riparian areas and protect seasonal and permanent wetlands.
- Provide for the needs of species that depend on perches, cavity trees, bark foraging sites, and downed woody debris through the application of MFRC site-level guidelines and the DNR's Wildlife Management Leave Tree and Snag Guidelines.
- Apply DNR policies and guidelines in the Interdisciplinary Forest Management Policy System for managing wildlife species' habitats.
- Consult WMA plan guidance on WMA lands and LUP Comprehensive Conservation Management Plan guidance on leased federal lands in the Beltrami Island State Forest.
- Account for the habitat needs of migratory bird species, particularly ground-nesting species and old forest obligates that have shown long-term population declines.
- Provide for the needs of species associated with conifer stands and mixed conifer/hardwood stands.
  - Increase acres of long-lived conifer cover types through active management, allow some stands to naturally succeed to conifer types, or increase mixed forest conditions in some stands through selective harvesting.
- Provide site-specific benefits for wildlife species through management opportunity areas.

### 3.5 Riparian and Aquatic Areas

The management of riparian areas can influence water quality and temperature, erosion rates, deposition of woody debris into water bodies, and the diversity of fish, wildlife, and plant species found in and near water bodies. DNR personnel check the application of guidelines for managing riparian areas adjacent to lakes, streams, rivers, and permanent open-water ponds when managing within riparian areas.

#### **GDS-5A: Manage riparian areas to provide vegetation conditions associated with habitat for fish, wildlife, and plant species.**

Riparian areas encompass the transition zone between the terrestrial and aquatic habitats that occur along lakes, streams, and open-water wetlands. A riparian management zone (RMZ) is the portion of the riparian area

where site conditions and landowner objectives are used to determine management activities that address riparian resource needs.

#### GDS-5A Strategies

- Retain a relatively continuous forest cover to protect and maintain aquatic habitat types, aesthetics, recreation, and forest products.
- Consult with Fisheries staff on management within the RMZ of designated trout streams.
- Maintain or increase water quality and habitat for Lake Sturgeon within the St. Louis River watershed.
- Manage to maintain forest, particularly older conifers, in riparian areas to provide shade, coarse woody debris, and leaf litter input.
- Emphasize conifers where appropriate and discourage aspen and birch in the RMZ of designated trout streams.
- Conserve shoreline beauty for recreational use of public lands in northern Minnesota by following the Little Shipstead-Newton-Nolan Act.
- Refer to Minnesota's Wildlife Action Plan, the MFRC's Riparian Science Technical Committee's Analysis of Current Science Behind Riparian Issues, and other applicable research for information on managing riparian areas for wildlife and other ecological considerations.

#### **GDS-5B: Protect wetlands and seasonal ponds during forest management.**

Wetland areas include lowland forested areas, lowland brush and lowland grass cover types, and seasonal ponds. The areas provide hydrologic buffering and species habitat diversity. They are protected using different site-level forest management guidelines than those required for riparian areas adjacent to lakes, streams, rivers, or permanent open-water ponds.

#### GDS-5B Strategies

- Meet or exceed MFRC Voluntary Site-Level Guidelines.
- Check the application of wetlands and seasonal pond guidelines as a part of stand exam review, timber sales supervision, and inspections.
- Maintain conifers in and around wetlands and vernal pools.

## 3.6 Timber Productivity

#### **GDS-6: Increase or maintain timber productivity and quality on state timberlands.**

#### GDS-6 Strategies

- Move toward harvesting stands in even-aged-managed cover types at their designated rotation ages. This is largely accomplished through modeled stand selection.
- Use site preparation, interplanting, release from competition (e.g., herbicide application or mechanical/hand release), and tree protection.
- Apply selective harvest treatments and thinning.

- Seek opportunities to increase tree quality, promote understory development and biodiversity of a stand, and increase forest health.
- Some uneven-aged managed cover types may be initially treated through even-aged methods to improve long-term stand age structure and timber quality.
- Some even-aged managed cover types may use uneven-aged prescriptions to meet various goals.
- Minimize the use of pesticides (herbicides, insecticides, etc.). Follow operational standards to control competing vegetation, forest insects, and diseases on state lands.
- Continue to improve, implement, supervise, and enforce current DNR timber sale regulations to protect and minimize damage to sites or residual trees from treatment activities. For example:
  - Avoid damage to residual trees during harvest or thinning operations.
  - Minimize compaction and rutting by determining the acceptable operating season.
- Manage certain stands for large-diameter, high-quality products by retaining adequate stocking and basal area.

### 3.7 Forest Pests, Pathogens, and Non-native Invasive Species

#### **GDS-7A: Limit damage to forests from insects, disease, and non-native invasive species to acceptable levels where feasible.**

Forest management will not attempt to eliminate native insects and diseases or their processes from the landscape but rather to limit their impact on individual sites to a level that allows goals for timber production, water quality, aesthetics, recreation, wildlife, and biodiversity to be realized. At acceptable levels, they promote a diversity of tree species and generate important elements of forest structure that are important as habitat and in nutrient cycling, such as snags and coarse (large) woody debris. Considering native and non-native insects and diseases in forest management planning and activities can significantly reduce or avoid many adverse economic and environmental impacts on Minnesota forests.

#### GDS-7A Strategies

- Identify and monitor insect, disease, and non-native invasive species populations as part of the forest health monitoring program and document their occurrence on state-managed lands.
- Involve private landowners and local units of government in gathering and disseminating information.
- Consider the least intensive site preparation methods possible to ensure success.
- Apply recommended strategies from DNR forest health specialists as appropriate.
- Follow Department guidance to minimize the spread of invasive species.
- Provide information and training to equipment operators and tree fellers regarding techniques that minimize damage to retained trees (e.g., leave trees or crop trees) and minimize the spread of invasive insects, diseases, and plants.
- Use fire as a tool in appropriate situations to prevent or control insect and disease outbreaks.

## **GDS-7B: Reduce adverse impacts of wildlife on forest vegetation on state forest lands.**

Wildlife species such as deer, hare, porcupine, beaver, and other rodents impact forests and plant regeneration through browsing, stem damage, and girdling. Solutions require an understanding of the dynamics of herbivory, seasonal wildlife movements, population structure, population control tools and their effectiveness, and proven repellents or exclusion methods. The management strategies below attempt to minimize adverse impacts.

### **GDS-7B Strategies**

- Take into account the potential for wildlife impacts to planted or naturally regenerating trees before damage occurs.
  - Work with Area wildlife staff to identify sites where significant damage may occur before forest management activities occur. Where necessary, incorporate plans for post-sale damage mitigation into forest regeneration and development plans.
  - In riparian areas, favor tree species that are less palatable to beavers.
- Focus forest regeneration efforts in areas less likely to be negatively affected by wildlife.
  - Avoid unprotected plantings of susceptible species near known deer concentration areas.
  - Avoid planting susceptible species in locations surrounded by vegetation types preferred by ungulates without some plan for protection from browsing.
- Use mitigation techniques on sites where damage from wildlife is anticipated.
  - Use targeted, rather than stand-wide, competition control.
  - Seed or plant more heavily to account for expected mortality.
  - Plant susceptible species away from the edge of the site.
  - Use protective measures such as fenced enclosures, bud capping, repellents, tree shelters, etc.
  - Seed or plant a mix of species rather than a single species.
- When deciding what to regenerate, consider species or stock sources that are less palatable to wildlife.

## **3.8 Climate Change**

### **GDS-8: Using best-available science, manage state lands to help forests adapt to the effects of and mitigate global climate change.**

Minnesota DNR recognizes that climate change is occurring at a rate that exceeds historical levels and will have serious implications for people and the natural world.

Most tree species in Minnesota reach the limit of their geographic distribution within the boundaries of the forested portion of the state. Projections of future tree distributions can help guide climate change adaptation. Management is based on our current knowledge and will be adjusted based on future research findings.

Although the effects of climate change on forest vegetation at the section scale during the planning period are uncertain, the following strategies will help forests adapt to the projected effects of climate change.

## GDS-8 Strategies

- Maintain or increase species and structural diversity, using resources including the DNR's [NPC silviculture strategies for forest stand prescriptions](#), including information on species affinity for warmer and/or drier site conditions and [NIACS climate change projections for tree species in the NSU Section](#).
- Maintain refugia for species that cannot migrate.
- Maintain connectivity of islands of habitat that allows the migration of plants and animals.
- Enhance genetic diversity in planting and seeding. Evaluate site conditions with respect to climate change when selecting tree species for regeneration or conversion.
- Maintain or increase conifers adjacent to cold-water streams to provide a cooling effect in warm weather and retain snowpack longer, slowing discharge in the spring.

## 3.9 Visual Quality

### GDS-9: Minimize forest management impacts on visual quality in sensitive areas.

Scenic beauty is a primary reason people choose to spend their recreation and vacation time in or near forested areas. The following strategies, which apply *MFRC Site-Level Guidelines*, aim to protect visual quality during and after management activities in forests near recreational trails, lakes, waterways, public roads, and highways.

## GDS-9 Strategies

Applying *MFRC Voluntary Site-Level Guidelines* satisfies this GDS, including:

- Minimize visibility of harvest areas by limiting the apparent size of the harvest area.
- Avoid management operations whenever possible during periods of peak recreational use.
- Locate roads and trails to minimize visibility from nearby vantage points, such as scenic overlooks, streams, and lakes.
- Encourage long-lived species and other visually important species (e.g., paper birch) along high-visual quality identified roadways. This will minimize the frequency of management activities in areas with high visual sensitivity and provide larger-crowned, larger-diameter trees that improve forest aesthetics.

## 3.10 Access to State Land

### GDS-10: Plan forest access routes and collaborate with federal, tribal, private, and local units of government to share access and minimize new construction.

## GDS-10 Strategies

- Thoughtfully plan access routes:
  - Use existing access routes where possible.
  - Control access to limit conflicts with recreation.
  - Eliminate unnecessary access routes.

- Minimize timberland area lost to road development.
- Cooperate with other forest landowners to retain existing access to State land and coordinate new road access.
- Account for treaty rights in access route decisions.
- Close access routes at the conclusion of management activities when appropriate.
- Evaluate if access is needed in sensitive areas on a case-by-case basis through interdisciplinary coordination.
  - Avoid access routes across reserved or deferred areas, if possible (e.g., old growth).
  - If the only reasonable access to stands to be treated is across reserved/deferred areas, then strive to minimize impacts.
  - Avoid ETS species during access route planning and development.

### 3.11 Cultural Resources

#### **GDS-11: Protect cultural resources on state-administered lands.**

Cultural resources are objects or areas that have spiritual, traditional, scientific, or educational value. Examples of cultural resources that may interact with forest management include archaeological sites, cemeteries, historic structures, and traditional harvest locations. In addition to federal and state laws that protect certain types of cultural resources, the *Voluntary Site-Level Forest Management Guidelines* provide information and recommendations to assist private and public land managers in taking responsible actions when cultural resources are encountered.

#### GDS-11 Strategies

- DNR archeologists or state historic preservation officers review stand exam lists and fish and wildlife management projects. Recommendations for mitigation are implemented as part of the sale design.
- Establish positive, continuing, and respectful communications with Tribal Nations on conservation, natural resource, and land management issues. Refer to Operation Order 129.
- Ensure treaty rights are considered in management activities.
- Manage for culturally significant wildlife species, such as moose.

### 3.12 Natural Disturbance Events

#### **GDS-12: Promptly evaluate and determine the appropriate response to natural disturbance events on state land.**

By promptly evaluating known disturbance events (e.g., fire, wind, insects, or disease) on DNR-administered lands, DNR land managers can quickly assess which forest management activities are necessary to mitigate the event's impacts. Where quick action is needed to salvage timber from damaged stands, the DNR will use the annual plan addition process for public review.

- The Department will evaluate large-scale (1,000's to 10,000's of acres) disturbance events affecting DNR-administered lands to determine appropriate action.
  - Assess the extent and significance of the event on DNR-administered forest lands in the Section.
  - Recommend forest management actions.
  - Analyze effects on how disturbances might interact with how much volume is offered to advance desired future conditions.
  - When possible, cooperate in assessing and implementing management actions with other agencies and landowners.
  - Internal communications protocol:
    - Initial notification/Call to action: The responsible land manager calls a meeting of DNR decision-makers of all affected divisions within the first few days after the initial assessment.
    - Follow-up and evaluation: complete a multi-discipline After Action Review at the request of the regional manager.
- Local DNR land managers will evaluate and determine appropriate actions for small-scale (10s – 100s of acres) disturbance events and take the appropriate action to address the situation.

### 3.13 Management Opportunity Areas

Management opportunity areas (MOAs) are areas on DNR-administered lands that offer an opportunity to maintain or create spatial patterns to address natural resource values that are difficult to achieve at the stand level or through the normal stand development process. They contribute toward meeting goals in this plan, including providing wildlife habitat for a range of species (e.g., ruffed grouse management areas) and providing older forest and older forest characteristics distributed throughout the Section (e.g., old forest management complexes).

Preliminary MOAs were incorporated in the modeling to create the DNR's 10-year stand exam list for fiscal years 2021-2030. For some MOA types, cover type harvest age and the percent of stand area reserved from harvest differed from standard DNR management on non-school trust lands. On school trust lands within MOAs, standard DNR management rotation ages and reserve amounts apply. In practice, MOA reserve amounts can be applied on average at the MOA scale to meet MOA objectives.

The preliminary MOAs included in the stand exam list modeling in the NSU Section were vetted by DNR staff and managers in the Divisions of Ecological and Water Resources, Fish and Wildlife, and Forestry. As a result of that review process, MOAs and MOA management guidance documents were adopted in the NSU Section.

Management within adopted MOAs will be designed to meet the MOA's intent and strategies (described in the guidance documents) to the greatest possible extent while balancing other forest resource goals and adhering to DNR policies. However, it is important to remember that not all MOA objectives are achievable on every stand within a MOA. Rather, objectives are met at the scale of the MOA through a combination of the resource conditions that preceded the current planning period, the spatial and temporal configuration of stands on the

10-year stand exam list, and the design of management activities within the MOA. Therefore, there is flexibility in how MOAs are implemented. This is necessary because there are multiple ways to achieve MOA goals, and the degree to which MOA guidance will impact any individual stand will vary based on MOA goals and site conditions.

Management opportunity areas are not “no-harvest” zones. Normal procedures, including annual plan additions (APAs; stands added to the stand exam list in a given year), are allowed within MOAs and may be necessary to manage appropriately. Management opportunity area goals should be considered when determining annual stand exam list transactions, including APAs. As with stands on the annual stand exam list, management within APA stands is expected to follow the MOA intent and strategies when possible.

Individual MOA guidance documents can be downloaded from the links in the tables for each MOA type in [Appendix B](#).

# Appendix A: Summary of Issues and General Direction Statements

**Table A.1: General direction statements (GDSs) that address each issue. The Cover Types column indicates whether one or more cover type accounts in section 3.1 address an issue. See below for a summary of each issue and GDS, Chapter 2 for a full description of each issue, and Chapter 3 for a full description of each GDS.**

Issue	GDS												Cover Types												
	1A	1B	1C	2A	2B	3A	3B	3C	3D	3E	3F	3G		3H	4	5A	5B	6	7A	7B	8	9	10	11	12
A1	X	X	X			X						X	X												X
A2		X	X			X	X		X	X	X	X		X	X										
A3	X							X					X												X
B1	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
B2	X	X	X											X							X				X
B3									X		X														
B4																	X								X
B5								X	X												X				
B6								X	X																
C1	X			X																					X
C2					X																				
D1									X																
D2		X	X			X								X											X
E1							X		X	X	X			X											
F1	X	X	X			X	X	X	X	X			X	X	X	X					X				
G1														X	X	X					X				
H1																	X	X	X	X					X
I1																			X					X	X
I2																			X					X	
I3																								X	
J1	X	X	X				X			X											X				X
K1																						X			
L1																						X			
M1																							X		

## Summary of Issue Statements

### A. Forest Age and Growth Stages

[A1. Representing growth stages and forest types across the landscape, given age class distribution goals.](#)

[A2. Managing for older forest and old forest qualities on the landscape.](#)

[A3. Managing for young, early successional forest.](#)

### B. Forest Composition, Structure, Spatial Arrangement, Growth Stages, and Native Plant Communities

[B1. Addressing biodiversity, forest health, and productivity of native plant communities through management of forest composition, structure, representation of growth stages, within-stand diversity, and spatial arrangement of vegetative types.](#)

[B2. Determining which tree species to increase or manage within forest communities in the Section with respect to various natural resource objectives and projected environmental change.](#)

[B3. Maintaining or enhancing imperiled and highly imperiled native plant communities in the Section.](#)

[B4. Retaining characteristics of natural stand-replacement disturbance events while applying intensive management of forest communities.](#)

[B5. Using management to better reflect natural landscape patterns \(the size and configuration of growth stages and types resulting from broad-scale natural disturbances\) in the Section.](#)

[B6. Reducing forest fragmentation to maintain connectivity among habitat types.](#)

### C. Harvest Levels for Timber and Non-Timber Forest Products

[C1. Contributing to sustainable forest management that meets the department's direction to continue to develop the desired forest age class distributions and species mixes over time by offering timber volume for sale, considering all forest resources and the objectives of the different forest lands administered by the DNR.](#)

[C2. Managing non-timber forest products.](#)

### D. Biological Diversity

[D1. Maintaining or enhancing biodiversity and native plant community composition, structure, and function through stand management within larger areas of biodiversity significance.](#)

[D2. Retaining or restoring within-stand structural complexity \(e.g., vertical structure, stem size and density, coarse woody debris, and pit and mound micro-topography\) when stands are harvested before reaching older growth stages in which these characteristics would normally develop.](#)

## **E. Rare Features**

[E1. Protecting rare plants and animals \(including species in greatest conservation need\), their habitats, and other rare features in the Section.](#)

## **F. Wildlife**

[F1. Addressing the needs of game and nongame species through vegetation management.](#)

## **G. Watersheds, including Riparian and Aquatic Areas**

[G1. Addressing the impacts of vegetation management on surface waters \(wetlands, streams, and lakes\).](#)

[G2. Addressing cumulative impacts to aquatic resources of vegetation management on a watershed or sub-watershed level.](#)

## **H. Timber Productivity**

[H1. Maintaining or increasing timber productivity on state lands.](#)

## **I. Disturbance Impacts on Forest Ecosystems**

[I1. Addressing disturbances, such as harmful forest insects, disease, and herbivory, on forest ecosystems.](#)

[I2. Addressing non-native invasive species threats and invasions.](#)

[I3. Considering catastrophic natural disturbances in vegetation management decisions.](#)

## **J. Climate Change**

[J1. Managing vegetation to prepare for and respond to the effects of climate change.](#)

## **K. Visual Quality**

[K1. Minimizing the effects of vegetation management activities on visual quality.](#)

## **L. Access to State Land**

[L1. Providing access to stands identified for management.](#)

## **M. Cultural Resources**

[M1. Protecting cultural resources during vegetation management activities on state-administered lands.](#)

## **N. Balancing Vegetation Management Needs with Legal Requirements**

[N1. Including various state and federal legal requirements in the SFRMP planning process.](#)

# Summary of General Direction Statements

## 1. Forest Composition and Within-stand Diversity

[GDS 1A: Maintain diversity of cover types.](#)

[GDS-1B: Manage within stands to reflect the composition, structure, and function of native plant communities.](#)

[GDS-1C: Maintain or increase species, age, and structural diversity within some stands.](#)

## 2. Harvest Levels

[GDS-2A: Provide a sustainable supply of timber.](#)

[GDS-2B: Manage the availability of non-timber forest products.](#)

## 3. Biological Diversity, Young and Old Forest, and Spatial Distribution

[GDS-3A: Ensure older forest stands and older forest characteristics within stands are distributed across the landscape.](#)

[GDS-3B: Maintain or enhance vegetation conditions associated with known occurrences of species in greatest conservation need.](#)

[GDS-3C: Maintain existing large patches and increase average patch size on state lands over time with consideration of natural spatial patterns. Identify ways to increase average patch size over time.](#)

[GDS-3D: Maintain or enhance vegetation conditions associated with existing biodiversity significance factors in MBS sites of high and outstanding biodiversity significance.](#)

[GDS-3E: Protect, maintain, or enhance endangered, threatened, and special concern species and their habitats in the Section.](#)

[GDS-3F: Protect, maintain, or enhance rare native plant communities in the Section.](#)

[GDS-3G: Represent native plant community class growth stages on state lands.](#)

[GDS-3H: Ensure young, early successional forest is distributed across the landscape over time.](#)

## 4. Wildlife Habitat

[GDS-4: Provide a variety of vegetation conditions and habitat components at multiple scales simultaneously to support wildlife species found in the Section.](#)

## 5. Riparian and Aquatic Areas

[GDS-5A: Manage riparian areas to provide vegetation conditions associated with habitat for fish, wildlife, and plant species.](#)

[GDS-5B: Protect wetlands and seasonal ponds during forest management.](#)

## **6. Timber Productivity**

[GDS-6: Increase or maintain timber productivity and quality on state timberlands.](#)

## **7. Forest Pests, Pathogens, and Non-native Invasive Species**

[GDS-7A: Limit damage to forests from insects, disease, and non-native invasive species to acceptable levels where feasible.](#)

[GDS-7B: Reduce adverse impacts of wildlife on forest vegetation on state forest lands.](#)

## **8. Climate Change**

[GDS-8: Using best-available science, manage state lands to help forests adapt to the effects of and mitigate global climate change.](#)

## **9. Visual Quality**

[GDS-9: Minimize forest management impacts on visual quality in sensitive areas.](#)

## **10. Access to State Land**

[GDS-10: Plan forest access routes and collaborate with federal, tribal, private, and local units of government to share access and minimize new construction.](#)

## **11. Cultural Resources**

[GDS-11: Protect cultural resources on state-administered lands.](#)

## **12. Natural Disturbance Events**

[GDS-12: Promptly evaluate and determine the appropriate response to natural disturbance events on state land.](#)

# Appendix B: Management Opportunity Areas

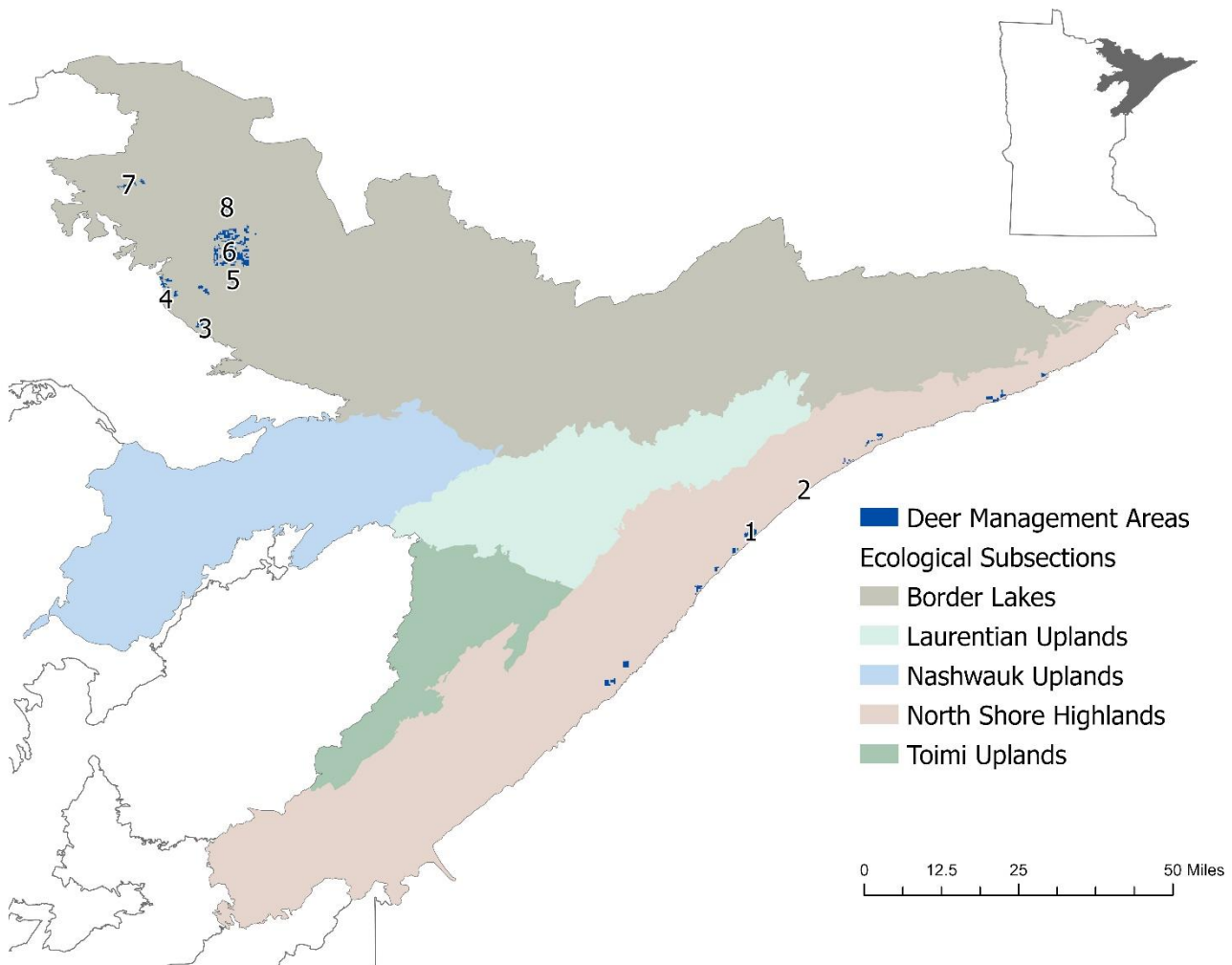
Management opportunity areas (MOAs) are areas on DNR-administered lands that offer good opportunities to maintain or create spatial patterns to address natural resource values that are difficult to achieve at the stand level or through the normal stand development process. They contribute toward meeting goals in this plan, including providing wildlife habitat for a range of species (e.g., ruffed grouse management areas), providing older forest and older forest characteristics distributed throughout the Section (e.g., old forest management complexes), and considering species of special concern or conservation need in management (e.g., moose management areas).

Individual MOA templates can be downloaded from the links in the tables for each MOA type below.

## Deer Management Areas

Deer management areas provide habitat elements, such as winter cover, for deer on the landscape.

**Map B.1: Deer Management Areas (DMAs) in the NSU Section. DMAs are labeled by number. The table below contains the names associated with each numbered DMA on the map.**



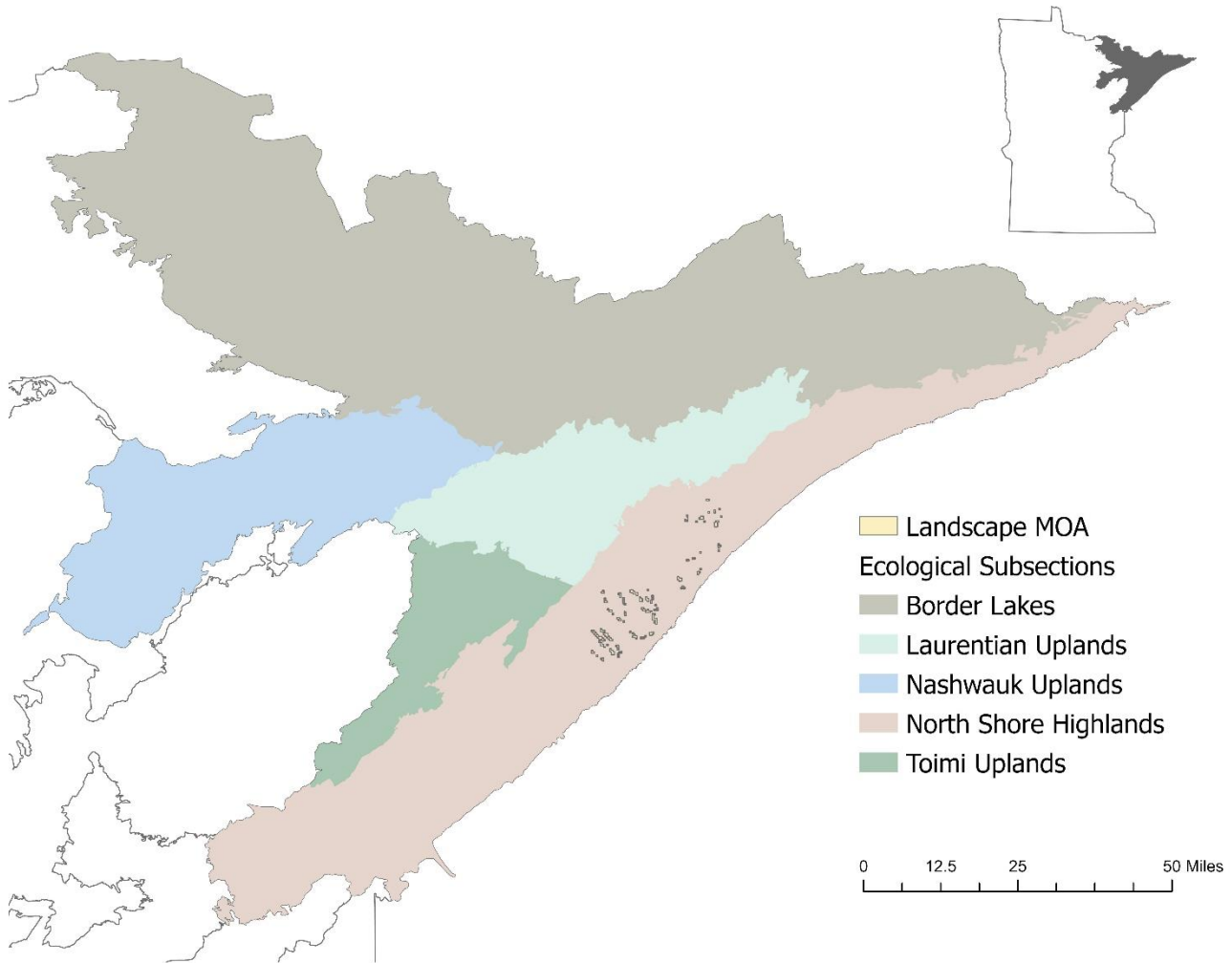
**Table B.1: Deer management/winter habitat areas in the NSU Section. The map numbers correspond to the numbers on the map above. Click on the name of a MOA to view or download its management guidance template.**

<b>MOA Name</b>	<b>Map Number</b>	<b>Forestry Area</b>	<b>Acres</b>
<a href="#"><u>Corner Lake</u></a>	8	Tower	654
<a href="#"><u>Elephant Lake</u></a>	6	Tower	9,544
<a href="#"><u>Leveaux</u></a>	2	Two Harbors	78
<a href="#"><u>North Pelican Lake</u></a>	4	Tower	2,463
<a href="#"><u>North Shore</u></a>	1	Two Harbors	5,868
<a href="#"><u>Pelican River</u></a>	5	Tower	181
<a href="#"><u>Rat Root</u></a>	7	Tower	930
<a href="#"><u>South Pelican Lake</u></a>	3	Tower	707

## Landscape Management Opportunity Area

Landscape MOAs address forest resource values that aren't captured in another MOA category. They provide the opportunity to address landscape-level values in an area.

**Map B.2: Location of MOAs that address other landscape-scale objectives not captured in other categories.**



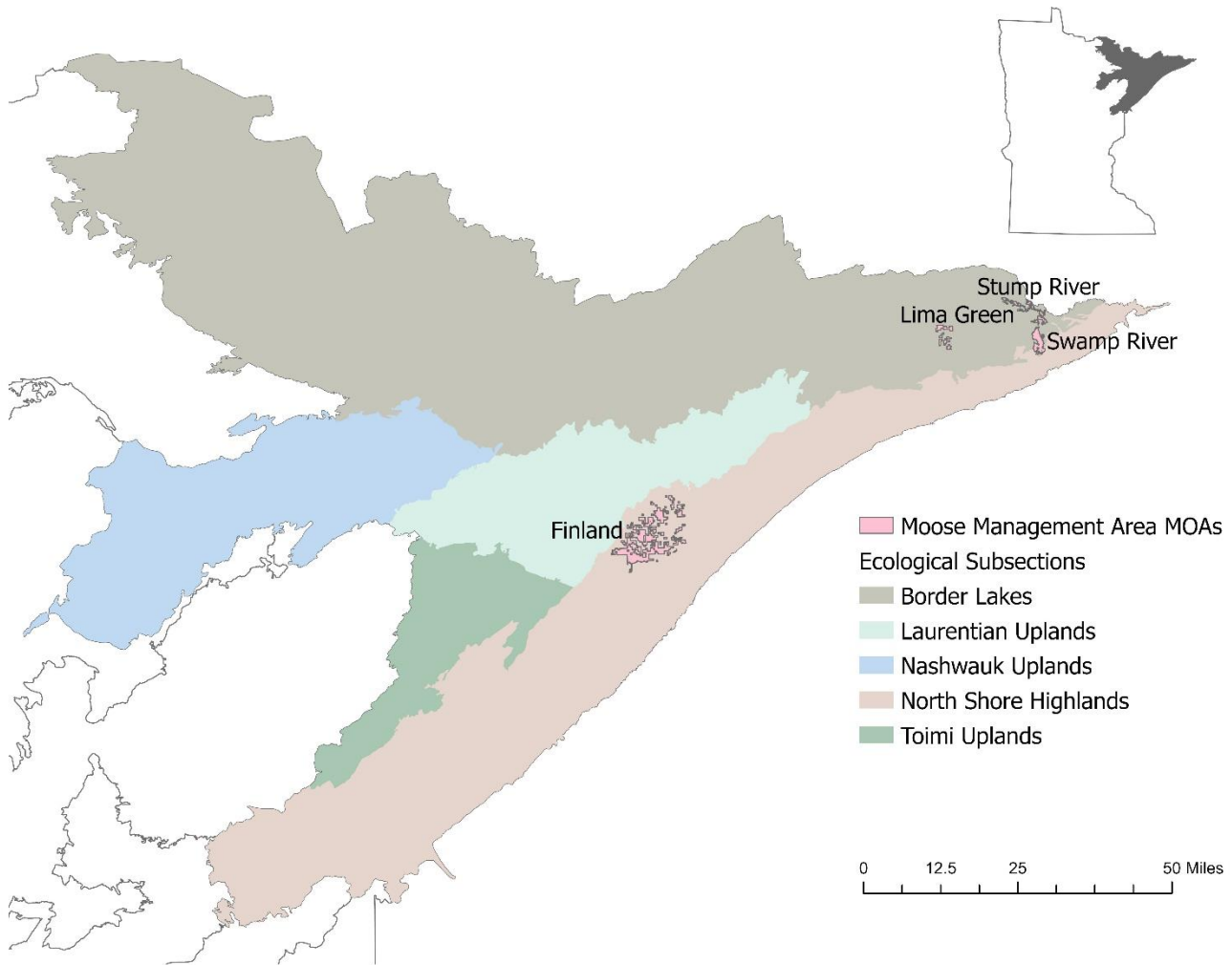
**Table B.2: Landscape management opportunity areas in the NSU Section. Click on the name of a MOA to view or download its management guidance template.**

MOA Name	Forestry Area	Acres
<a href="#">Lake County Fisheries</a>	Two Harbors	7,974

## Moose Management Opportunity Areas

Moose management MOAs aim to develop large blocks of habitat to support moose.

**Map B.3: Location of MOAs that address other landscape-scale objectives not captured in other categories.**



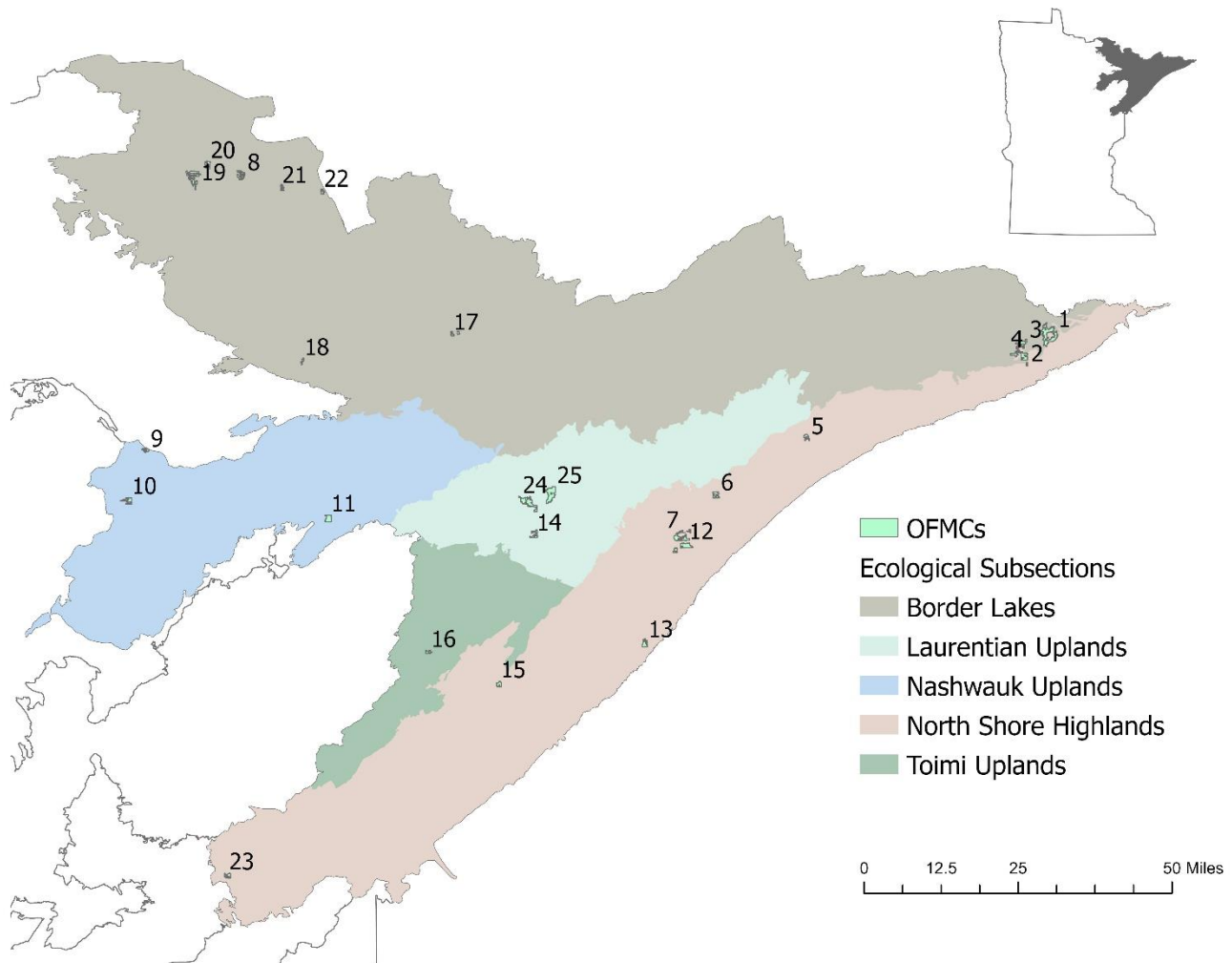
**Table B.3: Moose management opportunity areas in the NSU Section. Click on the name of a MOA to view or download its management guidance template.**

MOA Name	Forestry Area	Acres
<a href="#">Finland</a>	Two Harbors	21,044
<a href="#">Lima Green</a>	Two Harbors	1,965
<a href="#">Stump River</a>	Two Harbors	1,532
<a href="#">Swamp River</a>	Two Harbors	4,219

## Old Forest Management Complexes

The conservation value of designated old-growth can be further enhanced by managing additional stands around old-growth stands and their special management zones (SMZs) as OFMCs. Old forest management complexes complement and support values represented in the designated old-growth stands. They serve policy, management, and ecological purposes and include three elements: 1) designated old-growth or future old-growth stands, 2) SMZs around these stands, and 3) additional stands managed for older forest characteristics. Refer to the DNR Old Growth Forests Guidelines and amendments for more information.

**Map B.4: Location of old forest management complexes (OFMCs; numbered in the map). The table below contains the names associated with each numbered OFMC in the map.**



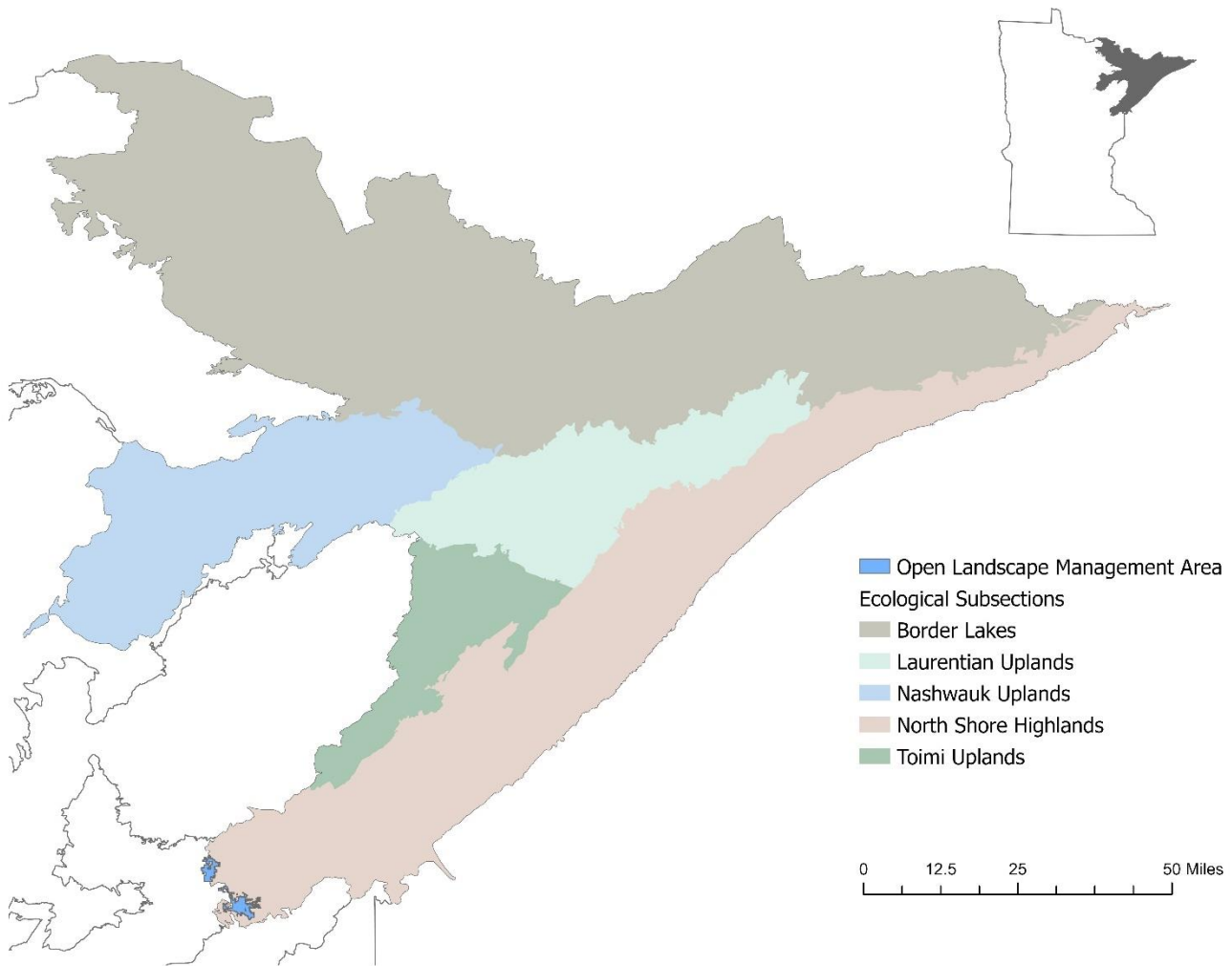
**Table B.4: Old forest management complexes in the NSU Section. Click on the name of a MOA to view or download its management guidance template.**

<b>MOA Name</b>	<b>Map Number</b>	<b>Forestry Area</b>	<b>Acres</b>
<a href="#">Amundsen Lake</a>	8	Tower	473
<a href="#">Art Lake</a>	7	Two Harbors	1,176
<a href="#">Ash River</a>	19	Tower	1,239
<a href="#">Beatrice Lake</a>	9	Hibbing	249
<a href="#">Beaver River</a>	13	Two Harbors	449
<a href="#">Bower Lake</a>	10	Hibbing	560
<a href="#">Bright Star</a>	20	Tower	435
<a href="#">Egge Ridge</a>	12	Two Harbors	979
<a href="#">Honeymoon Trail</a>	5	Two Harbors	282
<a href="#">Hovland Woods North</a>	3	Two Harbors	431
<a href="#">Hovland Woods South</a>	4	Two Harbors	1,294
<a href="#">Johnson Lake</a>	21	Tower	129
<a href="#">Mud Creek</a>	15	Two Harbors	310
<a href="#">Niles Bay</a>	18	Tower	134
<a href="#">North Arm</a>	17	Tower	256
<a href="#">Pike Mountain</a>	11	Hibbing	595
<a href="#">Rogers Lake</a>	23	Cloquet	371
<a href="#">Sand Lake Peatland East</a>	25	Two Harbors	1,658
<a href="#">Sand Lake Peatland South</a>	14	Two Harbors	372
<a href="#">Sand Lake Peatland West</a>	24	Two Harbors	1,402
<a href="#">Sand Point</a>	22	Tower	191
<a href="#">Spring Beauty</a>	2	Two Harbors	60
<a href="#">Sullivan Lake</a>	16	Cloquet	192
<a href="#">Swamp River</a>	1	Two Harbors	2,482
<a href="#">Thunderbird Lake</a>	6	Two Harbors	409

## Open Landscape Management Area

Forests or patches of trees in these areas are managed to benefit species with open landscape habitat requirements. Forest stands on the edge of open landscapes may be harvested at or before standard DNR harvest ages to create regenerating trees that temporarily mimic brushland habitat.

**Map B.5: Location of open landscape management areas in the NSU Section.**



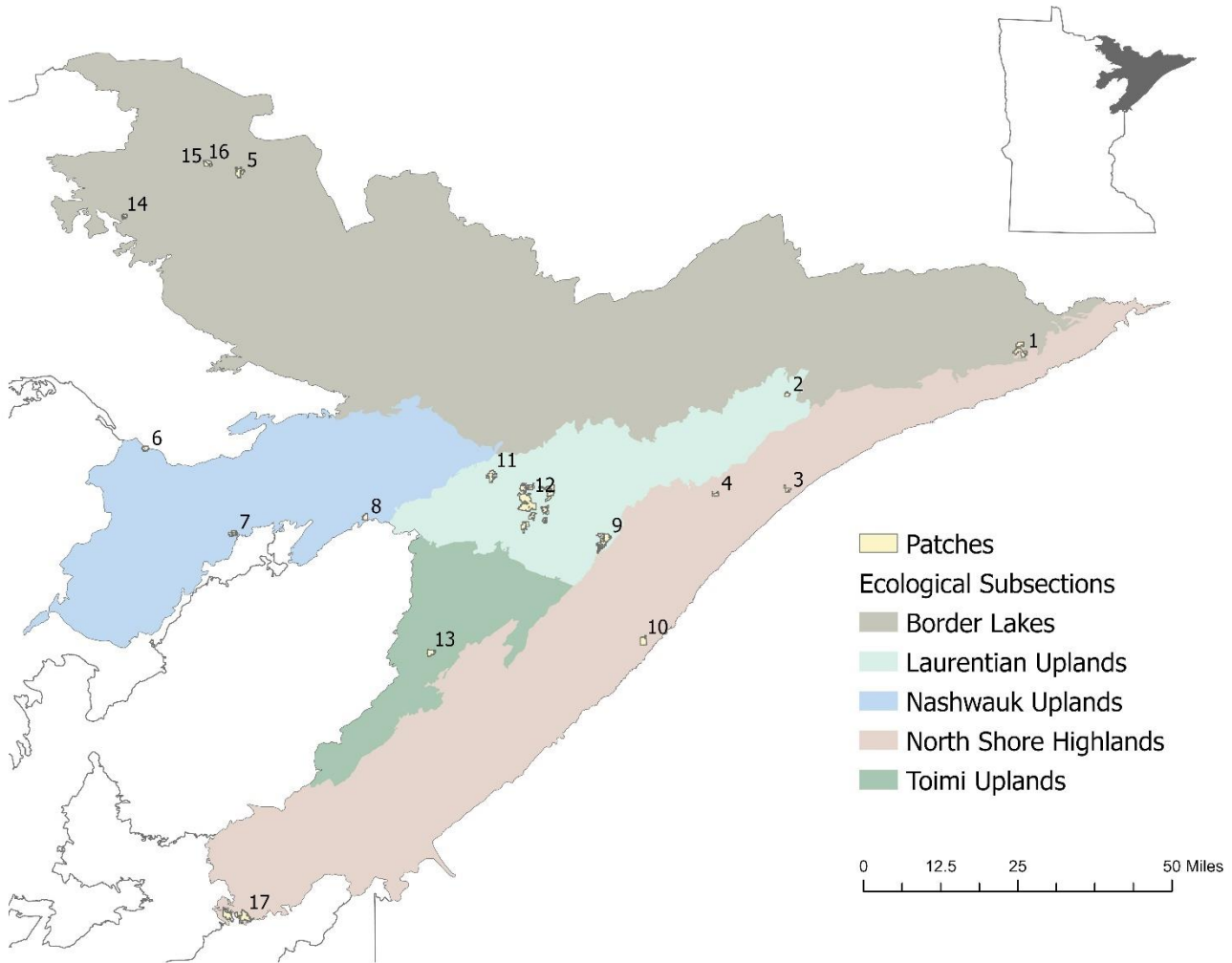
**Table B.5: Open landscape management opportunity areas in the NSU Section. Click on the name of a MOA to view or download its management guidance template.**

MOA Name	Forestry Area	Acres
<a href="#">Mervin</a>	Tower	473

## Patches

Large forest patches reduce habitat fragmentation and provide for some species dependent on continuous areas of older forest. They also help represent natural variability in patch size across the landscape.

**Map B.6: Location of patch management opportunity areas in the NSU Section.**



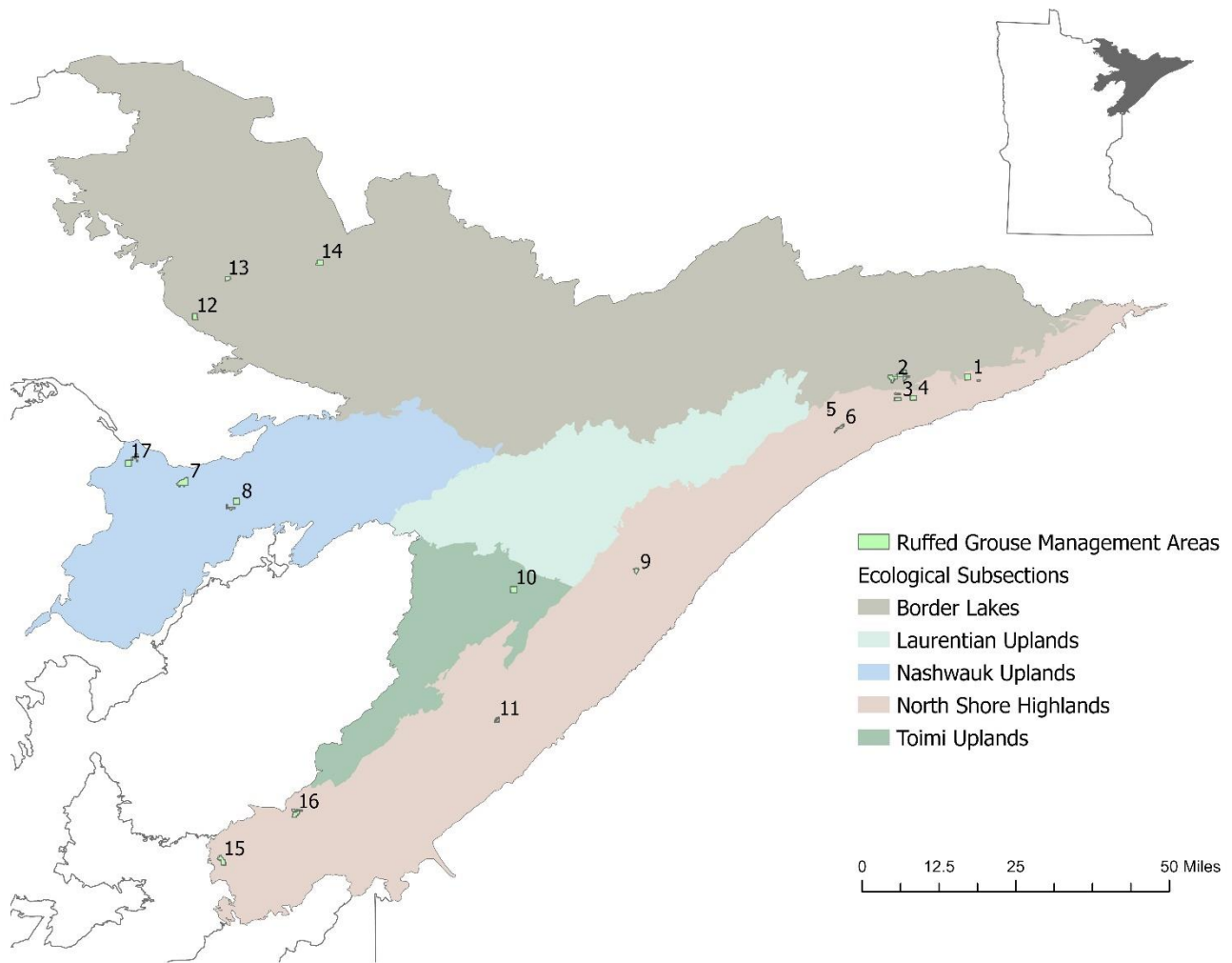
**Table B.6: Patch management opportunity areas in the NSU Section. Click on the name of a MOA to view or download its management guidance template.**

<b>MOA Name</b>	<b>Map Number</b>	<b>Forestry Area</b>	<b>Acres</b>
<a href="#"><u>Amundsen Lake</u></a>	5	Tower	892
<a href="#"><u>Ash River</u></a>	15	Tower	364
<a href="#"><u>Beatrice Lake</u></a>	6	Hibbing	439
<a href="#"><u>Biondich Camp</u></a>	14	Tower	334
<a href="#"><u>Bright Star</u></a>	16	Tower	293
<a href="#"><u>Buhl</u></a>	7	Hibbing	494
<a href="#"><u>Dunka River</u></a>	11	Tower	1,037
<a href="#"><u>Giants Ridge</u></a>	8	Tower	429
<a href="#"><u>Headwaters Peatland</u></a>	12	Two Harbors	8,082
<a href="#"><u>Hovland Woods</u></a>	1	Two Harbors	1,488
<a href="#"><u>Kettle Lake</u></a>	17	Cloquet	2,648
<a href="#"><u>South Ridge Beaver River</u></a>	10	Two Harbors	801
<a href="#"><u>Spur End Fen</u></a>	9	Two Harbors	1,865
<a href="#"><u>Sullivan Lake</u></a>	13	Cloquet	661
<a href="#"><u>The Grade</u></a>	2	Two Harbors	288
<a href="#"><u>Thunderbird</u></a>	4	Two Harbors	325
<a href="#"><u>Tofte Heights</u></a>	3	Two Harbors	339

## Ruffed Grouse Management Area

Ruffed grouse management areas (RGMA) are managed to supply all of the habitat needs of ruffed grouse, as well as other species with similar habitat requirements, such as woodcock, and maximize their abundance. These species need several age classes of certain forest cover types, especially aspen, within a relatively small area. The configuration of habitat elements within RGMA is meant to maximize the abundance of grouse to provide quality hunting experiences around Hunter Walking Trail networks.

**Map B.7: Location of ruffed grouse management areas in the NSU Section.**



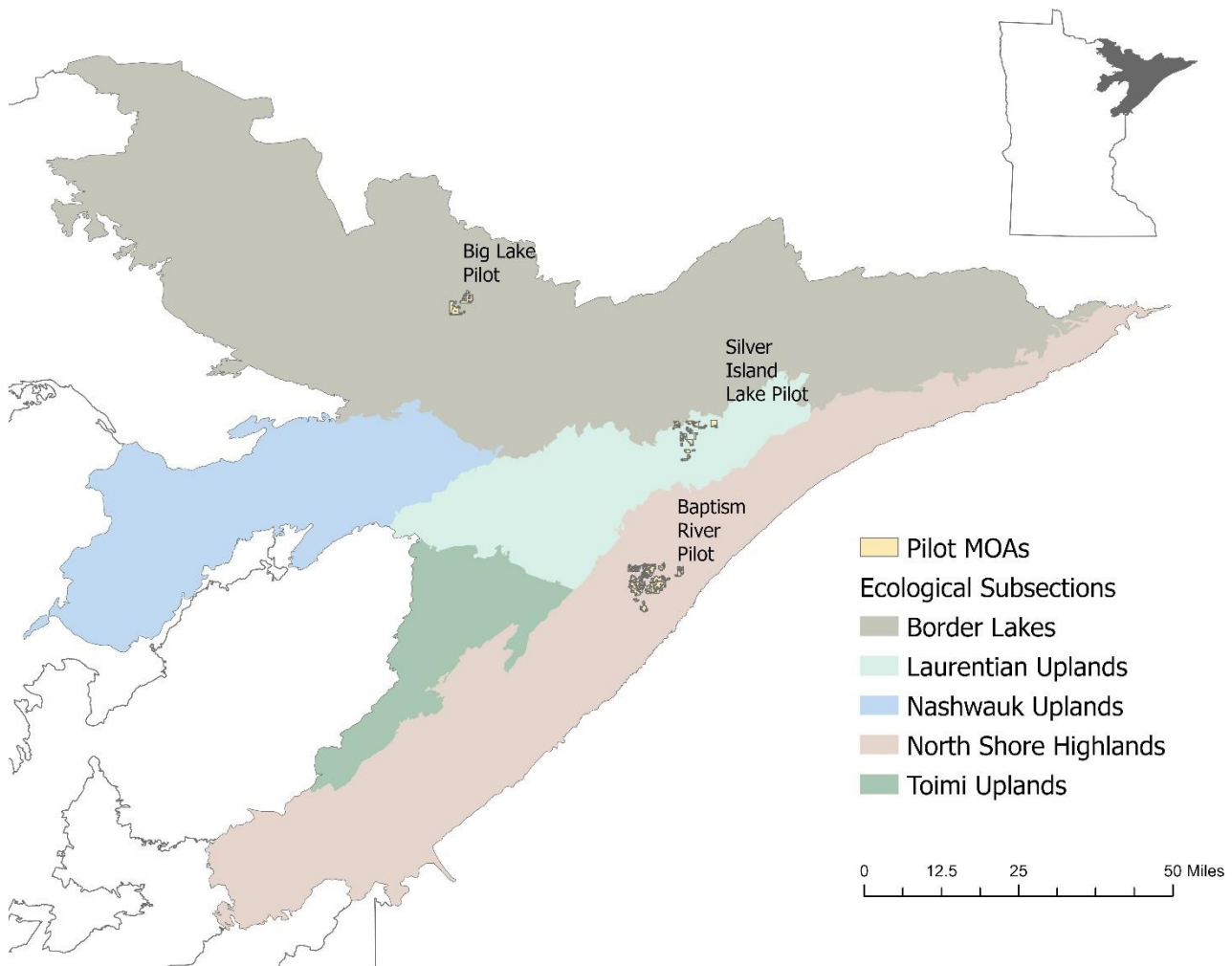
**Table B.7: Ruffed grouse management areas in the NSU Section. Click on the name of a MOA to view or download its management guidance template.**

<b>MOA Name</b>	<b>Map Number</b>	<b>Forestry Area</b>	<b>Acres</b>
<a href="#">Birch Hill</a>	15	Cloquet	696
<a href="#">Caribou Lake</a>	6	Two Harbors	308
<a href="#">Dale Honer</a>	2	Two Harbors	1,534
<a href="#">Devil Track</a>	3	Two Harbors	466
<a href="#">Echo Lake</a>	14	Tower	563
<a href="#">Kadunce River</a>	1	Two Harbors	719
<a href="#">McNiven</a>	8	Hibbing	919
<a href="#">Moose Walk</a>	9	Two Harbors	304
<a href="#">Nelson Creek</a>	10	Two Harbors	664
<a href="#">Paradise Lake</a>	11	Two Harbors	250
<a href="#">Pelican Lake</a>	12	Tower	521
<a href="#">Pelican River North</a>	13	Tower	324
<a href="#">Peloquin</a>	17	Hibbing	979
<a href="#">Pendant Lake</a>	4	Two Harbors	466
<a href="#">Shannon River</a>	7	Hibbing	1,086
<a href="#">St. Louis River</a>	16	Cloquet	789
<a href="#">Wills Lake</a>	5	Two Harbors	40

## Pilot Management Opportunity Areas

In 2016, the DNR explored developing pilot management opportunity areas (MOAs) in the NSU section. Subsequently, three pilot MOAs were developed. One – the Baptism River Forest Interior Pilot MOA – focuses on developing habitat for interior-forest species that require larger blocks of mature forest. Two – the Big Lake and Silver Island Upland-Lowland Habitat Pilot MOAs – focus on developing mature to older upland forest adjacent to mature to older lowland conifer forest. The details for each pilot MOA can be viewed through the links in the table below.

**Map B.8: Location of pilot MOAs in the NSU Section.**



**Table B.8: Pilot MOAs in the NSU Section. Click on the name of a MOA to view or download its management guidance template.**

<b>MOA Name</b>	<b>Forestry Area</b>	<b>Acres</b>
<a href="#"><u>Baptism River Forest Interior Pilot MOA</u></a>	Two Harbors	10,168
<a href="#"><u>Big Lake Upland Lowland Habitat Pilot MOA</u></a>	Tower	2,950
<a href="#"><u>Silver Island Upland Lowland Habitat Pilot MOA</u></a>	Two Harbors	4,158

## Appendix C. Modeled Management Regimes

---

In the STH analysis, model parameters that defined management activities (regimes) were necessarily simplified and generic and were meant to represent the average management activity in the average stand to estimate volume resulting from harvest. Differences in management were incorporated into the analysis for the Division of Forestry and Division of Fish and Wildlife administered lands. During modeling to develop the 10-year stand exam list for each ecological section, including NSU, DNR leadership of the Divisions of Ecological and Water Resources, Fish and Wildlife, and Forestry, with input from project team members and field staff, made decisions on management regimes that further defined the STH model parameters. These include standard prescriptions by cover type, even-aged rotation ages and reserve amounts, and uneven-aged parameters by cover type, DNR administrator, and ecological section. In some cases, management regimes also differed within areas designated as needing management different from the standard regimes to benefit particular forest resources. Examples include areas with native plant communities that have global conservation ranks, old growth forest special management zones, and management opportunity areas (MOAs).

The modeled management regimes used to develop the 10-year stand exam list for NSU are reported below. It is important to remember that these simplified assumptions were necessary for the model, which cannot work with the nuance of site-level variation; however, in reality, sites may differ in their objectives and characteristics. While achieving the DNR's planned level of disturbance depends on generally following these model assumptions, they do not represent rigid rules for site-level management. Some flexibility in the application of those parameters during management activities is necessary, which is purposefully undefined to maintain the ability of professional field staff to make their best judgments based on site-specific conditions.

## Even-Aged Management Rotation Age and Reserves Tables

Table Abbreviations:

- RA = rotation age
- SI = site index
- UE = managed uneven-aged (reserve amounts do not apply)
- RES % = percent of stand acres reserved from harvest

Special Management Area/Management Area Type	Abbreviation
Old growth special management zones	OG SMZ
Old forest management complex	OFMC
High conservation value forest modeled assuming low/medium harvest	HCVF Low/HCVF Med
Open landscape management area	OLMA
Ruffed grouse management area	RGMA
Deer management area/winter habitat area	DMA
Moose management area	MMA
Interior forest	INT
Upland-lowland	UPLD

Dashes indicate that standard DNR or Division of Fish and Wildlife management regimes apply for even-aged managed cover types or that the cover type is managed uneven-aged.

Note: School trust lands follow standard rotation ages regardless of the land administrator.

Cover Type	Standard DNR		Fish and Wildlife		OG SMZ		OFMC		Patch		HCVF Low		OLMA	
	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%
Ash/Lowland Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Aspen/Balm-of-Gilead - SI 65+	40	5	60	10	40	10	55	10	50	10	50	10	45	10
Aspen/ Balm-of-Gilead - SI < 65	50	5	60	10	50	10	60	10	55	10	55	-	45	10
Birch	55	5	60	15	55	10	65	10	60	10	60	10	50	10
Jack Pine	60	5	55	15	60	5	60	5	55	5	55	5	-	-
Black Spruce Upland	60	5	55	15	60	5	60	5	55	5	55	5	-	-
Balsam Fir	50	5	50	15	50	10	55	15	50	15	50	15	-	-
White Spruce Planted	50	5	45	5	-	-	50	5	50	5	45	5	-	-
White Spruce Natural	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Black Spruce Lowland - SI 40+	80	5	90	10	80	5	80	10	80	10	80	10	-	-
Black Spruce Lowland - SI 30-39	100	5	120	10	100	5	100	10	100	10	100	10	-	-
Black Spruce Lowland - SI 23-29	120	5	120	10	120	5	120	10	120	10	120	10	-	-
Tamarack - SI 40+	75	5	90	5	75	5	75	5	75	5	70	5	-	-
Tamarack - SI < 40	100	5	110	5	100	5	100	5	100	5	95	5	-	-
Red Pine Plantation - SI 65+	60	5	55	5	60	5	60	5	60	5	60	5	-	-
Red Pine Plantation - SI 55-64	65	5	60	5	65	5	65	5	65	5	65	5	-	-
Red Pine Plantation - SI < 55	70	5	65	5	70	5	70	5	70	5	70	5	-	-
Red Pine Natural	115	5	110	66	115	10	120	10	120	10	115	10	110	5
White Pine Plantation - SI 65+	60	5	UE	UE	-	-	60	-	65	-	60	10	-	-
White Pine Plantation - SI 55 – 60	65	5	UE	UE	-	-	60	-	65	-	60	10	-	-
White Pine Plantation - SI < 50	70	5	UE	UE	-	-	60	-	65	-	60	10	-	-
White Pine Natural	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Northern Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Central Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Oak - SI 75+	85	5	90	15	-	-	-	20	80	20	-	20	90	20
Oak - SI < 75	85	5	90	15	-	-	-	20	80	20	-	20	90	20
Cedar	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-

**Note:** Dashes indicate that typical division management regimes apply for even-aged-managed cover types or that the cover type is managed uneven-aged.

Cover Type	Standard DNR		Fish and Wildlife		RGMA		HCVF Med		UPLD		INT		DMA		MMA	
	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%
Ash/Lowland Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-
Aspen/Balm-of-Gilead - SI 65+	40	5	60	10	45	10	40	10	40	10	40	10	40	10	40	10
Aspen/ Balm-of-Gilead - SI < 65	50	5	60	10	10	45	50	10	50	10	50	10	50	10	50	10
Birch	55	5	60	15	50	10	50	10	50	10	50	10	60	10	60	10
Jack Pine	60	5	55	15	-	-	45	5	45	5	45	5	55	5	55	5
Black Spruce Upland	60	5	55	15	-	-	45	5	45	5	45	5	55	5	55	5
Balsam Fir	50	5	50	15	-	-	45	5	45	10	45	5	50	15	50	15
White Spruce Planted	50	5	45	5	-	-	50	5	50	10	50	5	50	-	50	-
White Spruce Natural	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-
Black Spruce Lowland - SI 40+	80	5	90	10	-	-	80	5	80	5	80	5	80	5	80	5
Black Spruce Lowland - SI 30-39	100	5	120	10	-	-	100	5	100	5	100	5	100	5	100	5
Black Spruce Lowland - SI 23-29	120	5	120	10	-	-	120	5	120	5	120	5	120	5	120	5
Tamarack - SI 40+	75	5	90	5	-	-	70	5	-	5	70	5	-	-	-	-
Tamarack - SI < 40	100	5	110	5	-	-	95	5	-	5	95	5	-	-	-	-
Red Pine Plantation - SI 65+	60	5	55	5	-	-	60	5	55	5	60	5	-	-	-	-
Red Pine Plantation - SI 55-64	65	5	60	5	-	-	65	5	60	5	65	5	-	-	-	-
Red Pine Plantation - SI < 55	70	5	65	5	-	-	70	5	65	5	70	5	-	-	-	-
Red Pine Natural	115	5	110	66	-	-	110	5	110	5	100	5	110	10	-	-
White Pine Plantation - SI 65+	60	5	UE	UE	-	-	60	5	60	5	60	5	-	-	-	-

Cover Type	Standard DNR		Fish and Wildlife		RGMA		HCVF Med		UPLD		INT		DMA		MMA	
	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%
White Pine Plantation - SI 55 – 60	65	5	UE	UE	-	-	65	5	65	5	65	5	-	-	-	-
White Pine Plantation - SI < 50	70	5	UE	UE	-	-	70	5	70	5	70	5	-	-	-	-
White Pine Natural	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-
Northern Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-
Central Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-
Oak - SI 75+	85	5	90	15	90	20	80	10	80	10	80	10	80	15	80	15
Oak - SI < 75	85	5	90	15	90	20	80	10	80	10	80	10	80	15	80	15
Cedar	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-

**Note:** Dashes indicate that typical division management regimes apply for even-aged-managed cover types or that the cover type is managed uneven-aged.

## Uneven-Aged Management Regimes

The model used to develop the 10-year stand exam list selected stands for uneven-aged management based on criteria including cover type, site index, stand age, stand basal area, and the time since the last treatment. The following tables show uneven-aged management regimes included in the model used to develop the 10-year stand exam list. The “lock” numbers in each table represent the number of years that must pass after treatment before a stand is eligible for subsequent treatment. The treatment age and treatment BA columns refer to the stand age and basal area, respectively, at which a stand is eligible for treatment in the model. Parameters that do not apply to a given cover type or section are denoted “NA.”

### NSU Standard Uneven-Aged Regimes

**Note:** Trust lands were modeled with Forestry regimes regardless of land administrator or management opportunity area type.

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash Lowland Hardwoods	All	>= 70	NA	20
Northern hardwoods	> 40	>= 40	NA	20
White pine (natural)	All	>= 45	NA	20
White spruce (natural)	All	>= 80	NA	20

### NSU Division of Fish & Wildlife Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash Lowland Hardwoods	All	NA	>= 90	20
Northern Hardwoods	All	NA	>= 90	30
Oak	All	>= 100	NA	20

### NSU Deer Management MOA Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash Lowland Hardwoods	>= 55	NA	>= 110	30
Northern Hardwoods	All	NA	>= 130	25
White Pine	All	NA	>= 130	30
White Spruce (natural)	All	>= 75	>= 100	25
White Spruce (planted)	All	>= 35	NA	15

### NSU Forest Interior MOA Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash Lowland Hardwoods	All	>= 70	NA	20
Central Hardwoods	All	>= 30	NA	20
Northern Hardwoods	All	>= 30	NA	25
White Pine (natural)	All	>= 45	NA	25
White Pine (planted)	All	>= 30	NA	20
White Spruce	All	>= 80	NA	20

### NSU HCVF and G1/G2 Medium Harvest Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	>= 45	NA	>= 90	20
Central Hardwoods	All	>= 30	>= 110	20
Northern Hardwoods	>= 40	NA	>= 110	20
Oak	>= 60	>= 50	NA	20
Oak	<= 55	>= 80	NA	20
White Pine (natural)	All	>= 45	NA	20
White Pine (planted)	All	>= 30	NA	30
White Spruce (natural)	All	>= 35	NA	20
White Spruce (planted)	All	>= 80	NA	20

### NSU Moose/Large Block MOA Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash Lowland Hardwoods	>= 45	NA	>= 90	20
Northern Hardwoods	All	NA	>= 30	20
White Pine (natural)	All	>= 100	NA	30
White Spruce (natural)	All	>= 70	NA	30

## NSU Old Forest Management Complex (OFMC), HCVF, and G1/G2\* Low Harvest Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	All	>= 40	NA	20
Central Hardwoods	All	>= 60	NA	20
Northern Hardwoods	All	>= 60	NA	20
Oak	All	>= 60	NA	20
White Pine (natural)	All	>= 60	NA	25
White Pine (planted)	All	>= 35	NA	20
White Spruce (natural)	All	>= 55	NA	20
White Spruce (planted)	All	>= 55	NA	20

\*G1/G2 are NatureServe global conservation status ranks that indicate a native plant community is critically imperiled or imperiled.

## NSU Old Growth Special Management Zone (OG SMZ) Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	All	>= 60	NA	20
Central Hardwoods	All	>= 60	NA	20
NH	All	>= 60	NA	20
Oak	All	>= 60	NA	20
White Pine (natural)	All	>= 60	NA	25
White Pine (planted)	All	>= 30	NA	15
White Spruce (natural)	All	>= 55	NA	20
White Spruce (planted)	All	>= 55	NA	20

## NSU Older Forest Patch MOA Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Northern Hardwoods	All	>= 30	>= 110	20
Oak	<= 55	>= 80	NA	20
White Pine (planted)	All	>= 30	NA	20
Central Hardwoods	<= 55	>= 30	>= 110	20

## NSU Upland/Lowland MOA Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash Lowland Hardwoods	All	$\geq 70$	NA	20
Central Hardwoods	All	$\geq 30$	NA	20
Northern Hardwoods	All	$\geq 30$	$\geq 90$	20
White Pine (natural)	All	$\geq 45$	NA	20
White Pine (planted)	All	$\geq 30$	NA	30
White Spruce	All	$\geq 80$	NA	20

## Thinning Regimes

The following tables list the thinning regimes that were used in the model. It indicates when a stand is available for thinning the model based on the site index, the number of times it has already been thinned, and the age of the stand. For example, an unthinned red pine stand is available for its first thinning at age 25, next at age 35, next at age 45, and so on, until it reaches age 90.

### NSU Standard DNR Thinning Regimes

Cover type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Central Hardwoods	>=60	Unthinned	30	70
Central Hardwoods	>=60	Thin1	45	70
Central Hardwoods	>=60	Thin2	60	70
Northern Hardwoods	<=35	Unthinned	30	70
Northern Hardwoods	<=35	Thin1	45	70
Northern Hardwoods	<=35	Thin2	60	70
Oak	All	Unthinned	40	80
Oak	All	Thin1	55	80
Oak	All	Thin2	70	80
Red Pine (natural)	All	Unthinned	25	90
Red Pine (natural)	All	Thin1	35	90
Red Pine (natural)	All	Thin2	45	90
Red Pine (natural)	All	Thin3	55	90
Red Pine (natural)	All	Thin4	65	90
Red Pine (natural)	All	Thin5	75	90
Red Pine (planted)	All	Unthinned	25	90
Red Pine (planted)	All	Thin1	35	90
Red Pine (planted)	All	Thin2	45	90
Red Pine (planted)	All	Thin3	55	90
Red Pine (planted)	All	Thin4	65	90
Red Pine (planted)	All	Thin5	75	90
White Pine (planted)	All	Unthinned	25	90
White Pine (planted)	All	Thin1	35	90
White Pine (planted)	All	Thin2	45	90
White Pine (planted)	All	Thin3	55	90
White Pine (planted)	All	Thin4	65	90
White Pine (planted)	All	Thin5	75	90
White Spruce (planted)	All	Unthinned	30	60

### NSU Division of Fish and Wildlife Thinning Regimes

Cover type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
White Pine (natural)	All	Unthinned	70	
White Pine (planted)	>= 65	Unthinned	35	50
White Pine (planted)	>= 65	Thin1	55	70
Red Pine (planted)	All	Unthinned	65	
Red Pine (planted)	All	Thin1	65	
White Spruce (natural)	All	Unthinned	70	90
White Spruce (natural)	All	Thin1	95	115
White Spruce (planted)	All	Unthinned	35	45
White Spruce (planted)	All	Thin1	50	60

### NSU Deer Management Area (DMA) MOA Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Oak	All	Unthinned	100	115
Oak	All	Thin1	120	135
White Pine (planted)	All	Unthinned	35	50
White Pine (planted)	All	Thin1	55	70
White Spruce (planted)	All	Thin1	70	85

### NSU HCVF and G1/G2 Medium Harvest Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Red Pine	All	Unthinned	40	150
Red Pine	All	Thin1	55	150
Red Pine	All	Thin2	70	150
Red Pine	All	Thin3	85	150
Red Pine	All	Thin4	100	150
Red Pine	All	Thin5	115	150

### NSU Moose Management Area MOA Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
White Pine (planted)	All	Unthinned	35	50
White Pine (planted)	All	Thin1	55	70
White Spruce (planted)	All	Unthinned	30	35
White Spruce (planted)	All	Thin1	40	45
White Spruce (planted)	All	Thin2	50	55

### NSU Older Forest Patch MOA Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Central Hardwoods	>=60	Unthinned	30	40
Central Hardwoods	>=60	Thin1	45	55
Central Hardwoods	>=60	Thin2	60	70
Oak	>=60	Unthinned	30	40
Oak	>=60	Thin1	45	55
Oak	>=60	Thin2	60	70
Red Pine	All	Unthinned	40	150
Red Pine	All	Thin1	55	150
Red Pine	All	Thin2	70	150
Red Pine	All	Thin3	85	150
Red Pine	All	Thin4	100	150
Red Pine	All	Thin5	115	150
White Pine	All	Unthinned	40	150
White Pine	All	Thin1	55	150
White Pine	All	Thin2	70	150
White Pine	All	Thin3	85	150
White Pine	All	Thin4	100	150
White Pine	All	Thin5	115	150
White Spruce (natural)	All	Unthinned	25	80
White Spruce (natural)	All	Thin1	40	80
White Spruce (natural)	All	Thin2	55	80
White Spruce (planted)	All	Unthinned	30	60

### NSU Ruffed Grouse Management Area (RGMA) MOA Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Oak	All	Unthinned	50	65
Oak	All	Thin1	70	85
White Spruce (natural)	All	Unthinned	25	35
White Spruce (natural)	All	Thin1	40	50
White Spruce (natural)	All	Thin2	55	65
White Spruce (planted)	All	Unthinned	50	65

### NSU Upland/Lowland MOA Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Red Pine (natural)	All	Unthinned	25	100
Red Pine (natural)	All	Thin1	35	100
Red Pine (natural)	All	Thin2	45	100
Red Pine (natural)	All	Thin3	55	100
Red Pine (planted)	<= 50	Unthinned	25	70
Red Pine (planted)	<= 50	Thin1	35	70
Red Pine (planted)	<= 50	Thin2	45	70
Red Pine (planted)	55-60	Unthinned	25	65
Red Pine (planted)	55-60	Thin1	35	65
Red Pine (planted)	55-60	Thin2	45	65
Red Pine (planted)	65+	Unthinned	25	60
Red Pine (planted)	65+	Thin1	35	60
Red Pine (planted)	65+	Thin2	45	60

## Appendix D: Planned Acre and Volume Summary Tables

---

This appendix includes summary tables for volume estimates and planned acres from the 10-year stand exam list for the NSU Section.

The DNR’s sustainable forest management strategic direction is designed to create a balance of young, intermediate, and older forest and a mix of tree species. As the forest ages, the DNR commonly uses timber harvest to disturb forests to sustainably provide diverse forest benefits over time. Timber harvest is accomplished through offering volume for sale on timber harvest permits. Thus, timber volume offered is a key metric in assessing the DNR’s progress toward creating and maintaining our desired landscape-scale forest age class and diversity objectives, which are the foundation for providing the range of benefits for which the DNR manages forests, including wildlife habitat, biodiversity, timber productivity, forest health, wood supply and healthy natural resource economies, recreation, carbon sequestration and storage, and water quality and quantity. Using information generated during the STHA project, the DNR determined the amount of timber volume that should be offered from lands administered by the divisions of Forestry and Fish and Wildlife to achieve the forest management objectives specific to each DNR land administrator.

The 10-year stand exam list for the NSU Section was created at the same time as the 10-year stand exam lists for all other ecological planning sections in a statewide process. Additional details on SFRMP modeling, stand selection criteria, and stand exam list results are available in the [Sustainable Timber Harvest: Development of the DNR 10-year Stand Exam List report](#).

**Table D.1: Total acres on the 10-year stand exam list (“Acres Planned”) and model-estimated volume (“Modeled Volume” in cords) for those acres by administrator within NSU on the FY 2021-2030 stand exam list.**

<b>Administrator</b>	<b>Acres Planned</b>	<b>Modeled Volume (based on acres planned)</b>
Forestry	148,323	1,784,570
Fish and Wildlife	2,357	27,390
Total	150,680	1,811,960

# Glossary

---

**Access route:** A temporary access or permanent road connecting the most remote parts of the forest to existing public roads. Forest roads provide access to forest lands for timber management, fish and wildlife habitat improvement, fire control, and various recreational activities. Also, see Forest Road.

**Acre:** An area of land containing 43,560 square feet, roughly the size of a football field or a square 208 feet on a side. A “forty” of land contains 40 acres, and a “section” of land contains 640 acres.

**Age class:** An interval, commonly ten years, into which the age range of trees or forest stands is divided for classification or use.

**Age class distribution:** The proportionate amount of various age classes of a forest or forest cover type within a defined geographic area (e.g., ecological classification system subsection). A cover type age class distribution is **balanced** when it has an even number of acres in each age class (usually 5 to 10-year increments) up to the normal rotation age for the cover type.

**Annual plan addition:** stands added to the stand exam list and released for public comment as needed throughout the year. Examples of reasons for APAs include insect, disease, animal, or environmental damage (e.g., storm or fire) that needs to be treated quickly; operational considerations such as harvesting a stand adjacent to a stand on the exam list, avoiding repeated entries to stands with limited or difficult access, and cooperating with adjacent landowners; and incorrect inventory, such as incorrect stand boundaries or cover type classification, for stands that should be harvested.

**Annual stand examination list:** List of stands to be considered for treatment in a particular year that was selected from the 10-year stand examination list. Treatment may include harvest, thinning, regeneration, prescribed burning, re-inventory, etc.

**Artificial regeneration:** Renewal of a forest stand by planting seedlings or sowing seeds.

**Assessment:** A compilation of information about the trends and conditions related to natural and socio-economic resources and factors.

**Basal area (BA):** The cross-sectional area of a tree taken at the base of the tree (i.e., measured at 4.5 feet above the ground). Basal area is often used to measure and describe the density of trees within a geographic area using an estimate of the sum of the basal area of all trees cross-sectional expressed per unit of land area (e.g., basal area per acre).

**Biodiversity (biological diversity):** The variety and abundance of species, their genetic composition, and the communities and landscapes in which they occur, including the ecological structures, functions, and processes occurring at all of these levels.

**Biodiversity Significance:** The relative value, in terms of size, condition, and quality, of native biological diversity for a given area of land or water. Adapted from the Guidelines for MBS Statewide Biodiversity Significance Rank: The Minnesota Biological Survey (MBS) uses a statewide ranking system to evaluate

and communicate the biodiversity significance of surveyed areas (MBS sites) to natural resource professionals, state and local government officials, and the public. MBS sites are ranked according to several factors, including the quality and types of Element Occurrences, the size and quality of native plant communities, and the size and condition of the landscape within the Site. Areas are ranked as Outstanding, High, Moderate, or Below the Minimum Threshold for statewide biodiversity significance.

**Outstanding Sites:** Those containing the best occurrences of the rarest species, the most outstanding examples of the rarest native plant communities, and/or the largest, most intact functional landscapes present in the state.

**High Sites:** Those containing very good quality occurrences of the rarest species, high-quality examples of the rarest native plant communities, and/or important functional landscapes.

**Moderate Sites:** Those containing significant occurrences of rare species and/or moderately disturbed native plant communities and landscapes that have a strong potential for recovery.

**Sites Below the Minimum Threshold:** Those lacking significant populations of rare species and/or natural features that meet MBS minimum standards for size and condition. These include areas of conservation value at the local level, such as habitat for native plants and animals, corridors for animal movements, buffers surrounding higher quality natural areas, and open space areas.

**Browse:** (n) Portions of woody plants, including twigs, shoots, and leaves used as food by animals like deer and rabbits. (v) To feed on leaves, young shoots, and other vegetation.

**Clearcut:** The removal of all or most trees during harvest to permit the re-establishment of an even-aged forest. A harvesting method used to regenerate shade-intolerant species, such as aspen and jack pine.

**Coarse woody debris:** Stumps and fallen tree trunks or limbs of more than 6-inch diameter at the large end.

**Competition:** The struggle between trees or other vegetation to obtain sunlight, nutrients, water, and growing space.

**Connectivity:** An element of spatial patterning where patches of vegetation such as forest types, native plant communities, or wildlife habitats are connected to allow the flow of organisms and processes between them.

**Conversion:** Changing a stand or site from one cover type to another through management actions or without management actions.

**Cord:** A pile of wood four feet high, four feet wide, and eight feet long, measuring 128 cubic feet, including bark and air space. The actual volume of solid wood may vary from 60 to 100 cubic feet, depending on the size of individual pieces and how tight the wood is stacked. In the Lake States,

pulpwood cords are usually four feet x four feet x 100 inches and contain 133 cubic feet. The pulpwood volume of standing trees is estimated in cords. For example, a 10-inch DBH tree, which is 70 feet tall, is about 0.20 cords; or five trees of this size would equal one cord of wood.

**Corridor:** A defined tract of land connecting two or more areas of similar habitat types through which wildlife species can travel.

**Cover type:** Expressed as the tree species having the greatest presence (i.e., in terms of volume for older stands or number of trees for younger stands) in a forest stand. A stand where the major tree species is aspen would be considered an aspen cover type.

**Cover type distribution:** The location and/or proportionate representation of cover types in a forest or a given geographic area.

**Cultural resource:** An archaeological site, cemetery, historical structure, historical area, or traditional use area of cultural or scientific value.

**Desired Future Condition (DFC):** Broad vision of landscape vegetation conditions in the long-term future.

**Disturbance:** Any event, either natural or human-induced, that alters the structure, composition, or functions of an ecosystem. Examples include forest fires, insect infestation, windstorms, and timber harvesting.

**Disturbance regime:** Natural or human-caused pattern of periodic disturbances, such as fire, wind, insect infestations, or timber harvest.

**Dominant trees:** Trees in the upper layer of the forest canopy are larger than the average trees in the stand.

**Early successional forest:** The forest community that develops immediately following the removal or destruction of vegetation in an area. Plant succession is the progression of plants from bare ground (e.g., after a forest fire or timber harvest) to mature forest consisting primarily of long-lived species such as sugar maple and white pine. Succession consists of a gradual change of plant and animal communities over time. Early successional forests commonly depend on and develop first following disturbance events (e.g., fire, windstorms, or timber harvest). Examples of early successional forest tree species are aspen, paper birch, and jack pine. Each stage of succession provides different benefits for a variety of species.

**Ecological Classification System (ECS):** A method to identify, describe, and map units of land with different capabilities to support natural resources. This is done by integrating climatic, geologic, hydrologic, topographic, soil, and vegetation data.

**Ecological integrity:** In general, ecological integrity refers to the degree to which the elements of biodiversity and the processes that link them together and sustain the entire system are complete and

capable of performing desired functions. Exact definitions of integrity are relative and may differ depending on the type of ecosystem being described.

**Ecological Section and Subsection:** Section and subsection are levels within the DNR's Ecological Classification System (ECS). From largest to smallest in terms of geographic area, the ECS is comprised of the following levels: Province --> Section --> Subsection --> Land Type Association --> Land Type --> Land Type Phase.

**Element Occurrence (EO):** An area of land and/or water where a rare feature (plant, animal, natural community, geologic feature, animal aggregation) is or was present. An Element Occurrence Rank provides a succinct assessment of the estimated viability or probability of persistence (based on condition, size, and landscape context) of occurrences of a given Element. An Element Occurrence Record is the locational and supporting data associated with a particular Element Occurrence. Element Occurrence Records for the State of Minnesota are managed as part of the rare features database by the Natural Heritage and Nongame Research Program. (Adapted from Biotics EO Standards: Chapter 2)

**Endangered species:** A plant or animal species that is threatened with extinction throughout all or a significant portion of its range in Minnesota.

**Enhance:** To modify a vegetative community component to favor a certain function or value. For example, changing the structure of a degraded plant community to bring it closer to a native plant community.

**Even-aged:** A forest stand composed of trees of primarily the same age or age class. A stand is considered even-aged if the difference in age between the youngest and oldest trees does not exceed 20 percent of the rotation age (e.g., for a stand with a rotation age of 50 years, the difference in age between the youngest and oldest trees should be ten years).

**Even-aged prescription:** Planned forest management action that promotes the stand composition of trees of primarily the same age or age class. Examples of even-aged silvicultural treatments, or prescriptions, include clearcut and shelterwood harvests.

**Extirpated:** The species is no longer found in this portion of its historical range.

**Forest Inventory and Analysis (FIA):** A statewide forest survey of timber lands jointly conducted by the Minnesota Department of Natural Resources and the U.S. Department of Agriculture—Forest Service that periodically, through a system of permanent plots, assesses the current status of and monitors recent trends in, forest area, volume, growth, and removals.

**Forest Inventory Module (FIM):** The FIM provides a database and application through which field foresters can maintain an integrated and centralized inventory of the forests on publicly owned lands managed by the Division of Forestry and other DNR Divisions. In the field, foresters collect raw plot and tree data. Those data are summarized in stand-level data that are linked to a spatial representation of stand boundaries.

**Forest land:** Consists of all lands included in the forest inventory that have forested cover types, from aspen and pine cover types to stagnant conifers.

**Forest management:** The practical application of biological, physical, quantitative, managerial, economic, social, and policy principles to the regeneration, management, utilization, and conservation of forests to meet specified goals and objectives while maintaining the productivity of the forest. Note: forest management includes management for aesthetics, fish, recreation, urban values, water, wilderness, wildlife, wood products, and other forest resource values. From: The Dictionary of Forestry. 1998. The Society of American Foresters. J.A. Helms, ed.

**Forest road:** A temporary or permanent road connecting the remote parts of the forest to existing public roads. Forest roads provide access to public land for timber management, fish and wildlife habitat improvement, fire control, and various recreational activities.

**Forest stand:** A group of trees occupying a given area and sufficiently uniform in species composition, age, structure, site quality, and condition so as to be distinguishable from the forest in adjoining areas.

**Fragmentation:** Breaking up contiguous or homogeneous land cover through conversion to different vegetation types, age classes, or uses. Forest fragmentation occurs in landscapes with distinct contrasts between land uses, such as between woodlots and farms. Habitat fragmentation occurs when a contiguous or homogeneous forest area of a similar cover type and age is broken into smaller dissimilar units.

**Free to grow:** when seedlings have grown taller than the surrounding competing vegetation.

**Game Species:** In this plan, game species include those terrestrial species that are hunted and trapped.

**Gap:** The space occurring in forest stands due to individual tree or groups of trees mortality or blowdown. Gap management uses timber harvest methods to emulate this forest spatial pattern.

**Geographic Information System (GIS):** Computer software used to manipulate, analyze, and visually display inventory and other data and prepare maps of the same data.

**Group selection:** A process of harvesting selected tree patches to create openings in the forest canopy and encourage the reproduction of uneven-aged stands.

**Growth stage:** Growth stages of native plant communities as presented in the Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province are periods of stand maturation where the mixture of trees in the canopy is stable. Growth stages are separated by periods of transition where tree mortality is high and different among the species, usually involving the death of early successional species and replacement by shade-tolerant or longer-lived species.

**Habitat:** “The resources and conditions present in an area that produce occupancy – including survival and reproduction – by a given organism. Habitat is organism-specific; it relates the presence of a species, population, or individual (animal or plant) to an area’s physical and biological characteristics.

Habitat implies more than vegetation or vegetation structure; it is the sum of the specific resources that are needed by organisms.” (Hall et al., 1997)

**Herbivory:** A plant-animal interaction whereby an organism eats some or all of a plant. Herbivory occurs both above and below ground. Dominant herbivores include beaver, deer, moose, hares, rabbits, small mammals, and forest tent caterpillars.

**High-quality native plant community:** A community that has experienced relatively little human disturbance, has few exotic species, and supports the appropriate mix of native plant species for that community. A high-quality native plant community may be unique or have a limited occurrence in the subsection, have a known association with rare species, or be an exemplary representative of the native plant community diversity prior to European settlement.

**Intensive management:** Intensity of management refers to the degree of disturbance associated with silvicultural treatments. In this plan, references to it range from less intensive to more intensive management. Examples of more intensive management are 1) Site preparation techniques such as rock-raking that disrupts the soil profile and leaves coarse woody debris in piles; 2) broadcast herbicide use that eliminates or dramatically reduces herbaceous plant and shrub diversity; 3) Conversions of mixed forest stands through clearcutting and/or site preparation that result in the establishment of a more simplified monotypic stand such as mostly pure aspen regeneration or high-density pine plantations. Examples where more intensive management may be needed are to regenerate a site successfully to a desired species, control insect or disease problems, and manage wildlife habitat (e.g., maintenance of wildlife openings).

**Intermediate cut:** The removal of immature trees from the forest sometime between establishment and final harvest with the primary objective of improving the quality of the remaining forest stand.

**Landscape:** A general term referring to geographic areas that are usually based on some sort of natural feature or combination of natural features. They can range in scale from very large to very small. Examples include watersheds (from large to small), the many levels of the Ecological Classification System (ECS), and Minnesota Forest Resources Council (MFRC) regional landscapes. The issue being addressed usually defines the type and size of the landscape used.

**Leave trees:** Live trees selected to remain on a site to provide present and future benefits, such as shelter, resting sites, cavities, perches, nest sites, foraging sites, mast, and coarse woody debris.

**Legacy patch:** An area within a harvest unit that is excluded from harvest; this area is representative of the site and is to maintain a source area for recolonization, gene pool maintenance, and establishment of microhabitats for organisms that can persist in small patches of mature forest.

**Managed acres:** Acres that are available for management purposes in the DNR’s forest resource management plan system. Managed acres exclude areas that are managed under other processes, such as Scientific and Natural Areas, state parks, and aquatic management areas outside of Lake County.

**Management Opportunity Areas (MOA):** Groups of stands intended to use vegetation management to provide opportunities to address values such as biodiversity, rare features, diversity of native plant community growth stages, and wildlife needs that cannot be addressed through site-level management within individual stands.

**Mast:** Nuts, seeds, catkins, flower buds, and fruits of woody plants that provide food for wildlife.

**Mature tree:** A tree that has reached the desired size or age for its intended use. Size or age will vary considerably depending on the species and the intended use.

**Merchantable timber:** Trees or stands having the size, quality, and condition suitable for marketing under a given economic condition, even if not immediately accessible for logging.

**Mesic:** Moderately moist.

**Minnesota Biological Survey (MBS) Sites of Biodiversity Significance:** Areas of land identified by Minnesota Biological Survey (MBS) staff, ranging from tens to thousands of acres in size, selected for survey because they are likely to contain relatively undisturbed native plant communities, large populations and/or concentrations of rare species, and/or critical animal habitat. The MBS site provides a geographic framework for recording and storing data and compiling descriptive summaries.

**Minnesota Forest Resources Council (MFRC):** The Minnesota Forest Resources Council is a state council established by the Sustainable Forest Resources Act (SFRA) of 1995 to promote long-term sustainable management of Minnesota's forests.

**MFRC Voluntary Site-Level Forest Management Guidelines:** A set of best management practices for timber harvesting and forest management on forested lands in Minnesota.

**Mixed forest or stand:** A forest or stand composed of two or more prominent species.

**Mortality:** Death or destruction of forest trees due to competition, disease, insect damage, drought, wind, fire, or other factors.

**Multi-aged stand:** A stand with two or more age classes.

**Native Plant Community (NPC):** A group of native plants that interact with each other and their environment in ways not greatly altered by modern human activity or introduced organisms. These groups of native plants form recognizable units, such as an oak forest, prairie, or marsh, that tend to reoccur over space and time. Native plant communities are classified and described by hydrology, landforms, soils, and natural disturbance regimes (e.g., wildfires, wind storms, and normal flood cycles).

**Natural disturbances:** Disruption of existing conditions by natural events such as wildfires, windstorms, drought, flooding, insects, and disease. May range in scale from one tree to thousands of acres.

**Natural regeneration:** The growth of new trees in one of the following ways: (a) from seeds naturally dropped from trees or carried by wind or animals, (b) from seeds stored on the forest floor, or (c) from stumps that sprout or roots that sucker.

**Natural spatial patterns:** The size, shape, and arrangement of patches in forested landscapes are determined primarily by natural disturbance and physical factors.

**Non-forest land:** Land that has never supported forests and land formerly forested where timber management is precluded by development for other uses such as crops, improved pasture, residential areas, city parks, improved roads, and power line clearings.

**Nongame species:** In this plan, nongame species include all animal species that are not hunted, trapped, or game fish (i.e., birds, mammals, fish, reptiles, amphibians, and invertebrates).

**Non-native invasive species:** Any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem and whose introduction does or is likely to cause economic or environmental harm or harm to human health.

**Non-timber forest products:** Non-timber forest products, also known as special forest products, can be categorized into five general areas: foods, herbs, medicinals, decoratives, and specialty items. Special forest products might include berries, mushrooms, boughs, bark, Christmas trees, lycopodium, rose hips and blossoms, diamond willow, birch tops, highbush cranberries, burls, conks, Labrador tea, seedlings, cones, nuts, aromatic oils, extractives.

**Normal Rotation Age (NRA):** For even-aged managed cover types, normal rotation age is based on the age of trees at which their average annual growth for some metric (height, basal area, diameter) is maximized. Normal rotation age also considers other available data related to forest productivity, wood quality, and local knowledge.

**Older forest:** A forest stand of any particular forest cover type is considered older forest whenever its age exceeds the normal rotation age established for that cover type.

**Older forest conditions:** forest age and structural conditions typically found in mature to very old forests, such as large diameter trees, large snags, downed logs, mixed species composition, and greater structural diversity. These older forest conditions typically develop at stand ages greater than the normal rotation ages identified for even-aged managed forest cover types.

**Old Forest Management Complex (OFMC):** This represents an area of land made up of several to many stands that are managed for old growth and their special management zones (SMZ) in the vicinity of designated old growth stands.

**Old growth forests:** Forests defined by age, structural characteristics, and relative lack of human disturbance. These forests are essentially free from catastrophic disturbances and contain old trees (generally over 120 years old), large snags, and downed trees. Additional details on managing old-growth forests on DNR-administered lands are contained in the DNR's Old Growth Forest Policy and related reference documents.

**Overstory:** The canopy in a stand of trees.

**Patch:** An area of forest that is relatively homogenous in structure, primarily in height and stand density, and differs from the surrounding forest. It may be one stand or a group of stands.

**Plantation:** A stand composed primarily of trees established by planting or artificial seeding.

**Prescribed burn:** To deliberately burn wildlands (e.g., forests, prairie, or savanna) in either their natural or modified state and under specified conditions within a predetermined area to meet management objectives for the site. A fire ignited under known conditions of fuel, weather, and topography to achieve specific objectives.

**Prescription:** A planned treatment (clearcut, selective harvest, thin, reforest, reserve, etc.) designed to change the current stand structure to meet management goals. A written statement that specifies the practices to be implemented in a forest stand to meet management objectives. These specifications reflect the desired future condition at the site and landscape level and incorporate knowledge of the special attributes of the site.

**Pulpwood:** Wood that is cut or prepared primarily for manufacture into wood pulp or chips for subsequent manufacture into paper, fiberboard, or chipboard. Generally, trees five to 12 inches in diameter at breast height are used.

**Range of Natural Variation (RNV):** Refers to the expected range of conditions (ecosystem structure and composition) to be found under naturally functioning ecosystem processes (natural climatic fluctuations and disturbance cycles such as fire and windstorms). RNV provides a benchmark (range of reference conditions) to compare with current and potential future ecosystem conditions.

**Rare plants:** All species that are listed as Federally endangered, threatened, or as candidates for Federal listing; all species that are State listed as endangered, threatened, or special concern. Several rare species are also tracked, which currently have no legal status but need further monitoring to determine their status.

**Rare animal:** All animal species that are listed as Federally endangered or threatened (except the gray wolf), as well as all animal species that are listed as State endangered, threatened, or special concern. All Species in Greatest Conservation Need are species identified in the State Wildlife Action Plan whose populations are rare, declining, or vulnerable to decline.

**Rare species:** A plant or animal species that is designated as endangered, threatened, or a species of special concern by the state of Minnesota (this includes all species designated as endangered or threatened at the federal level) or an uncommon species that does not (yet) have an official designation, but whose distribution and abundance need to be better understood.

**Refuge/refugia:** Area(s) where plants and animals can persist through a disturbance event or as the climate changes.

**Regeneration:** The act of renewing tree cover by establishing young trees naturally (e.g., stump sprouts, root suckers, natural seeding) or artificially (e.g., tree planting, seeding).

**Release:** Freeing seedlings from competition before they are free to grow.

**Restore:** To return a stand, site, or ecosystem to its original structure and species composition through active management actions.

**Riparian area:** The area of land and water forming a transition from aquatic to terrestrial ecosystems along streams, lakes, and open-water wetlands.

**Riparian Management Zone (RMZ):** That portion of the riparian area where site conditions and landowner objectives are used to determine management activities that address riparian resource needs. It is the area where riparian MFRC site-level guidelines apply.

**Rotation age:** The period of years between when a forest stand (i.e., primarily even-aged) is established (i.e., regeneration) and when it receives its final harvest. This period is an administrative decision based on economics, site conditions, growth rates, and other facts.

**Salvage cut:** A harvest to remove trees killed or damaged by fire, wind, insects, disease, or other injurious agents. The purpose of salvage cuts is to use available wood fiber before further deterioration occurs to recover the value that otherwise would be lost.

**Sapling:** A tree that is one to five inches in diameter at breast height.

**Sawtimber:** Trees that yield logs suitable in size and quality for the production of lumber.

**Scientific and Natural Area (SNA):** Areas established by the DNR Division of Ecological and Water Resources to preserve natural features and rare resources of exceptional scientific and educational value.

**Seedbed:** The soil or forest floor on which seed falls.

**Seed tree:** Any tree that bears seed; specifically, a tree left standing to provide the seed for natural regeneration.

**Selection harvest:** Removal of single scattered trees or small groups of trees at relatively short intervals. The continuous establishment of reproduction is encouraged, and an all-aged stand is maintained. A management option used for shade-tolerant species.

**Shade tolerance:** Relative ability of a tree species to reproduce and grow under shade. The capacity to withstand low light intensities caused by shading from surrounding vegetation. Tolerant species tolerate shade, while intolerant species require full sunlight.

**Shelterwood harvest:** A harvest cutting in which trees on the harvest area are removed in a series of two or more cuttings to allow the establishment and early growth of new seedlings under partial shade and protection of older trees. Produces an even-aged forest.

**Silviculture:** The art and science of establishing, growing, and tending stands of trees. The theory and practice of controlling the establishment, composition, growth, and quality of forest stands to achieve certain desired conditions or management objectives.

**Site Index (SI):** A species-specific measure of actual or potential forest productivity or site quality, expressed in terms of the average height of dominant trees at specific key ages, usually 50 years in the eastern U.S.

**Site preparation:** Treatment of a site (e.g., hand or mechanical clearing, prescribed burning, or herbicide application) to prepare it for planting or seeding and to enhance the success of regeneration.

**Site productivity:** The relative capacity of a site to sustain a production level over time. The rate at which biomass is produced per unit area. For example, cords per acre growth of timber.

**Slash:** The non-utilized and generally unmarketable accumulation of woody material in the forest, such as limbs, tops, cull logs, and stumps that remain as residue after timber harvesting.

**Snag:** A standing dead tree.

**Special concern species:** A plant or animal species that is extremely uncommon in Minnesota, has unique or highly specific habitat requirements, and deserves careful monitoring. Species on the periphery of their ranges may be included in this category, as well as species that were once threatened or endangered but now have increasing or stable and protected populations.

**Special Management Area (SMA):** An area that receives alternate modeling during stand selection and different treatment during management to account for values other than timber on the landscape. Different types of special management areas are determined by statute (e.g., endangered and threatened species), by policy (e.g., old growth special management zones), or during the SFRMP process (management opportunity areas).

**Special Management Zone (SMZ):** A buffer immediately surrounding designated old-growth forest stands. It is intended to minimize edge effects and windthrow damage to old growth stands. The minimum width is 330 feet from the edge of the old growth stand. Timber harvest is allowed in the SMZ, but there are limitations on how much can be clearcut at any given time.

**Species in Greatest Conservation Need (SGCN):** Animals whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability, as defined in the state Wildlife Action Plan.

**Stand:** A contiguous group of vegetation similar in age, species composition, and structure and growing on a site of similar quality to be a distinguishable unit. A forest is comprised of many stands. A pure stand is composed of essentially a single species, such as a red pine plantation. A mixed stand is composed of a mixture of species, such as a northern hardwood stand consisting of maple, birch, basswood, and oak. An even-aged stand is one in which all of the trees present are essentially the same age, usually within ten years of age for aspen and jack pine stands. An uneven-aged stand is one in

which various ages and sizes of trees are growing together on a uniform site, such as a northern hardwood stand with three or more age classes.

**Stand age:** In the DNR's forest inventory, the average age of the main species within a stand.

**Stand density:** The number of trees per unit area. Density is usually evaluated in terms of basal area, number of trees, volume, or percent crown cover.

**Stand examination list:** DNR forest stands to be considered for treatment (e.g., harvest, thinning, regeneration, prescribed burning, re-inventory, etc.) over the planning period based on established criteria (e.g., rotation age, site index, basal area, desired future cover type composition, etc.). These stands are assigned preliminary prescriptions, and most will receive the prescribed treatment. However, based on field appraisal visits, prescriptions may change for some stands because of new information on the stand or its condition.

**Stand selection criteria:** Criteria used to help identify stands to be treated.

**Stocking:** An indication of the number of trees in a stand as compared to the desired number for best growth and management, such as well-stocked, overstocked, and partially stocked. A measure of the proportion of an area actually occupied by trees.

**Succession:** The natural replacement, over time, of one plant community with another.

**Sucker:** A shoot arising from below ground level from a root. Aspen regenerates from suckers.

**Suppressed:** The condition of a tree characterized by low growth rate and low vigor due to competition from overtopping trees or shrubs.

**Sustainability:** Protecting and restoring the natural environment while enhancing economic opportunity and community well-being. Sustainability addresses three related elements: the environment, the economy, and the community. The goal is to maintain all three elements in a healthy state indefinitely. Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

**Sustainable treatment level:** A treatment level (e.g., harvest acres or volume per year) that can be sustained over time at a given intensity of management without damaging the forest resource base or compromising the ability of future generations to meet their own needs. Treatment levels may need to be varied above and/or below the sustainable treatment level until the desired age class structure or stocking level is reached.

**Thermal cover:** Habitat component (e.g., conifer stands such as white cedar, balsam fir, and jack pine) that provides wildlife protection from the cold in the winter and heat in the summer. Vegetative cover is used by animals to protect against the weather.

**Thinning:** A silvicultural treatment made to reduce the density of trees within a forest stand primarily to improve growth, enhance forest health, or recover potential mortality. Row thinning is where selected

rows are harvested, usually the first thinning, which provides equipment operating room for future selective thinnings. Selective thinning is where individual trees are marked or specified (e.g., by diameter, spacing, or quality) for harvest. Variable density or variable retention thinnings vary the distribution of trees that are removed or retained in the stand. Commercial thinning is thinning after the trees are of merchantable size for timber markets. Pre-commercial thinning is done before the trees reach merchantable size, usually done in overstocked (very high stems per acre) stands to provide more growing space for crop trees that will be harvested in future years.

**Threatened species:** A plant or animal species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range in Minnesota.

**Timberland:** Forestland capable of producing timber of a marketable size and volume at the normal harvest age for the cover type. It does not include lands withdrawn from timber utilization by statute (e.g., Boundary Waters Canoe Area Wilderness) or administrative regulation such as designated old growth forests and state parks. On state forest lands, this includes stands that can produce at least three cords per acre of merchantable timber at the normal rotation age for that cover type. It does not include very low-productivity sites such as those classified as stagnant spruce, tamarack, cedar, offsite aspen, or non-forest land.

**Timber productivity:** The quantity and quality of timber produced on a site. The rate at which timber volume is produced per unit area over a period of time (e.g., cords per acre per year). The relative capacity of a site to sustain a level of timber production over time.

**Timber Stand Improvement (TSI):** A practice in which the quality of a residual forest stand is improved by removing less desirable trees and large shrubs to achieve the desired stocking of the best quality trees or to improve the reproduction, composition, structure, condition, and volume growth of a stand. TSI occurs after trees in the stand are free to grow and includes pruning.

**Tolerant:** A plant capable of becoming established and growing beneath overtopping vegetation. A tree or seedling capable of growing in shaded conditions.

**Underplant:** The planting of seedlings under an existing canopy or overstory.

**Understory:** The shorter vegetation (shrubs, seedlings, saplings, small trees) within a forest stand that forms a layer between the overstory and the herbaceous plants of the forest floor.

**Uneven-aged management:** Forest management resulting from forest stands comprised of intermingling trees or small groups with three or more distinct age classes. Best suited for shade-tolerant species.

**Uneven-aged stand:** A stand of trees of various ages and sizes growing together on a uniform site. A stand of trees having three or more distinct age classes.

**Variable density:** Thinning or planting in a clumped or dispersed pattern so that tree spacing more closely replicates patterns after natural disturbance (e.g., use gap management, vary the residual density within a stand when thinning, or plant seedlings at various densities within a plantation).

**Variable retention:** A harvesting system based on the retention of structural elements or biological legacies (e.g., retain tree species and diameters present at older growth stages, snags, large downed logs, etc.) from the harvested stand for integration into the new stand to achieve various ecological objectives. Aggregate retention retains these structural elements in small patches or clumps within the harvest unit. Dispersed retention retains these structural elements as individual trees scattered throughout the harvest unit.

**Volume:** The amount of wood in a tree or stand according to some unit of measurement (board feet, cubic feet, cords) or some standard of use (pulpwood, sawtimber, etc.).

**Well stocked:** The situation in which a forest stand contains trees spaced widely enough to prevent competition yet close enough to utilize the entire site.

**Wildlife Management Area (WMA):** Areas established by the Department of Natural Resources to manage, preserve, and restore natural communities, perpetuate wildlife populations, and provide recreational and educational opportunities.

**Windthrow:** A tree pushed over by the wind. Windthrows are more common among shallow-rooted species.