Northern Minnesota & Ontario Peatlands

Section Forest Resource Management Plan

Preliminary Issues and Assessment

Minnesota Department of Natural Resources
October, 2014

Prepared October 2014

Notes relating to this document:
This *Preliminary Issues and Assessment* document and color maps may be viewed as PDF files on the *Northern Minnesota & Ontario Peatlands Subsection Forest Resource Management Plan* website at:
Northern Minnesota & Ontario Peatlands PDF

Information about the Section Resource Management Plan (SFRMP) process can be found at:
Information about SFRMP

Alternative Format available on request.

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Maps in this document depict information for an area within a “planning boundary.” This boundary closely approximates the Subsections while capturing data summary and planning efficiencies by using survey or jurisdiction lines in some cases.

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CHAPTER 1

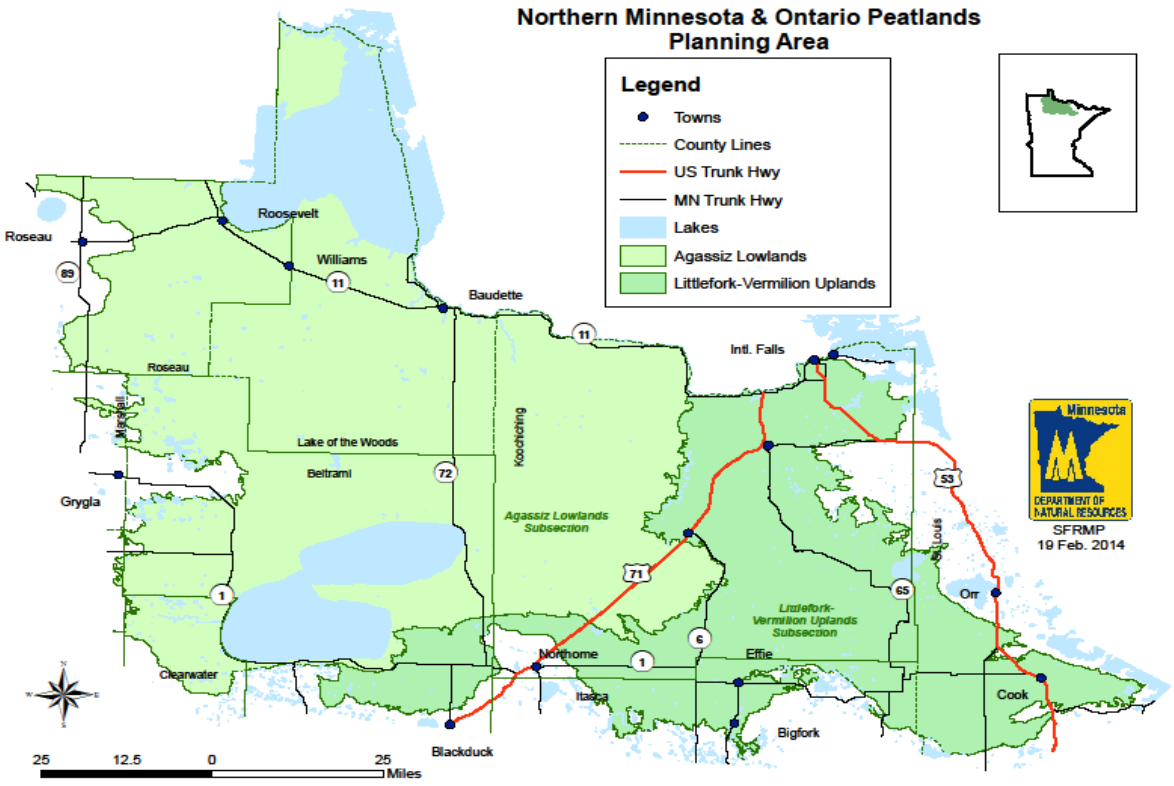
Background and Preliminary Issues

Northern Minnesota & Ontario Peatlands Section

1.1 Background: Description of the Planning Area

The Northern Minnesota & Ontario Peatlands consists of a total land area of approximately 5.3 million acres. The majority of the land cover in the NMOP is identified as lowland conifer deciduous, upland deciduous forest and aquatic environments (swamp, wetlands). The majority of the land is in public ownership. There is a little over 2.9 million acres (55%) of land in public ownership (federal, county, state). State ownership accounts for approximately 2.3 million acres. From these acres this planning process will identify Forestry and Wildlife administered lands that will be assigned a treatment prescription over the next ten years (10-year stand exam list). The total amount of acres on the 10-year stand exam list will be determined by the cover type acres, age class distribution and management strategies identified in the *Northern Minnesota & Ontario Peatlands Section Forest Resource Management Plan (NMOP SFRMP).*

M*ap 1.1.1 Location of Northern Minnesota & Ontario Peatlands Section*



Color maps may be viewed as PDF files on the Northern Minnesota & Ontario Peatlands Section Forest Resource Management Plan (SFRMP) Web site at: Northern Minnesota & Ontario Peatlands Section Forest Resource Management Plan

1.2 Section Forest Resource Management Planning

1. Introduction

In the past, the Minnesota Department of Natural Resources (DNR) directed timber harvesting on lands it administered through 5-year to 10-year forest resource management plans developed for each of its administrative forestry areas. Opportunities for public involvement were limited in the development and review of these timber management plans.

In response to growing public interest in DNR timber management planning, the DNR Subsection Forest Resource Management Plan (SFRMP) process was developed to provide a more standardized, formal process and opportunities for increased public involvement. In addition, it is based at the subsection level of the DNR's ecological classification system (ECS) rather than DNR administrative areas as in the past (i.e., DNR area forestry boundaries). See Ecological Classification System for a description of the ecological classification system. This NMOP SFRMP is the second SFRMP to be prepared for these DNR lands in northern Minnesota. The original SFRMPs were prepared in 2002 for the Agassiz Lowlands Subsection and in 2010 for the Littlefork-Vermillion Uplands. These two SFRMPs provided direction for vegetation management from 2002 through 2015. This NMOP SFRMP will provide direction for vegetation management starting in FY 2016 through 2025.

The SFRMP process aspires to integrate relevant available information and data to make recommendations concerning vegetation management on state administered lands. Efforts will be made to accommodate new information relative to new emerging issues. Where research efforts are still underway, the SFRMP process will attempt to incorporate to the extent possible results from the ongoing research through some form of adaptive management. Concerns associated with the emerging or stated issues will be acknowledged and recommendations for alternative scenarios where relevant will be considered. Where there is a strong concern about an emerging issue, the need for monitoring will be identified and adaptive management will be followed.

The SFRMP process is divided into two phases. In Phase I, the planning Team will prepare a *Preliminary Issues and Assessment document*. This document will identify important forest resource management *Issues* that need to be addressed in the subsection plan and *assess* the current forest resource conditions in the two subsections. In Phase II, the planning Team will prepare a draft *Section resource forest management plan* which includes Desired Future Forest Composition goals (DFFCs); General Direction Statements (GDSs) to further refine the DFFCs; and recommended stand level management *Strategies* to support the DFFCs and GDSs and stand-selection criteria leading to a ten year stand exam list. The DNR will seek stakeholder input on the *Preliminary Issues and Assessment document* and the *Draft NMOP Section Forest Resource Management Plan* (NMOP SFRMP).

2. Goals for the Planning Effort

This SFRMP will constitute DNR planning for *vegetation management* on state forest lands administered in the two subsections (Agassiz Lowlands and Littlefork Vermillion Uplands subsections by the Divisions of Forestry and Management Section of Wildlife. The focus of this effort will be:

- **Identifying a desired future forest composition (DFFC)** for 50 years or more. Composition could include the amount of various cover types, age-class distribution of cover types, and their geographic distribution across the section. The desired future forest composition goals for state forest lands in the section will be guided by assessment information, key issues, general future direction in response to issues, and strategies to implement the general future direction.

- **Identifying forest stands to be treated over the next 10-year period.** SFRMPs will identify forest stands on DNR Forestry- and Wildlife- administered lands that are proposed for treatment (e.g., harvest, thinning, regeneration, and re-inventory) over the 10-year plan implementation period. Forest stands will be selected using stand selection criteria developed that will begin moving DNR forest lands toward the long-term DFFC goals. Examples of possible criteria include stand age and location, soils, site productivity, and size, number, and species of trees. Many decisions and considerations go into developing these criteria and the list of stands proposed for treatment. Examples include: 1) identifying areas to

be managed at normal rotation age; 2) identifying areas to be managed for their ecological values; 3) management of riparian areas, 4) management of visually sensitive travel corridors; 5) management for the appropriate mix of age and cover-type distributions; and 6) regeneration, thinning, and prescribed burning needs. The DNR will select management activities (including "no action") that best move the forest landscape toward the DFFC goals for state forest lands.

Consistent with state policy (Minnesota Statutes 89A), the SFRMP process will pursue the sustainable management, use, and protection of the state's forest resources to achieve the department's economic, environmental, social, and sustainability goals.

This SFRMP accommodates several process revisions and additional issues from past SFRMP planning efforts. Included in these changes are efforts to reflect climate change in forest vegetative management. The objectives of considering climate change in vegetation management will include: continue strategies from past SFRMPs to provide for a diverse forest composition and structure; reflect climate change in cover type change goals; foster within stand diversity; and, consider adjustments to increase tree specifies projected to do better as climate changes.

3. Process

The objectives of the DNR SFRMP process are to:

- effectively inform and involve the public and stakeholders.
- complete the planning process in each ecological classification system (ECS) section within a reasonable amount of time (the target is to complete a SFRMP plan in 12 months).
- Develop a plan that is reasonable and feasible within current staffing levels and workloads; and,
- Develop plans that are credible to stakeholders and enables sustainable forest management.

Gained experience, and the necessity to broaden the focus of SFRMPs to respond to new and evolving vegetation management issues in the future will demand a flexible and adaptable process. The SFRMPs will need to be flexible to reflect changing conditions. The SFRMP process will provide for annual reviews by DNR planning Teams for the purpose of monitoring implementation and determining whether plans need to be updated to respond to unforeseen substantial changes in forest conditions.

DNR planning Teams will include staff from the DNR Divisions of Forestry and the Management Section of Wildlife, as well as the Division of Ecological and Water Resources and other agency staff as needed. These planning Teams will have primary responsibility for the work and decision-making involved in crafting Subsection plans.

The planning Team considers and coordinates with both forest management plans of other agencies as well as coordinates with other levels of government that may affect the management of state lands included in the NMOP SFRMP. This information will help the DNR make better decisions on the forest lands it administers.

Early tasks of the SFRMP process includes: 1) identify important forest resource management *Issues* that will need to be addressed in the Section plan and 2) develop an *overivew* of the current forest resource conditions in the ECS Section. The *Preliminary Issues and Assessment document* developed by the Team, will consider the following basic elements (i.e., chapters in this *document*):

- Land use and cover
- Land ownership and administration
- Forest composition and structure
- Timber harvests
- Ecological information
- Stand damage and mortality
- Wildlife species status and trends

In the following tasks of the SFRMP process, the planning Team will 1) finalize the list of *Issues* addressed in the SFRMP (stakeholder comments may lead to revisions of the *Issues* to be addressed),

2) identify *DFFC* goals, 3) develop *General Direction Statements (GDSs), Strategies* to implement the DFFCs; and 4) develop the *stand-selection criteria* that will be used to identify the stands and acres to be treated over the next 10 years.

4. Relationship of SFRMP to Other Landscape-Level Planning Efforts.

a. Minnesota Forest Resource Council (MFRC) Landscape Planning Efforts

The 1995 Sustainable Forest Resources Act (Minn. Stat. Chapter 89A) directed the MFRC to establish a landscape-level forest resources planning and coordination program to assess and promote forest resource sustainability across ownership boundaries in large forested landscapes.

Volunteer, citizen-based regional forest resource committees are central to carrying out the general planning process. Within each landscape region, committees of citizens and representatives of various organizations work to:

- Gather and assess information on a region's current and future ecological, economic, and social characteristics;
- Use information about a region to identify that region's key forest resource issues;
- Plan ways to address key issues in order to promote sustainable forest management within the region; and,
- Coordinate various forest management activities and plans among a region's forest landowners and managers in order to promote sustainable forest management.

The MFRC Northern Landscape encompasses the NMOP Subsection. Recommended Desired Future Conditions identified in the MFRC Northern Landscape Plan were completed for the northern landscape in June, 2003. These recommendations will be considered and incorporated into the SFRMP process. This information will help the DNR make better decisions on DNR administered lands and assist in cooperating with management in the larger landscape.

For more information on the MFRC landscape planning and coordination program, visit the MFRC Web site at: Minnesota Forest Resources Council

b. National Forest plans

Superior National Forest

The federal Superior National Forest overlays a minor portion of the NMOP section on its eastern boundary. Efforts are made to coordinate with the United States Forest Service on forestry management activities primarily through noticification of annual stand exam lists prepared by MNDNR Forestry Areas. The United States Forest Service has developed a management plan that guides all natural resource management activities for the Superior National Forest. It describes desired resource conditions, resource management practices, levels of resource production and management, and the availability of suitable land for resource management.

To view the entire Superior National Forest Management Plan please click on the following link: Superior National Forest Management Plan

Chippewa National Forest

The Chippewa National Forest overlays portions of the southern NMOP Section. The United States Forest Service has prepared a forest management plan that guides all natural resource management activities for the Chippewa National Forest. It describes desired resource conditions, resource management practices, levels of resource production and management, and the availability of suitable land for resource management.

To view the entire Chippewa National Forest Management Plan please click on the following link: Chippewa National Forest Managment Plan

c. Beltrami Island Land Utilization Project (LUP) Comprehensive Management Plan

The Agassiz Lowlands Subsection includes approximately 85,000 acres of land owned by the U.S. Dept. of Interior- Fish & Wildlife Service. These lands were privately owned by homesteaders at one time. The sand ridges and peatlands were not productive farmland. During the Great Depression the federal Resettlement Administration purchased these lands and provided opportunities for the former residents to move to locations more suited to agriculture. A 50 year lease was arranged to the MN Department of Conservation to manage the lands under custody of the Fish & Wildlife Service. This was known as the Beltrami Island Land Utilization Project. The lease was renewed in 1985 with the DNR Division of Wildlife having management responsibility of these lands.

A comprehensive conservation management plan for these lands was completed in 2013, as directed by the 1997 National Wildlife Refuge System Improvement Act and a 2009 amendment to the lease between the USFWS and the MN DNR. The Beltrami Island Land Utilization Project Comprehensive Conservation Management Plan is available on the MN DNR website- Beltrami Island Land Utilization Project

The LUP lands are managed for wildlife habitat with fiber production a byproduct. Timber harvests are usually planned and conducted as a method of changing the stand age or vertical and/or horizontal physical structure of the stand. It is a useable option if enough merchantable material is removed from the stand to make the harvest commercially viable. The vegetation management on LUP land is included in the SFRMP plan, but differs as guided by the goals of the Beltrami Island Land Utilization Project Comprehensive Conservation Management Plan. Those broad goals often are to attempt to move a stand to a larger mix of species, to increase the quantity and age of conifer species, to create more horizontal or vertical stand structure, to retain more older stands on the landscape, or to slow runoff within the Roseau River watershed.

5. Relationship of SFRMP to Other DNR Planning Efforts

While the SRFMP process focuses on developing vegetation management plans for state-administered forest lands within the Section the SFRMP Teams consider other state, federal, and even local planning efforts affecting the Section, particularly as they relate to management direction, decisions, and products that can assist in determining appropriate vegetation management direction on DNR lands. The following sections highlight a number of efforts that that SFRMP Team considers in order to incorporate relevant information, management direction, and products in the SFRMP process.

a. Off-Highway Vehicle (OHV) Planning Process

The DNR completed a major OHV planning process in 2005. The process began with a statewide road and trail inventory effort on DNR and county lands in the state. The resulting road/trail inventory maps are available for consideration in the SFRMP process. This road/trail inventory is most useful when SFRMP Teams work to identify new access needs for proposed vegetation management.

While the SFMRP process does not include OHV system planning, SFRMP Teams need to consider existing OHV trails and OHV system plans (where available), as well as other recreational trails and facilities, in making decisions on forest stand management next to these facilities and in determining new access needs. Likewise, OHV system plans should consider management direction and the results of stand selection (e.g., large patch areas, areas where temporary access is preferred, areas where new access is needed) developed through the SFRMP process.

For more information about the OHV planning process, visit the DNR Web site at:
DNR off highway vehicle planning process.

b. Minnesota State Park Unit Planning Process

The SFRMP process will not address the management of DNR forest lands within the boundaries of the state parks within the Section.

However, the SFRMP process will consider potential vegetation management impacts on department administered lands adjacent to state parks. Likewise, state park plans need to consider the vegetation management direction and objectives in SFRMPs. Additionally, the SFRMP process should consider the role of state parks in meeting DFFCs and associated goals (e.g., biodiversity, wildlife habitat, community types, etc.).

c. Scientific and Natural Areas and Watershed Protection Areas

The State's eighteen Peatland Scientific and Natural Areas (SNA's) were designated in statute in 1991 (MN Statutes 84.035 and 84.036, with several minor revisions in 1992, 1996 and 1997). Together, these two Statutes may be cited as the "Minnesota Peatland Protection Act."

The Statutes included findings, definitions, SNA designation, discussion of "restricted activities", and "allowed activities". The Commissioner of the DNR was directed to develop management plans for each unit, and establish baseline data. Direction was provided for ditch abandonment, compensation of the Trust for Trust Fund Lands, and acquisition (MN Statute 84.036).

The eighteen SNA's and Watershed Protection Areas (WPA's) were delineated by a Task Force on Peatlands of Special interest; and this Task Force identified 22 unique sites, as outlined in the DNR publication; "Protection of Ecologically Significant Peatlands in Minnesota," published in 1984. The NMOP Subsection contains 15 or these Peatland SNA's.

There are 15 Peatland Scientific and Natural Areas (SNAs) with their associated Watershed Protection Areas (WPAs) within the NMOP section. The SFRMP process will not address the management of the DNR forest lands within the boundaries of the SNA's however it will address the management of the WPAs. For information about these management units, visit the DNR Web site at: DNR Scientific and Natural areas

Because of the intimate interdependence between peatland features and the surrounding hydrologic regime, the Task Force on Peatlands of Special Interest, who did the analysis work to designate these peatlands SNAs and their WPAs, recommended a two-level management approach. The processes that perpetuate the peatland ecosystem, as well as plant communities and rare species, are extremely sensitive to changes in water levels and water chemistry. Accordingly, adequate protection of significant peatland features requires two types of protection. First, the peatland features must be protected directly from onsite physical disturbance. Second, the hydrology of the surrounding peatland area must be sufficiently protected in order to maintain the ecological integrity of the features under special protection. To accommodate this two-level approach, the Task Force defined two management zones, a core preservation zone, the designated Peatland SNA and a watershed protection zone, or WPA. The Watershed Protection area is the buffer surrounding the SNA required to maintain the ecological integrity of the SNA. Management n this area should be restricted to those activities unlikely to have a hydrologic impact on the SNA.

Minnesota Statutes 84.035 and 84.036 designated the Peatland Scientific and Natural Areas. The surrounding, larger Watershed Protection Areas (WPA's) are recognized in several Department rules.

- Rule 6132.200, the Non-ferrous Metallic Mineral Mining Rule references the Peatland SNA's as areas where mining shall be excluded under certain conditions, and where surface disturbance is prohibited within ¼ mile of the SNA. It also identifies WPA's as areas where mining shall be "restricted."

- In Rule 6131.0100, the Peat Mining Rule, peat mining is excluded except in a state or national emergency, within SNA's. Peat mining "avoidance" areas include both he SNA areas and the associated WPA's, as described in the 1984 DNR report as "Peatland Protection Management Areas."

In addition, the Wetland Conservation Act (WCA) specifies that wetlands in WPA's are also "Rare Natural Communities" under WCA (Rule 8420.0548 Subp. 3). A replacement plan for activities that involve the modification of a rare natural community, as determined by the Department of Natural Resources' Natural Heritage Program, must be denied if the local government unit determines that the proposed activities will permanently adversely affect the natural community. See Wetland Conservation Act - rare natural communities

These wetlands also qualify for Exceptional natural resource value projects under WCA (Rule 8420.0541 Subpart 4) see: Wetland Conservation Act - Restoration and protection of Exceptional Natural Resource Value (ENRV)

General recommendations for timber harvest adjacent to an SNA are as follows:
Within the WPA, on state-managed land:

a. Winter harvest only unless silvicultural and ecological requirements dictate otherwise.
b. Standard review procedures (DNR Forest Coordination Framework) apply.
c. No over-the-counter sales or annual plan additions without interdisciplinary review.
d. Strongly discourage creation of new routes where existing routes are present. All winter roads will follow site-level guidelines whether existing or new.
e. Manage for science-based best practices for native plant communities.
f. If stand to be harvested has any portion within the WPA, consider hydrology in decision making. For example, conduct ecological classification (ECS) on all stands within the WPA being proposed for any action.

d. Wildlife Plans and Goals

Although SFRMP plans are not wildlife habitat plans, their implementation affects forest habitats and consequently, wildlife distribution and abundance. Because state forest management under a multiple-use policy requires the consideration of wildlife habitat, several wildlife plans are considered during the SFRMP process.

1) Division of Fish and Wildlife Strategic Plan

The Minnesota DNR's Division of Fish and Wildlife Strategic Plan has established population and or harvest objectives for many of the state's wildlife species that are hunted and trapped. These objectives have been determined by a variety of processes that involve some level of stakeholder involvement and public review. Population objectives consider both biological and social carrying capacities tempered by economic needs or constraints (e.g., crop depredation). Among other tools, the division establishes annual harvest levels to meet desired population goals. During SFRMP, wildlife managers work toward the development of a plan that facilitates achievement of the wildlife population and/or harvest goals for key wildlife species outlined in the division's strategic plan.

2) Bird Plans

Several bird plans under the umbrella of the North American Bird Conservation Initiative provide a continental synthesis of priorities and objectives that can guide bird conservation actions. These plans identify species of continental importance, give a continental population objective, identify issues, and recommend actions. Similarly, the North American Waterfowl Management Plan provides long-term trend information and population objectives for waterfowl species. Wildlife managers involved in SFRMP use this information to form their planning recommendations and decisions, particularly as they relate to desired future forest conditions and age-class composition.

3) Comprehensive Wildlife Conservation Strategy

The Minnesota Comprehensive Wildlife Conservation Strategy (CWCS) plan identifies wildlife species that are considered "species in greatest conservation need" because they are rare, their populations are declining, or they face serious threats of decline.

The federal government has mandated that partnerships within states develop a CWCS to manage their "species in greatest conservation need."

This plan identifies challenges, threats, and opportunities that face the species; it develops 10-year objectives for species populations, habitats, and priority research and information needs, and develops conservation actions that address the 10-year objectives. Wildlife managers use this information to form SFRMP recommendations and decisions.

4) Wildlife Management Area Master Plans (Comprehensive Management Plans)

The Department of Natural Resources prepared comprehensive management plans for the state wildlife management areas having resident managers. The plans include present and projected regional perspectives, resource inventories, and demand and use analyses, as well as acquisition and development plans, cost estimates, and resource management programs. These are ten-year management plans, and will be revised as new management practices develop, new resource philosophies evolve, and new problems are encountered.

5) Management Guidance Documents – Individual Wildlife Management Areas

The intent of Management Guidance Documents is to describe the purpose of individual Wildlife Management Areas (WMAs) and provide basic information to resource managers within the Minnesota Department of Natural Resources (MNDNR). These documents are developed by consolidating several Geographic Information Systems (GIS) and other databases along with input from MNDNR Area Wildlife Staff. These administrative documents include purpose and history of acquisition, habitat emphasis, natural and cultural feature information, facility development, and public access.

e. Application of Forest Certification Requirements

Forest certification is a voluntary third-party process that identifies and recognizes well-managed forest land. It takes into consideration the ecological, economic, and social components of forests and surrounding communities. There are two major internationally recognized forest certification systems for public land: Forest Stewardship Council® (FSC) and the Sustainable Forestry Initiative®(SFI). For more information on forest certification see: DNR Forestry Certification index

f. DNR Direction Documents and relationship to SFRMP

The following sections highlight several of the more prominent DNR direction documents and their relation to the SFRMP process.

1) DNR Strategic Conservation Agenda 2009–2013 and DNR Directions 2000.

The department's strategic planning documents, *DNR Strategic Conservation Agenda 2009–2013* and *DNR Directions 2000*, provide broad goals, strategies, and performance indicators for forest resources in Minnesota (see DNR Directions 2000, Forest Resources Subsection in Appendix A and DNR Strategic Conservation Agenda, Forests Subsection at: MN DNR Stratigic Conservation Agenda.
This broad statewide direction will be used as a platform from which to develop additional complementary/supplemental goals and strategies specific to each Subsection.

2) Old-Growth Forest Guidelines

The 1994 DNR Old-Growth Forest Guideline was developed via a stakeholder involvement process that led to consensus on old-growth forest goals by forest type by ECS Subsection for DNR lands. Following the completion of the guideline, the DNR undertook and completed an old-growth nomination, evaluation and designation process for DNR lands. The latest information on old-growth forest policy and results can be found at: Old growth forests in Minnesota.

Old-growth stand designation has been completed statewide and additional old-growth designation is not part of the SFRMP process. The primary significance of old growth in the SFRMP process is determining how DNR forest stands adjacent to and connecting adjacent old growth stands will be

managed (e.g., as extended rotation forests, part of large patches, scheduling of harvest, conversion to other forest types, etc.).

3) Extended Rotation Forest Guideline

The MN Department of Natural Resources adopted extended rotation forest (ERF) management guidelines in 1994 to maintain a range of forest age classes on DNR managed lands. Since the adoption of this Guideline, a formal review to document the current status of ERF management and analyze the environmental, economic and social effects of the policy to date has been completed. As a result of this analysis, the following recommendations guiding ERF designation have been adopted by the Department:

a. ERF is no longer a forest vegetation management option.
b. Use an adaptive approach to manage older forests. The amount of older forest on the landscape and harvest levels will be monitored to determine the amount, if any, of old forest to maintain on DNR-administered lands.
c. Prepare an old forest analysis as part of each SFRMP to determine the status of forests over normal rotation age. The analysis will be completed separately for DNR-managed timberlands and for all forest ownerships in the Section.
d. If the amount of older forest exceeds the desired age class distribution from the prior SFRMP, normal rotation ages can be used for stand selection on state timberlands. In this case no old forest designation would be required on state managed lands.
e. If the current older forest for a given cover type on all ownerships is less than the desired age class distribution for that cover type on DNR managed timberlands as stated in the original SFRMP, additional older forest can be designated.

4) DNR Forest-Wildlife Habitat Management Guidelines

DNR forest-wildlife habitat management guidelines provide direction to DNR wildlife and forestry staff for integrated management on state-administered lands. MFRC site-level guidelines will prevail when they overlap with DNR forest-wildlife habitat management guidelines. Species-specific sections of the guidelines that are still considered current are relevant in the SFRMP process in determining management around known species locations (i.e., eagles nests) or in the management of areas for particular types of habitat (e.g., open landscapes, ruffed grouse management areas, deer yards, etc.).

5) DNR Interdisciplinary Forest Management Coordination Framework

The DNR Interdisciplinary Forest Management Coordination Framework is a policy to ensure effective and timely coordination between the Divisions of Forestry, Fish and Wildlife and Ecological and Water Resources as a means to improve decision-making and achieve sustainable forest management. The scope of the framework is focused on the coordination of the planning and implementation of fish and wildlife, and forestry management practices primarily on lands administered by the divisions of Forestry, and Fish and Wildlife.

6) Incorporating Biodiversity Considerations in SFRMP

Biological diversity is defined in statute as the “variety and abundance of species, their genetic composition, and the communities and landscapes in which they occur, including the ecological structure, function, and processes occurring at all of these levels.” Protecting areas of significant biodiversity is consistent with state policy (Minnesota Statutes 89A) to pursue the sustainable management, use, and protection of the state’s forest resources to achieve the state’s economic, environmental, and social goals.

The DNR SFRMP process incorporates biodiversity considerations in planning for forest systems on DNR lands. Ecological and Water Resources staff provide ecological information pertinent to managing for biodiversity to the Section forest management Teams. Information includes such things as the management needs of rare features or high conservation values as found in High Conservation Value Forests (HCVFs), descriptors of biodiversity significance sites, hydrologic concerns, and baseline biodiversity data from the county survey’s. SFRMP direction in addressing issues and developing strategies, desired future forest compositions, and ten-year lists of stands to be treated will

reflect consideration of this information and the current, best understanding of how to manage for biodiversity. The NMOP SFRMP will identify specific Strategies that consider and manage the resource values of these areas.

7) White Pine Initiative

In 1996 a White Pine Regeneration Strategies Work Group was formed to prepare recommendations for white pine management on state lands. The primary white pine harvest objectives recommended by that Work Group include: white pine harvesting will be restricted to thinnings, selective harvests, or shelterwood harvests; adequate seed producing white pine will be retained and treatments carried out to increase white pine natural regeneration; reserve the better white pine trees that occur as scattered individuals or in small groups for their seed producing, aesthetic, wildlife and ecological benefit; and, manage all white pine under extended rotation forest guidelines to increase the acreage and distribution of older white pine stands and trees on the landscape.

8) School Trust Fund

The Minnesota Constitution established the School Trust Fund to ensure a long-term source of funds for public education in the state. The goal of the permanent School Trust Fund is to secure the maximum long-term economic return from the school trust lands consistent with the fiduciary responsibilities imposed by the trust relationship established in the Minnesota Constitution, with sound natural resource conservation and management principles, and with other specific policy provided in state law. Further, clarification of this direction is included in Operational Order #121, effective February 23, 2012. This Operational Order will direct management of School Trust Fund lands within the NMOP Section. See: DNR school trust lands

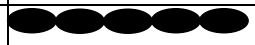
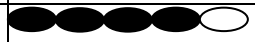
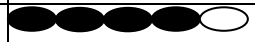
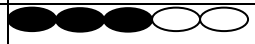
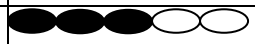
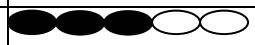
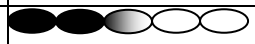
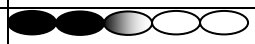
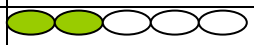
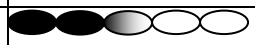
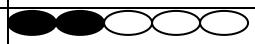
6. Minnesota Forest Resource Council's (MFRC) Voluntary Site-level Forest Management Guidelines

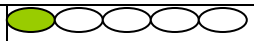
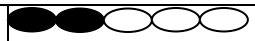
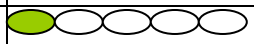
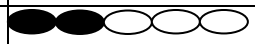
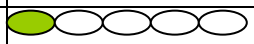
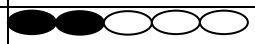
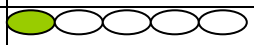
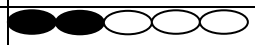
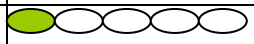
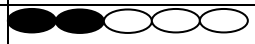
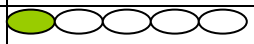
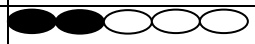
The MFRC's *Voluntary Site-Level Forest Management Guideline*s establish integrated forest resource management practices intended to provide cultural resource, soil productivity, riparian, visual, water quality, wetlands, and wildlife habitat protections in a balanced approach. These guidelines were developed through a collaborative statewide effort and received extensive input during development from stakeholders, DNR staff, and other agency staff. The DNR adopted and strongly endorses the *Voluntary Site-Level Forest Management Guidelines* developed through that collaborative process. These guidelines are the standard in managing DNR lands, i.e., they are not voluntary on DNR-administered lands. As the department standard, departures from the guidelines will not be proposed in SFRMPs for entire Sections or geographic areas within Sections. There is flexibility, and various options are available in application of the guidelines, but departures from the guideline standards need to be documented on a site-by-site basis. If departures above or below guideline recommendations (e.g., recommended minimums for riparian management zone [RMZ] width and residual basal area in the RMZ) are made, they will be documented during the timber sale appraisal and forest development processes.

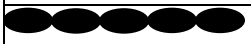
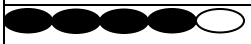
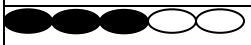
7. Grouping of DNR Direction Documents by 3-Level Hierarchy

The DNR uses a variety of written vehicles (e.g., policies, guidelines, recommendations, memos, operational orders, agreements) to communicate direction to DNR staff on a wide range of forest management issues such as old-growth forests, inter-divisional coordination, site-level mitigation, rare habitats and species, and accelerated management. Interdisciplinary and external involvement has varied in the development of these direction documents, as have the expectations for their implementation (i.e., must follow, follow in most cases, follow when possible). Chart 1.1 places a number of DNR direction documents within a defined policy hierarchy that clarifies decision authority and expected actions. This can serve as a useful reference for the public in understanding the array of forest management guidance available to staff and serve as a starting place for DNR staff to help provide more consistent application across the state. This list of policy/direction documents is not comprehensive, but does outline some of the more notable directions that must be considered as forest management is implemented.

Chart 1.2.1 Grouping of DNR Direction Documents by 3-level Hierarchy

Nomenclature	Developed by	Level of Review	Expectations	Departure Authority
Policies				
Old Growth Forest Guideline	DNR			No departures allowed
Forest/Wildlife Coordination Policy	DNR			No departures allowed
WMA Policy	Wildlife			Region - Interdisciplinary
SNA Est. & Admin. Op. Order	Eco Services			No departures allowed
MFRC Site-Level Guidelines	MFRC			Field appraiser w/ documentation
ID and Mgmt of EILC	CO/FRIT			Region - Interdisciplinary
Guidelines				
Rare Species Guides	Eco Services			Area ID Otherwise: field appraiser w/ doc.
Cover type Mgmt. Recommendations	SFRMP Teams			Field appraiser w/ documentation
NE Region Wood Turtle	NE Region (For, Wild, Trails)			Region - Interdisciplinary
Decorative Tree Harvest Guidelines	Forestry			Area - Interdisciplinary
Accelerated Management	Forestry			Area - Interdisciplinary
Gypsy Moth Mgmt. Guidelines	Forestry/ Dept. of Ag.			Field appraiser w/ documentation
For/Wild Habitat Guidelines	Wildlife/Forestry			Area - Interdisciplinary
Integrated Pest Management	Forestry			Field appraiser w/ documentation
Silvicultural Mgrs. Handbooks	NCES, Forestry			Field appraiser w/ documentation
NE R. Grouse Mgmt. Areas	Wildlife			Area - Interdisciplinary
Goshawk Considerations	Eco & Water Res			Known locations: Area - Interdisciplinary Otherwise, document use
MCBS H/O Biodiversity	Eco & Water Res			Consider if site conditions differ from FIM
ECS Field Guide Interps.	Eco & Water Res			Field appraiser w/ umentation
MCBS Rare NPC	Eco & Water Res			Known locations: Area - Interdisciplinary Otherwise, document use

Red-Shouldered Hawk	Eco & Water Res			Known locations: Area Interdisciplinary Otherwise, document use
Four-toed Salamander	Eco & Water Res			Known locations: Area - Interdisciplinary Otherwise, document use
Black-throated Blue warblers	Eco & Water Res			Document use
Seasonal ponds	Eco & Water Res			Document use
Boreal owl guidelines	Eco & Water Res			Known locations: Area - Interdisciplinary Otherwise, document use
Botrychium guidelines	Eco & Water Res			Known locations: Area - Interdisciplinary Otherwise, document use

KEY	
	Must follow; no departures
	Expected to follow; documented & approved departures OK
	Expected to follow to the degree possible
	Recommended in usual circumstances; departures OK based on site conditions
	Recommended when opportunities and conditions suitable
	Incorporate if possible
	Broad external technical & public
	Broad public/stakeholder
	Limited public/stakeholder
	Department ID review
	Local ID Team review
	Division review w/ peer technical input
	Division review

8. Public Involvement

Public involvement in the SFRMP process occurs at two points:

1. The public review of the *Preliminary Issues and Assessment document*. The *Preliminary Issues and Assessment document* will be posted on the Department's public website and notice sent to stakeholders to review and forward comments; and,
2. A public review and comment period on the *Draft NMOP SFRMP* which includes the 10-year Stand Exam List.

In addition, in an effort to provide for early stakeholder review and comment, three stakeholder webinars are implemented:

1. Introduction to the SFRMP planning process;
2. Stakeholder review of Modeling Scenarios comparing various factors affecting overall forest vegetation management; and,
3. Stakeholder review of the Draft NMOP SFRMP during the 30-day public review period.

Hardcopies of all SFRMP plan documents will be available on request. Electronic copies can be viewed on the DNR website at: Electronic SFRMP Copies

Chart 1.2.2 Public Involvement and Process Timelines for the NMOP SFRMP

SFRMP Task	Public Notification/Participation	Public Comment Period	Completion
I. Preparation of the Planning Process • Assemble initial assessment information and data sets	• DNR develops mailing list of public/ stakeholders. • Establish web-site for subsection.	N/A	prior to start of process
II. Preliminary Issues and Assessment Document • Background information • Preliminary Issues • Update FIM dataset • Begin SMA evaluations	• Inform the public of planning efforts, schedule, and how and when they can be involved. • Provide the *Preliminary Issue and Assessment* document on DNR website • Notice to Stakeholders • Stakeholder Webinar : Introduction and Background	on going	July 2014 June, 2014
III. Prepare Draft Plan Chapters 1, 2, 3, Appendices • Strategic Direction • GDSs, • Strategies, • 10-Year Stand Exam List (August 2014)	• Stakeholder Webinar: Scenarios • Mail summary to Stakeholders. • Provide documents to stakeholders on request and post DNR web site Stakeholder Webinar: review *Draft Plan*	30 days	October 2014 December 2014
IV. Prepare Final Plan • Respond to public comments • Present revised plan for approval • Notice to stakeholders of plan adoption	• Inform public of *Final Plan*. • Provide summary of public comments and how DNR responded. • Provide *Final Plan* in key locations and on Web/CD and in Area offices.	N/A	January 2015

1.3 Preliminary Issue Identification

One of the first steps in the SFRMP process is to identify issues that the plans will address. SFRMP Teams will use assessment information; local knowledge; existing plans, policies, and guidelines; and public input to help identify issues relevant to the scope of the plans. Section Teams will begin with the common set of issues developed from previous SFRMP plans. These common SFRMP issues will then be refined and supplemented based on Section-specific conditions and considerations.

What Is an SFRMP Issue?

A SFRMP issue is a natural resource-related concern or conflict that is directly affected by, or directly affects, decisions about the management of vegetation on lands administered by the Minnesota DNR Division of Forestry and Division of Fish and Wildlife. Relevant issues will likely be defined by current, anticipated, or desired forest vegetation conditions and trends, threats to forest vegetation, and vegetation management opportunities. The key factor in determining the importance of issues for SFRMP will be whether the issue can be addressed in whole or substantial part by vegetation management decisions on DNR-administered lands.

What Is Not a SFRMP Issue?

Issues that cannot be addressed in whole or substantial part by vegetation management decisions on DNR-administered lands are outside the scope of the SFRMP process. For example, SFRMP will not address recreation trails system issues or planning. However, aesthetic concerns along existing recreational trail corridors can be a consideration in determining forest stand management direction in these areas. Another example is wildlife populations; the plan will establish wildlife habitat goals but not goals for wildlife population levels.

Each issue considers the following:

- What is the issue?
- Why is this an issue? (i.e., What is the specific threat, opportunity or concern?)
- What are the likely consequences of not addressing this issue?
- How can this issue be addressed by vegetation management decisions on DNR-administered lands?

1.4 Preliminary Issues

The following pages contain the preliminary issues identified by the planning Team. These issues were developed based on the common issues from previous SFRMP plans, general field knowledge of department staff, and by reviewing forest resource information for the Sections. The next step of the SFRMP process will determine how vegetation management on DNR-administered lands will address these issues.

The NMOP planning Team has begun identifying important issues in these Sections that should guide forest planning. A preliminary issues list was developed to stimulate thought on issues that may impact forest planning in this Section. This plan will provide guidance for forest management on state lands for the next 10 years and update previously established goals for the next 50 to 100 years.

For any of these issues there is no one correct answer, direction or response from the Department in terms of the “correct” method of vegetation management. How the NMOP SFRMP ultimately addresses these issues will depend on many factors including: condition of the forest resources today; forest management goals for the future; the judgment and expertise of Department professionals; existing Department vegetation management directives and statutes; and recommendations from the public and stakeholders.

A. How should the age classes of forest types be represented across the landscape?

- **Why is this an issue?**

  Representation of all age classes and growth stages, including old-forest types, providesa variety of wildlife habitats, timber products, and ecological values over time.

- **How might DNR vegetation management address this issue?**

  Vegetation management can provide for a balance of all forest types and age classes.

- **What are possible consequences of not addressing this issue?**

  A forest without representation of all age classes and growth stages exposes itself to increased insect and disease problems, loss of species with age-specific habitat requirements, and loss of forest-wide diversity. Such a forest would also provide a boom-and-bust scenario for forest industries that depend on an even supply of forest products.

- **Other considerations?**
  What other factors ought to be considered with this issue?

B. What are appropriate mixes of vegetation composition, structure, spatial arrangement, growth stages, and plant community distribution on state lands across the landscape?

- **Why is this an issue?**
  This is an issue because different users and stakeholders have differing opinions concerning what the highest values within a forest are, what the highest priority uses, are, and what is appropriate management.

- **How might DNR vegetation management address this issue?**
  DNR can develop vegetation management strategies that produce effects similar to natural disturbances and can begin to restore certain species and conditions that were once more prevalent. Further, the DNR can attempt to accommodate as many forest users as practical given the limited state land base in the Subsection.

- **What are possible consequences of not addressing this issue?**
  1) Loss of wildlife habitat and associated species; 2) increase in invasive exotics; 3) loss of biodiversity; 4) simplification of stand and landscape communities; 5) loss of ecologically intact landscapes; 6) loss of the ability to produce a diversity of forest products, e.g., saw timber, and other non-timber products, and tourism; 7) decrease resilience to climate change; and 8) continued and heightened user conflicts on the existing state lands within the Subsection.

- **Other considerations?**
  What other factors ought to be considered with this issue?

C. How can the Department address the impacts of forest management on riparian and aquatic areas including wetlands?

- **Why is this an issue?**

  Riparian and aquatic areas are critical to fish, wildlife, and certain other forest resources.

- **How might DNR vegetation management address this issue?**
  The Minnesota Forest Resources Council (MFRC) site-level guidelines are the DNR's standard for vegetation management in riparian areas. At the site level, managers may want to exceed those guidelines. When planning vegetation management adjacent to aquatic and riparian areas, managers can consider specific conditions associated with each site such as soils, hydrology, and desired vegetation. Additionally, they can consider enhancements to the MFRC guidelines.

- **What are possible consequences of not addressing this issue?**
  Failure to consider vegetation management that affects riparian and aquatic areas could result in increased run-off and erosion; more conspicuous run-off events; less stable stream flows; and negative impacts to water quality, fisheries, and wildlife habitat.

- **Other considerations?**
  What other factors ought to be considered with this issue?

D. How can the Department develop new forest management access routes that minimize damage to other forest resources?

- **Why is this an issue?**
  Routes are necessary to access forest stands identified for management during the 10-year planning period. These routes provide access for a variety of forest management activities and recreation. Negative impacts include costs, land disturbance, losses to the timberland base, increased spread of invasive exotic species, potential for user-developed trails, and habitat fragmentation.

- **How might DNR vegetation management address this issue?**
  Using existing access routes or closing access routes after forest management activities have been completed might meet needs while minimizing negative impacts.

- **What are possible consequences of not addressing this issue?**
  Not planning for access needs could result in unfulfilled management goals; poorly located access routes; negative impacts on wildlife habitat; and excessive costs for development, maintenance, and road closure.

- **Other considerations?**
  What other factors ought to be considered with this issue?

E. How might the Department maintain or enhance biodiversity and native plant community composition on actively managed stands where historic disturbance patterns, have been interrupted?

- **Why is this an issue?**
  This is an issue because we have lost and continue to lose significant areas of native plant communities historically maintained by fire and other large-scale disturbances. Further, there is increased fire danger due to the build-up of fuels in some areas.

- **How might DNR vegetation management address this issue?**
  DNR will incorporate management techniques that maintain or enhance biological diversity and structural complexity into vegetation management plans, including increased use of prescribed burning.

- **What are possible consequences of not addressing this issue?**
  1) Degradation of existing biodiversity and ecosystem function; 2) fewer opportunities for maintaining or restoring ecological relationships; 3) reduction of species associated with declining habitat; 4) economic losses due to loss of site capability to maintain or restore ecological relationships; 5) reduction of species associated with declining habitat; 6) economic losses due to loss of site capability to maintain desired species, and 7) social and economic losses resulting from a decline in recreational activity associated with wildlife viewing and hunting.

- **Other considerations?**
  What other factors ought to be considered with this issue?

F. How might the Department provide habitat for game and non-game wildlife and plant species as well as maintain opportunities for hunting, trapping, and nature observation?

- **Why is this an issue?**
  This is an issue because wildlife habitat is being lost. Forest wildlife species are important to Minnesotans. Many factors, ranging from timber harvest to land use development, influences wildlife species and populations.

- **How might DNR vegetation management address this issue?**
  DNR can select vegetation management techniques that provide a variety of wildlife habitats and ecosystem functions.

- **What are possible consequences of not addressing this issue?**
  1) Reduction of some types of wildlife habitat; 2) reductions of species associated with declining habitats; 3) economic and social losses resulting from a decline in recreational activity associated with wildlife viewing, hunting, and aesthetics; economic loss resulting from loss of pollinators and broken foodchain cycles, and loss of system resilience.

- **Other considerations?**
  What other factors ought to be considered with this issue?

G. How might the Department address the impacts on forest ecosystems from forest insects and disease, invasive species (including plants), nuisance animals, herbivory, and changes in natural disturbances such as fires and windthrow?

- **Why is this an issue?**
  This is an issue because insect and disease occurrences have significant impacts on vegetation in these Sections. Further, these invasive and/or exotic species may displace native species/communities. All of the above-mentioned processes can impact the amount of forest land harvested and regenerated during the 10-year planning period. They can also influence the long-term desired future forest composition (DFFC) goals of the Section plans.

- **How might DNR vegetation management address this issue?**
  1) Stands known to be affected and stands at risk of future damage can be identified; 2) DNR can design flexibility into the plan to deal with specific stands that are or may be affected by these processes; 3) harvest schedules, management practices and contract specification can be amended to address potential future impacts.

- **What are possible consequences of not addressing this issue?**
  1) Reduced timber volume and recreational enjoyment of the forest;
  2) long-lasting change to native plant and animal communities;
  3) Increased fire danger;
  4) Significant loss of diversity; and
  5) Loss of resilience to catastrophic events.

- **Other considerations?**
  What other factors ought to be considered with this issue?

H. What are sustainable levels of harvest for forest products?

- **Why is this an issue?**
  One primary goal of the SFRMP is to achieve a long-term sustainable harvest of forest products while considering and planning for all forest users and species that depend on the various forest growth stages. Determining the sustainable level of harvest requires consideration of the needs of all forest wildlife, plant, and recreational needs. Further, DNR managed forestlands have been certified by two third party certifiers: the Forest Stewardship Council and the Sustainable Forestry Initiative. Certification of the DNR's forest lands verifies that sustainable forest management is being practiced by the DNR.

- **How might DNR vegetation management address this issue?**
  The DNR can develop a 10-year harvest plan for state lands in these Subsections that promotes a balance of all age classes for all even-aged cover types, monitor non-timber species to ensure no over treatment while incorporating efforts in the process to protect and consider all wildlife and plant species and cultural resources.

- **What are possible consequences of not addressing this issue?**
  1) Possible unsustainable harvests of these forest product resources;
  2) Adverse impacts to wildlife habitat and native plant communities;
  3) Unintended impacts to rare species;
  4) An increase in non-desirable species; and,
  5) An in-balance in the plant and animal communities with a loss in native biodiversity.

- **Other considerations?**
  What other factors ought to be considered with this issue?

I. How can the Department increase the quantity and quality of timber products on state lands?

- **Why is this an issue?**
  The demand for timber remains significant, while demand for other forest values has also increased. Minnesota's forest industry requires a sustainable and predictable supply of wood.

- **How might DNR vegetation management address this issue?**
  Vegetation management planning can identify forest stands for treatments that will increase timber productivity (e.g., harvesting at desired rotation ages, thinning, control of competing vegetation, and reforestation to desired species and stocking levels). The DNR can continue to be forward thinking and apply "creative" silivicultural techniques such as pre-commercial thinnings.

- **What are possible consequences of not addressing this issue?**
  Timber supplies would become less predictable and/or unsustainable over time, with potential negative impacts ranging from over supplies to scarcities of forest products, higher procurement costs for industry, increased chemical treatments, and waste. Increased management costs. Alternatively, wood and wood product imports might increase from countries that have fewer environmental controls, effectively exporting U.S. environmental issues.

- **Other considerations?**
  What other factors ought to be considered with this issue?

J. How can the Department implement forest management activities and minimize impacts on visual quality?

- **Why is this an issue?**
  Scenic beauty is one primary reason people choose to live near or use their recreation and leisure time in or near forested areas.

- **How might DNR vegetation management address this issue?**
  DNR managers will continue to follow Best Management Practices (BMPs) for visual quality as forest lands are managed and identify areas that may need additional mitigation strategies**.**

- **What are possible consequences of not addressing this issue?**
  Not addressing this issue may result in negative impacts to residents of the area and users of the forest, woodlands, and grasslands in the Subsection. It may result in loss of economic revenue and loss of public good will.

- **Other considerations?**
  What other factors ought to be considered with this issue?

K. How will land managers achieve desired results and continue to uphold various state and federal statutes?

- **Why is this an issue?**
  There exist a wide range of legal mandates the Divisions within the DNR must follow toguide timber, wildlife, ecological, recreation and cultural management on state lands. Many are conflicting, while fulfilling both department and division missions. For example, State Trust Fund lands must generate income for various trust accounts under state law, with timber sales the primary tool to achieve this directive. Conversely, wildlife habitatmanagement and preservation, not necessarily timber sales, is the mandate for acquiredWildlife Management Area (WMA) lands. Further, unless efforts are made to considerland management of other public land managers in the Section, conflicting objectives onadjacent lands could result.

- **How might DNR vegetation management address this issue?**
  Vegetation management will take administrative land status, relevant statutes and coordination with other land managers into consideration during the planning process.

- **What are possible consequences of not addressing this issue?**
  Failure to follow these mandates and legislative intent may be a violation of federal or state law. Opportunities for cooperative efforts may be lost.

- **Other considerations?**
  What other factors ought to be considered with this issue?

L. How will cultural resources be protected during forest management activities on state-administered lands?

- **Why is this an issue?**
  Cultural resource sites possess spiritual, traditional, scientific, and educational values. Some types of sites are protected by federal and state statutes.

- **How might DNR vegetation management address this issue?**
  DNR managers will continue to have all vegetation management projects reviewed for known cultural resources. They will survey unidentified sites and if cultural resources are found, modify the project to protect the resource. If cultural resources are discovered in the course of the planning process, stand site visit or treatment, the project will be modified to protect the resource.

- **What are possible consequences of not addressing this issue?**
  Loss or damage to cultural resources.

- **Other considerations?**
  What other factors ought to be considered with this issue?

M. How can the Department ensure that rare plants and animals, their habitats, and other rare features are protected in these Subsections?

- **Why is this an issue?**
  Protecting rare features (endangered, threatened, and special concern species and their habitats) is a key component of ensuring species, community, and forest-level biodiversity in this Section.

- **How might DNR vegetation management address this issue?**
  The Minnesota Biological Survey (MBS) has been completed in two of the seven counties making up the NMOP section. The MBS is in progress in the remaining five counties. As part of site visit protocol, DNR managers will check the Rare Features Database for the location of known rare features in this Sections and take these features into consideration. Identification and consideration of rare features will be addressed in two ways: identified in the management plan as part of stand selection criteria and considered as prescriptions are written prior to active management.

- **What are possible consequences of not addressing this issue?**
  1) Loss of rare species at the local and state level; 2) rare species declines leading to status changes; 3) rare habitat loss or degradation; and 4) loss of biodiversity at the species, community, and/or landscape level.

- **Other considerations?**
  What other factors ought to be considered with this issue?

N. How can The Department insure that forest management actions help maintain or enhance healthy watersheds?

- **Why is this an issue?**
  Forested lands act as a water filter and are a key component in the hydrologic cycle for sustaining high quality water and hydrology. Forest management operations can have a direct impact on surface water quantity and quality, and on stream stability. Forest management activities can also have a direct impact on watershed ecological function, groundwater hydrology and paludification processes.
- **How might DNR vegetation management address this issue?**
  Forest management can be planned topromote a forest condition that maintains or enhances watershed conditions.
- **What are possible consequences of not addressing this issue?**
  Several consequences can be identified including: 1) Missed opportunities to improve the health of watersheds; 2) loss of the ability of streams in impaired watersheds to maintain cold-water attributes in a possibly changing climate; 3) further degradation of watershed health, and 4) paludification with the resultant loss of productive forest habitat.
- **Other considerations?**

O. How can the Department ensure that forest management actions consider the effects of climate change on forest resources and the environment?

- **Why is this an issue?**
  Forest ecosystems in northern Minnesota will be affected directly and indirectly by global climate change. These forest ecosystems are predicted to undergo many changes as a result of a changing climate; forest management practices can have an important influence on the way that forests respond to climate change.

- **How might DNR vegetation management address this issue?**
  DNR can incorporate climate change adaptation strategies into forest management decisions. The three main climate change adaptation strategies are: 1) Resistance - improve the forest's defenses against change (i.e., protect forests from severe fire and wind disturbance), 2) Resilience - improve the forest's ability to accommodate some degree of change (i.e., maintain and enhance species and structural diversity), and 3) Response – actively facilitate forest change (i.e., promote landscape connectivity to enhance species migration).

- **What are the possible consequences of not addressing this issue?**
  Forest ecosystems would be less resilient to climate change. Forest managers will miss opportunities to help forest ecosystems more smoothly adjust to climate change. Forest impacts due to climate changes may be more drastic over time.

- **Other considerations?**

P. How will we ensure that Permanent School Trust Fund policy is implemented on state lands without compromising sound natural resource management?

- **Why is this an issue?**
  Trust Fund lands comprise approximately 43 percent of state lands in the NMOP. By statute, Trust lands are to be managed for long-term revenue maximization using sound resource management principles. Strategies for revenue maximization on these lands will have a higher profile in SFRMP than they have in the past, as well as influencing on-the-ground decision making.

- **How might DNR vegetation management address this issue?**
  Strategies for income maximization include using normal (economic) rotation ages for stand selection, and grouping these selections when possible to increase timber sale marketability and reduce road construction/costs. Management activities will remain consistent with direction set

forth by SFI/FSC Forest Certification, Minnesota Forest Resource Council Voluntary Site-Level Guidelines, and statutes such as Endangered Species protections.

- **What are the possible consequences of not addressing this issue?**
  The Commissioner of Natural Resources has been entrusted by the Minnesota Legislature to manage Permanent School Trust Fund lands according guidelines set forth in state statute, that is, long-term income maximization using sound resource management principles. A consequence of failing to manage School Trust lands according to statute could result in DNR losing management authority over those lands.
- **Other considerations?**

CHAPTER 2
Land Use and Cover
Northern Minnesota & Ontario Peatlands Section

2.1 Land Use and Cover

The National Land Cover Classification is used to describe the land cover making up the NMOP Section.

Land-Cover Classification

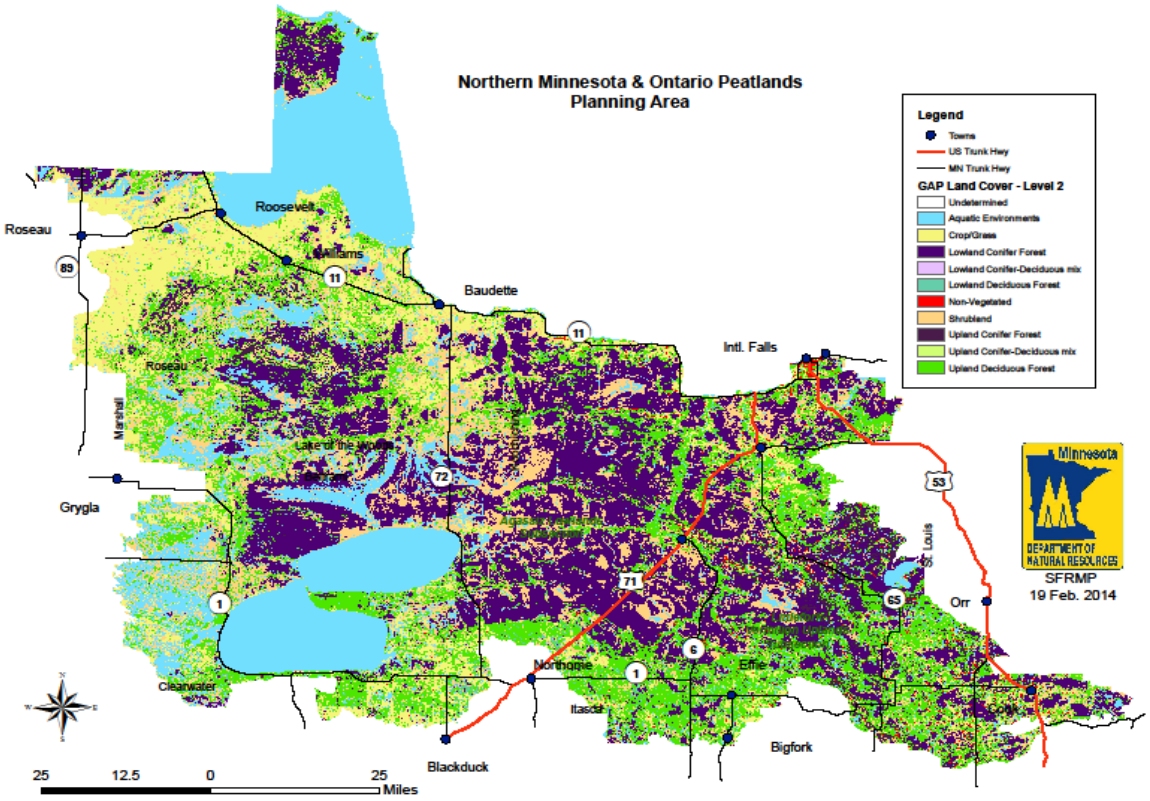
The GAP classification of vegetation (land cover map), which is a part of the larger project, was produced by computer classification of satellite imagery (Landsat 5 Thematic Mapper imagery [draft} by the Resource Assessment Unit of the DNR Division of Forestry. Units of analysis are divided by Ecological Classification System (ECS) subsections. The minimum mapping unit is one acre.

The following table and map show the GAP land-cover classification of the subsections in this plan.

Table 2.1.1 GAP Analysis in Acres and Percentages

Land Cover	Acres	Percent
Unclassified	13,655	0.25
Aquatic Environments	1,049,160	19.58
Crop/Grass	616,467	11.51
Lowland Conifer-Deciduous mix	1,492	0.03
Lowland Conifer Forest	1,378,532	25.73
Lowland Deciduous Forest	73,584	1.37
Non-Vegetated	4,3200	0.81
Shrubland	913,054	17.04
Upland Conifer-Deciduous mix	2,490	0.05
Upland Conifer Forest	150,550	2.81
Upland Deciduous Forest	1,115,751	20.82
Total	**5,357,935**	**100.00**

Map 2.1.1 Gap Analysis Program Land Cover



Color maps found in this document may be viewed as PDF files on the Northern Minnesota & Ontario Peatlands Section Forest Resource Management Plan (SFRMP) Web site at:
http://www.dnr.state.mn.us/forestry/Subsection/nmop/index.html

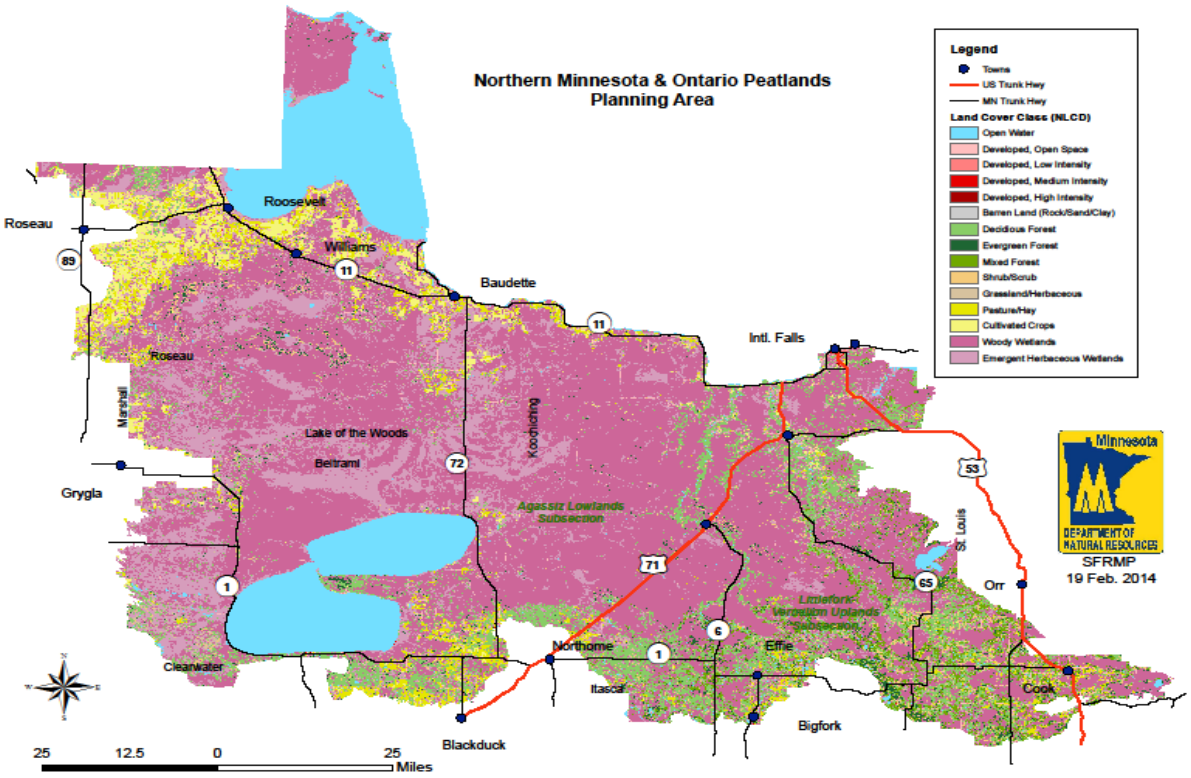
2.2 National Land Cover Classifications

The following table and map show the National Land Cover Classifications for land cover of the subsections in the NMOP subsections.

Table 2.1.2 National Land Cover type in Acres and Percentages

National Land Cover Classification	Acres	%
Open Water	625,840	12
Developed, Open Space	55,498	1
Developed, Low Intensity	8,611	<1
Developed, Medium Intensity	1,537	<1
Developed, High Intensity	711	<1
Barren Land (Rock/Sand/Clay)	1,635	<1
Deciduous Forest	485,677	9
Evergreen Forest	69,537	1
Mixed Forest	116,139	2
Shrub/Scrub	77,848	1
Grassland/Herbaceous	50,744	1
Pasture/Hay	171,515	3
Cultivated Crops	169,009	3
Woody Wetlands	2,632,920	49
Emergent Herbaceous Wetlands	876,189	16
Total	5,343,410	100.00

Map 2.1.2 NMOP Land Cover, National Land Cover Classification



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CHAPTER 3

Land Ownership and Administration
Northern Minnesota & Ontario Peatlands Section

3.1 Land Ownership

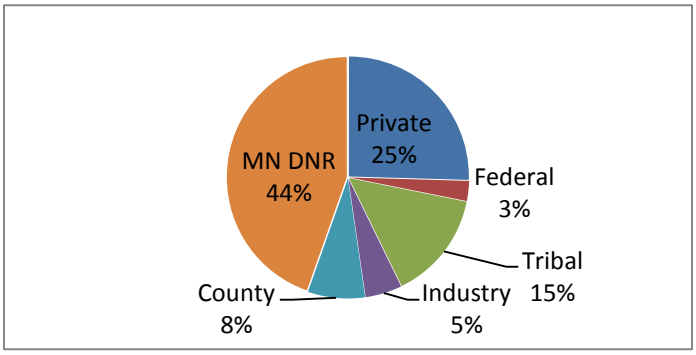
The NMOP subsections contain 5.3 million acres. Public ownership (federal, state and county lands) account for approximately 53% of the land base. Private ownership accounts for approximately 45% of the base. Private ownership includes private lands, tribal lands and industrial forest lands. Of the public land owners, the State of Minnesota administers 79% of total public lands in the NMOP ecological section.

Table 3.1.1 Land Ownership NMOP Subsections GAP Stewardship in Acres[1]

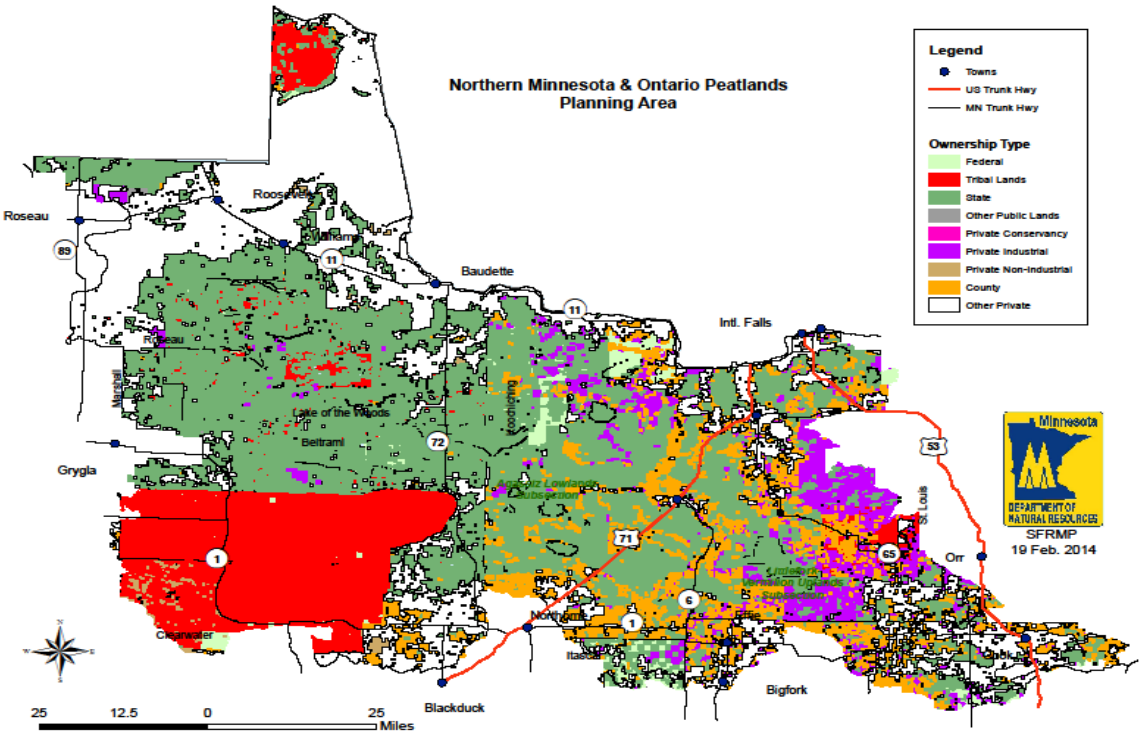
Ownership	Acres	Percent
Private	1,362,910	25
Federal	144,697	3
Tribal	781,598	15
Industry	264,128	5
County	412,511	8
MN DNR[2]	2,273,429	42
Eco/Water Resources	934	
Wildlife Section	429,258	
Forestry	1,827,929	
Parks	15,256	
Trails & Waterways	12	
Waters	40	
Undifferentiated	62,224	1
Other State	51,745	<1
Totals	**5,353,242**	

[1]Source: 1976 to 1998 Minnesota DNR GAP Stewardship---"All Ownership Types" data.
[2]SFRMP only covers DNR Divisions of Forestry, Trails and Waterways, and Fish and Wildlife – Wildlife Section - administered lands.

Chart 3.1.1 Northern Minnesota & Ontario Peatlands Land Ownership



Map 3.1.1 NMOP Subsections – Land Ownership



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http://www.dnr.state.mn.us/forestry/Subsection/nmop/index.html

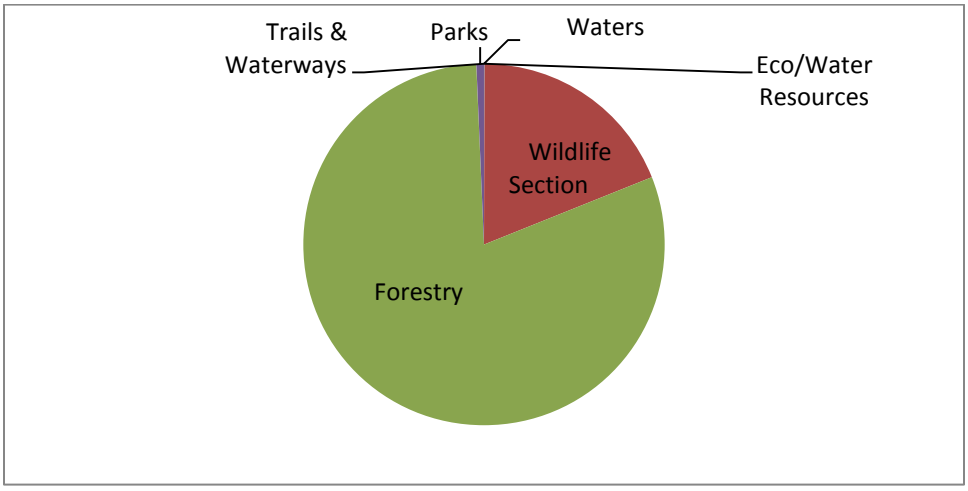
3.2 DNR Land Administration

Table 3.2.1 MNDNR Land Administration

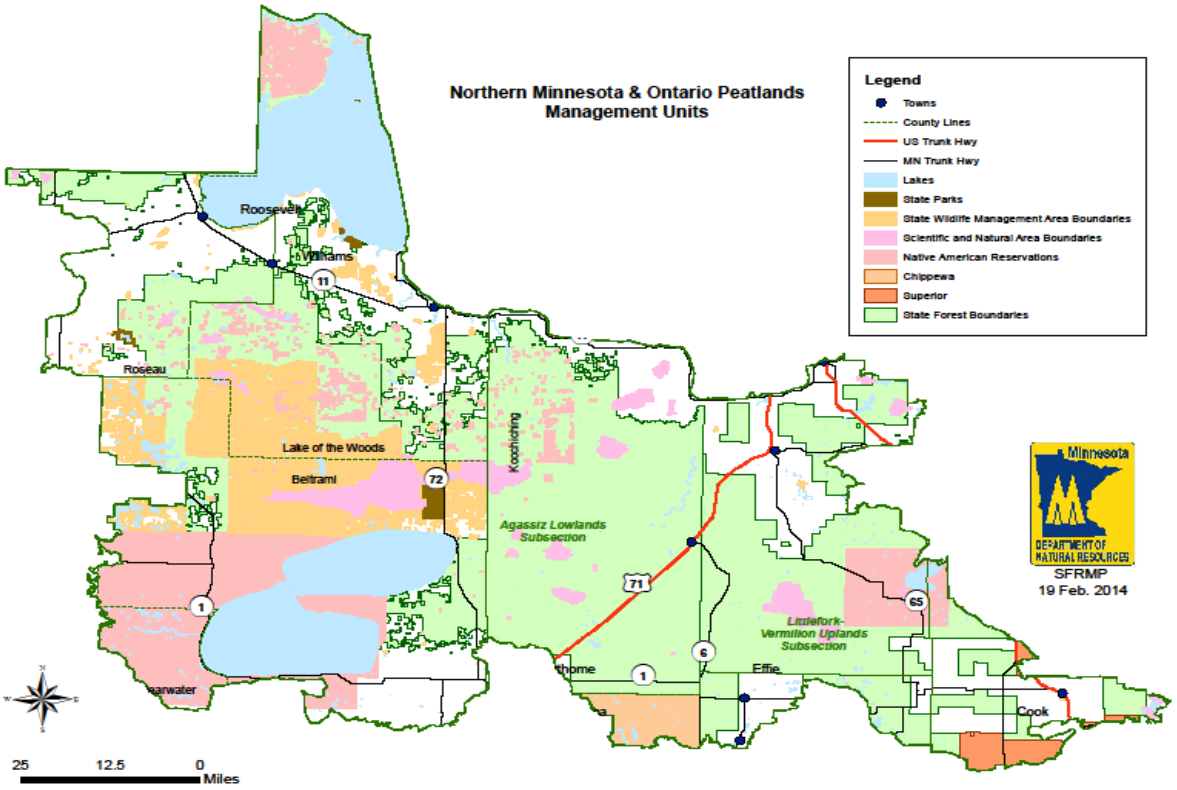
MN DNR Division	Acres	Percent
Eco/Water Resources	934	<1
Wildlife Section	429,258	19
Forestry	1,827,929	80
Parks	15,256	<1
Trails & Waterways	12	<1
Waters	40	<1
Total Administered	2,273,429	100

Table 3.2.1 shows total land administered by MNDNR Division in acres. As seen, the majority of state administered lands are managed by the Division of Forestry.

Chart 3.2.1 MNDNR Land Administration



Map 3.2.1 NMOP Section – Major Management Units



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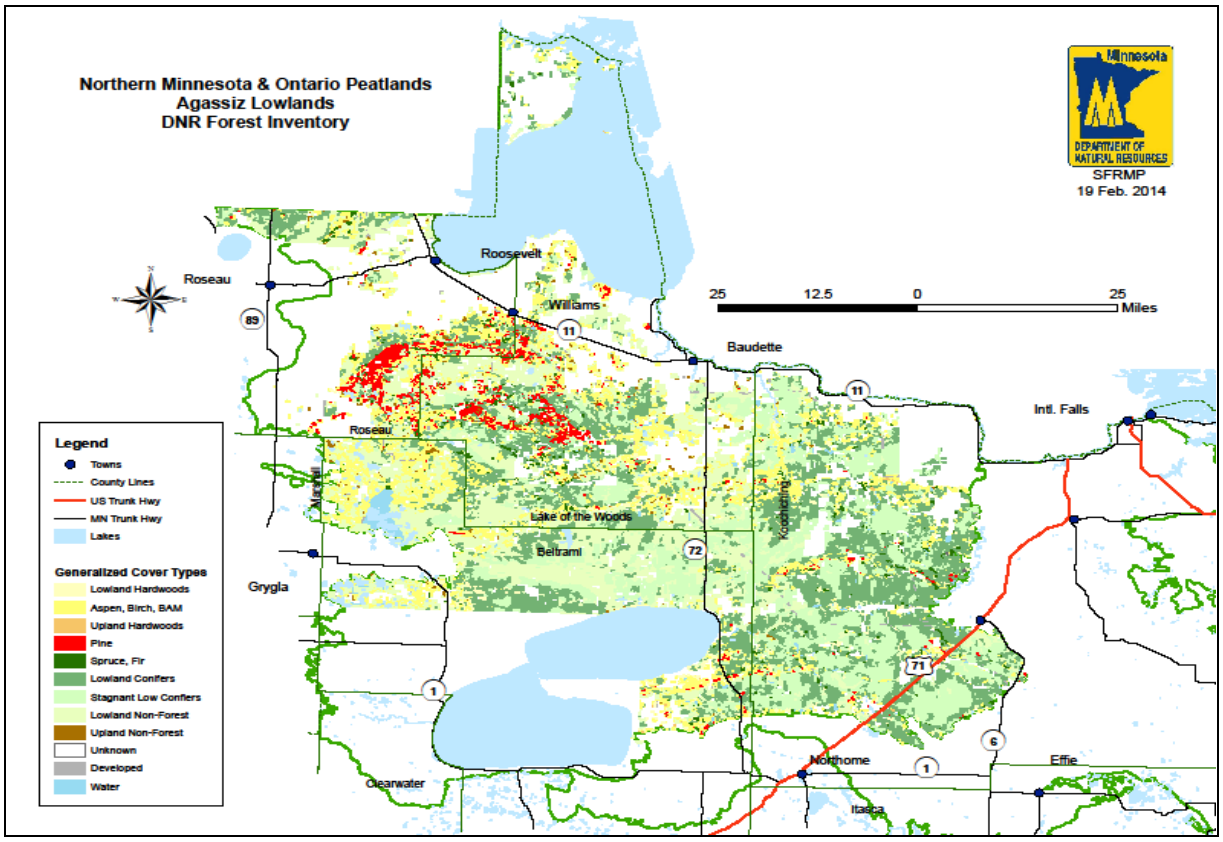
CHAPTER 4

Forest Composition and Structure

Northern Minnesota & Ontario Peatlands Section

4.1 Forest Cover types

Map 4.1.1 Agassiz Lowlands Forest Composition



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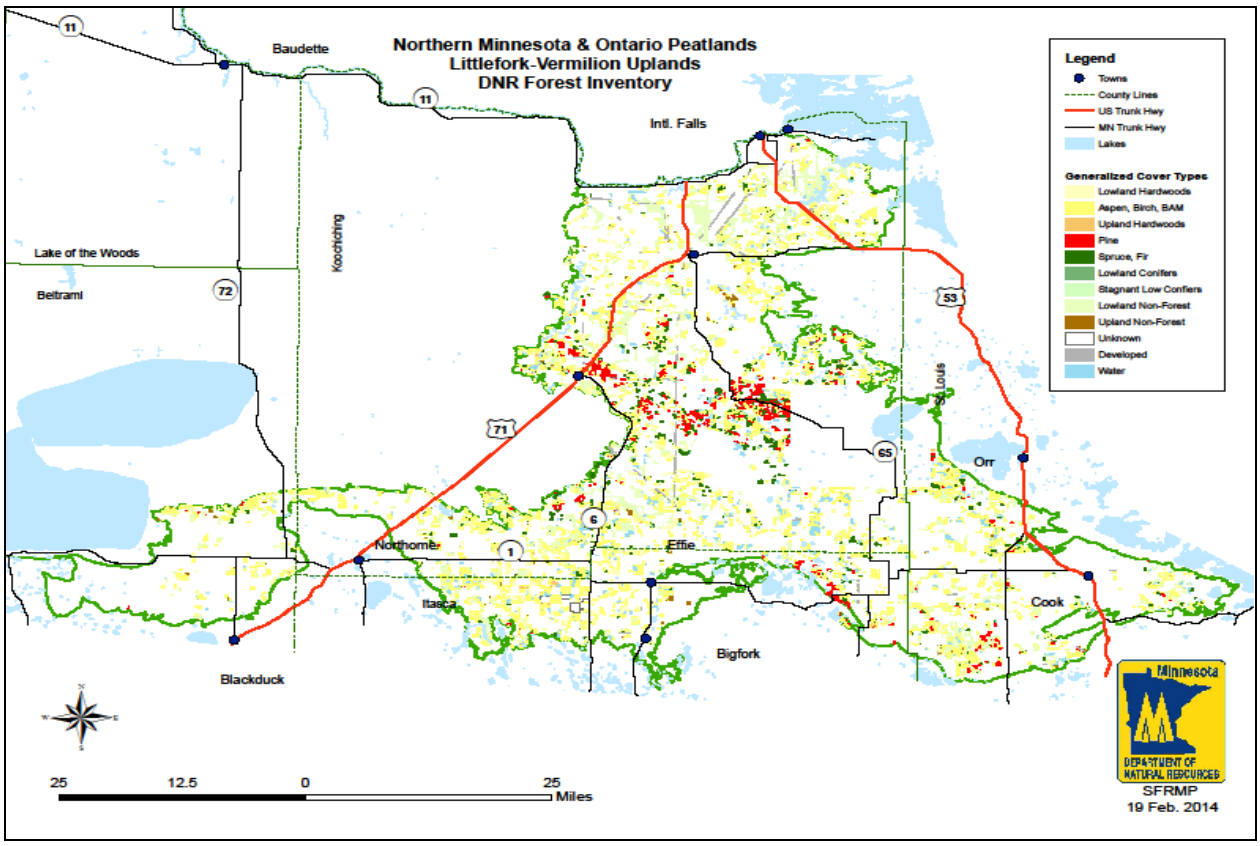
http://www.dnr.state.mn.us/forestry/Subsection/nmop/index.html

Map 4.1.2 Littlefork-Vermilion Uplands Forest Composition



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http://www.dnr.state.mn.us/forestry/Subsection/nmop/index.html

Table 4.1.1 Age Class Distributions

Age Class Distribution in Acres by Species and Subsection																								
Cover Type	**1 – 10**	**11 – 20**	**21 – 30**	**31 – 40**	**41 – 50**	**51 – 60**	**61 – 70**	**71 – 80**	**81 – 90**	**91 – 100**	**101 – 110**	**111 – 120**	**121 – 130**	**131 – 140**	**141 – 150**	**151 – 160**	**161 – 170**	**171 – 180**	**181 – 190**	**191 – 200**	**201 – 210**	**211 +**	**Total**	**% of Grand Total**
Ash/Lowland Hardwoods																								
Total	**722**	**733**	**1652**	**2209**	**1833**	**1415**	**2355**	**3800**	**5919**	**6626**	**6654**	**6312**	**5579**	**5006**	**3479**	**1778**	**1695**	**1225**	**291**	**277**	**124**	**370**	**60054**	**5.1%**
Agassiz Lowlands	579	547	836	1183	1175	1032	1520	2518	3961	3559	3463	3345	2857	2626	1018	797	509	889	99	47	17	343	32921	
Littlefork – Vermillion Uplands	143	186	816	1026	658	383	834	1,282	1958	3067	3191	2967	2722	2380	2461	981	1186	336	192	230	107	27	27133	
Aspen/Balm of Gilead																								
Total	**72135**	**76687**	**60783**	**36685**	**28946**	**26670**	**31037**	**23031**	**6957**	**1820**	**671**	**177**	**44**	**0**	**0**	**26**	**24**	**28**	**0**	**0**	**0**	**0**	**365721**	**30.8%**
Agassiz Lowlands	50632	55228	33751	21171	17575	18745	23160	17184	5245	1485	513	119	35	0	0	8	24	28	0	0	0	0	244903	
Littlefork – Vermillion Uplands	21503	21459	27032	15514	11372	7925	7877	5847	1712	335	158	58	9	0	0	17	0	0	0	0	0	0	120818	
Paper Birch																								
Total	**474**	**89**	**235**	**432**	**1809**	**703**	**764**	**630**	**516**	**132**	**146**	**165**	**61**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**34**	**0**	**6197**	**0.5%**
Agassiz Lowlands	348	56	194	414	1,658	599	615	360	452	102	110	143	18	0	0	0	6	0	0	0	0	0	5075	
Littlefork – Vermillion Uplands	126	33	41	18	150	104	148	270	64	31	36	22	43	0	0	0	0	0	0	0	34	0	1122	
Northern Hardwoods																								**%**
Total	**34**	**59**	**81**	**59**	**64**	**146**	**184**	**302**	**461**	**245**	**147**	**212**	**138**	**7**	**18**	**19**	**88**	**12**	**8**	**0**	**7**	**5**	**2,296**	**0.2%**
Agassiz Lowlands	0	20	72	59	16	94	135	60	59	98	7	128	73	0	18	0	0	9	0	0	0	0	849	
Littlefork – Vermillion Uplands	34	39	9	0	48	51	50	242	402	147	140	84	65	7	0	19	88	3	8	0	7	5	1,447	
Oak																								
Total	**20**	**53**	**21**	**13**	**1**	**20**	**58**	**29**	**117**	**42**	**41**	**0**	**0**	**53**	**0**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**478**	**0.04 %**
Agassiz Lowlands	7	0	13	13	1	14	58	29	117	15	41	0	0	0	0	12	0	0	0	0	0	0	318	
Littlefork – Vermillion Uplands	13	53	7	0	0	6	0	0	0	27	0	0	0	53	0	0	0	0	0	0	0	0	159	
White Pine																								
Total	**132**	**292**	**57**	**42**	**47**	**67**	**10**	**108**	**7**	**63**	**14**	**171**	**93**	**51**	**28**	**22**	**17**	**31**	**34**	**7**	**0**	**54**	**1,344**	**0.1%**
Agassiz Lowlands	57	19	39	34	36	58	10	85	7	27	0	23	69	33	28	13	0	0	0	1	0	12	549	
Littlefork – Vermillion Uplands	76	273	18	8	11	9	0	23	0	36	14	148	24	18	0	8	17	31	34	6	0	42	795	
Norway Pine																								
Total	**1,267**	**836**	**2,615**	**3,855**	**4735**	**2,292**	**908**	**1,088**	**641**	**304**	**432**	**169**	**130**	**71**	**15**	**0**	**16**	**4**	**9**	**4**	**2**	**10**	**19,402**	**1.6%**
Agassiz Lowlands Plantation	304	199	1849	2953	3712	1540	487	620	31	4	0	0	0	0	0	0	0	0	0	0	0	10	11,709	

Agassiz Lowlands Natural Origin	43	89	42	113	497	109	74	118	374	163	70	2	73	0	0	0	0	0	0	4	0	0	1,769	
Littlefork – Vermillion Uplands Plantation	846	522	725	760	497	637	293	103	31	7	26	17	15	13	0	0	5	0	9	0	0	0	4,507	
Littlefork – Vermillion Uplands Natural Origin	74	25	0	28	30	7	54	247	205	131	335	149	42	57	15	0	11	4	0	0	2	0	1,417	
Jack Pine																								
Total	**10,410**	**8,318**	**10,595**	**5,013**	**3,575**	**2,988**	**2,083**	**1,235**	**907**	**349**	**11**	**13**	**0**	**0**	**12**	**0**	**5**	**0**	**2**	**0**	**0**	**13**	**45,529**	**3.8%**
Agassiz Lowlands	9,189	7,070	8,974	3,777	2,808	2,659	1,880	928	718	304	11	5	0	0	12	0	5	0	0	0	0	0	38,338	
Littlefork – Vermillion Uplands	1,222	1,248	1,621	1,236	767	330	202	307	190	45	0	8	0	0	0	0	0	0	2	0	0	13	7,190	

White Spruce																							**Total**	**%**
Total	**779**	**814**	**3,178**	**3,793**	**2,108**	**1,459**	**727**	**474**	**269**	**102**	**195**	**226**	**55**	**6**	**0**	**19**	**0**	**0**	**0**	**0**	**0**	**0**	**14,204**	**1.2%**
Agassiz Lowlands	451	202	2,534	1,536	1,254	1,056	624	405	230	33	118	211	55	0	0	0	0	0	0	0	0	0	8,708	
LFV	329	613	644	2257	854	403	103	69	39	68	77	15	0	6	0	19	0	0	0	0	0	0	5,496	
Balsam Fir																								
Total	**1,350**	**954**	**925**	**2,463**	**6,092**	**3,503**	**2,706**	**2,247**	**1,866**	**859**	**483**	**139**	**27**	**78**	**0**	**7**	**0**	**0**	**7**	**48**	**0**	**0**	**23,754**	**2.0%**
Agassiz Lowlands	1099	616	497	1775	4294	2394	1640	1254	1031	545	201	81	27	19	0	7	0	0	0	0	0	0	15,482	
LFV	250	338	428	688	1798	1109	1066	993	835	314	282	58	0	59	0	0	0	0	7	48	0	0	8,272	
Black Spruce Lowland																								
Total	**20,973**	**23,231**	**19,621**	**25,314**	**27,296**	**17,074**	**14,988**	**17,018**	**18,379**	**19,859**	**25,550**	**24,672**	**20,656**	**15,853**	**9,467**	**4,353**	**3,354**	**1,144**	**475**	**301**	**188**	**126**	**309,891**	**26.1%**
Agassiz Lowlands	11,400	9,644	9,953	15,551	17,199	11,971	8,824	10,249	9,327	11,396	15,910	16,033	12,711	9,422	5,358	2,453	1,610	664	167	230	79	106	180,255	
LFV	9,573	13,586	9,669	9,763	10,097	5,103	6,164	6,769	9,052	8,463	9,640	8,639	7,945	6,431	4,109	1,900	1,745	481	308	71	109	20	129,636	
Tamarack																								
Total	**15974**	**11751**	**15079**	**18489**	**37290**	**24684**	**12859**	**9436**	**15419**	**20719**	**12629**	**8410**	**9383**	**9749**	**7253**	**7671**	**2378**	**1576**	**496**	**974**	**181**	**404**	**242804**	**20.4%**
Agassiz Lowlands	14681	9843	12955	16689	34447	22757	11899	8,377	13306	16598	10890	6667	8966	8,837	7,018	7,414	2,265	1,553	474	942	181	404	217164	
LFV	1293	1908	2124	1799	2843	1,927	960	1,058	2112	4121	1739	1743	417	912	235	257	114	23	21	32	0	0	25640	
White Cedar																								
Total	**243**	**363**	**763**	**1,013**	**2,933**	**1,729**	**2,001**	**2,334**	**2842**	**6098**	**7606**	**10597**	**11454**	**10637**	**10331**	**7277**	**4595**	**4696**	**3056**	**1907**	**1071**	**1359**	**94905**	**8.0%**
Agassiz Lowlands	217	235	457	640	2445	1304	1813	1778	2058	4877	5507	7532	8001	7336	6085	4244	2248	2723	1415	617	508	503	62545	

LFV	26	128	305	373	488	424	188	555	784	1220	2100	3066	3452	3302	4246	3033	2347	1973	1641	1290	563	856	32360	

Black Spruce Upland																								
Total	**67**	**48**	**373**	**190**	**198**	**105**	**129**	**211**	**336**	**54**	**19**	**29**	**2**	**19**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	**1,779**	**0.1%**
Agassiz Lowlands	0	43	324	20	169	38	24	196	325	35	19	29	0	11	0	0	0	0	0	**0**	0	0	1,232	
LFV	67	5	49	170	29	66	105	15	11	20	0	0	2	8	0	0	0	0	0	0	0	0	547	

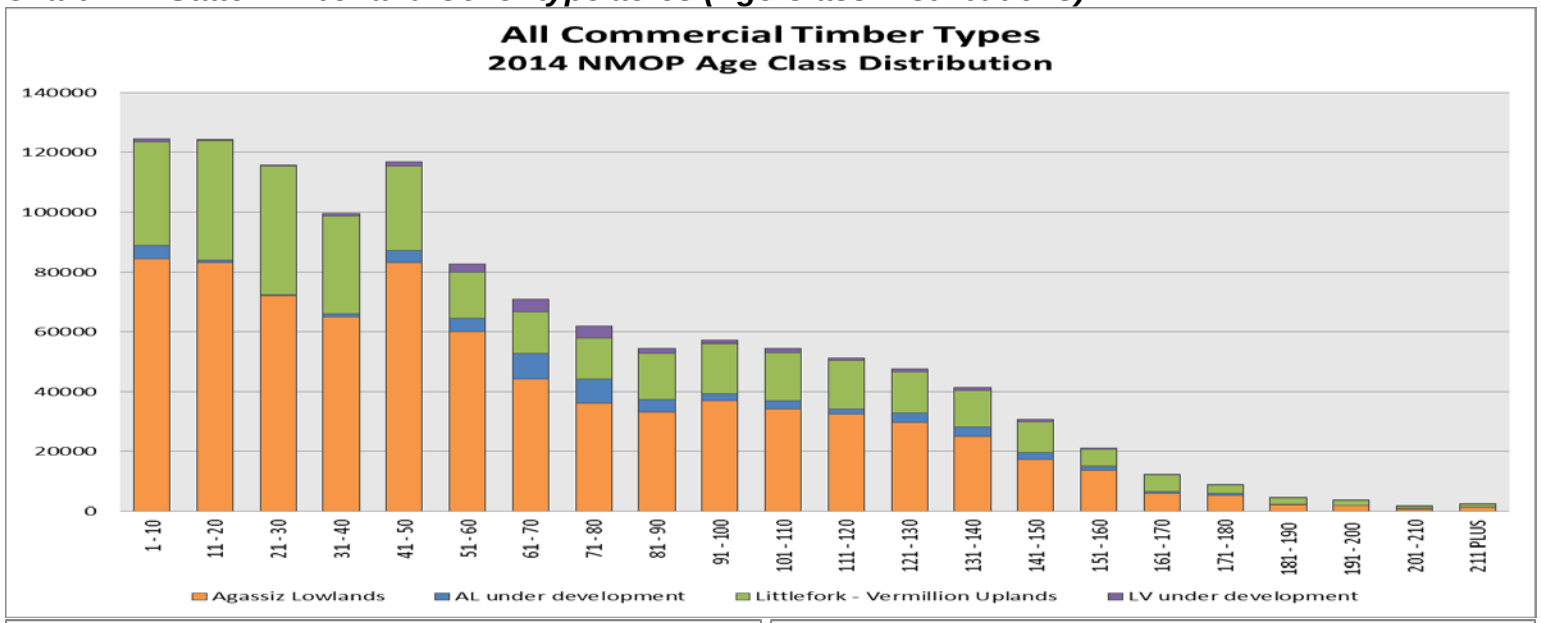
All Timber Cover Types	1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80	81 – 90	91 – 100	101 – 110	111 – 120	121 – 130	131 – 140	141 – 150	151 – 160	161 – 170	171 – 180	181 – 190	191 – 200	201 – 210	211+	Total
Total	124578	124229	115975	99570	116927	82856	70807	61935	54637	57272	54596	51293	47620	41530	30603	21183	12178	8717	4379	3517	1607	2340	1,188,350
Agassiz Lowlands	89005	83812	72488	65928	87286	64371	52763	44156	37241	39238	36860	34317	32886	28282	19537	14948	6666	5866	2156	1841	786	1378	821,810
LFV	35573	40417	43487	33642	29641	18485	18044	17780	17396	18033	17737	16976	14734	13248	11066	6235	5512	2851	2223	1676	821	963	366,539

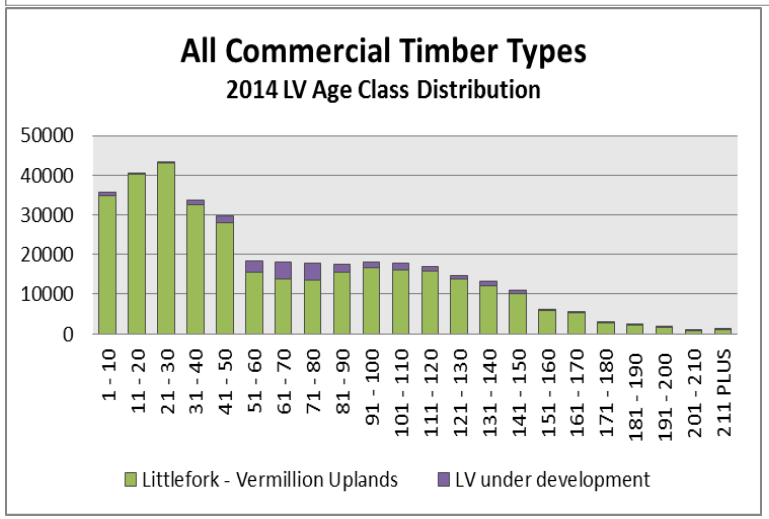
This table includes all DNR administrations (Forestry, Wildlife, and Parks) and all timber status types for the NMOP section working boundary. The numbers are based on the January 13th, 2014 inventory export from FIM (Prelim1_NMOP_FIM). Acres were calculated in the table on geometry and exported using 'cross-tab report' sorted on species, subsection, and development status.

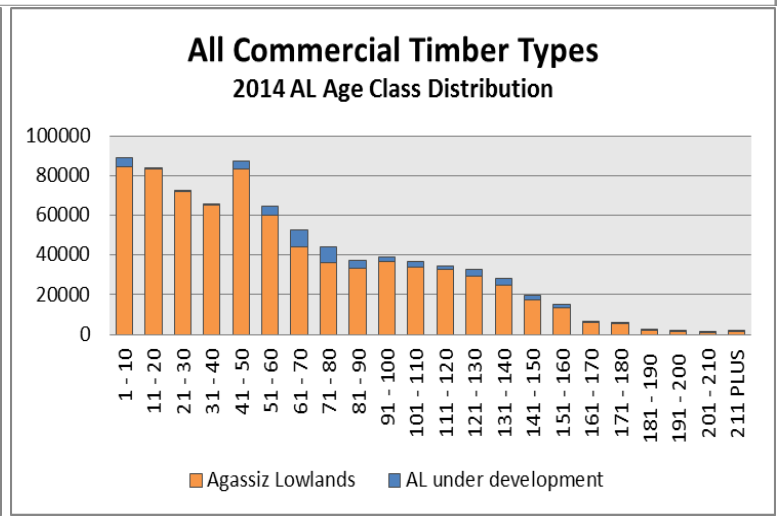
4.2 State Timberland Cover Type Acres

These charts show the acreage of all State timber cover types in the two subsections

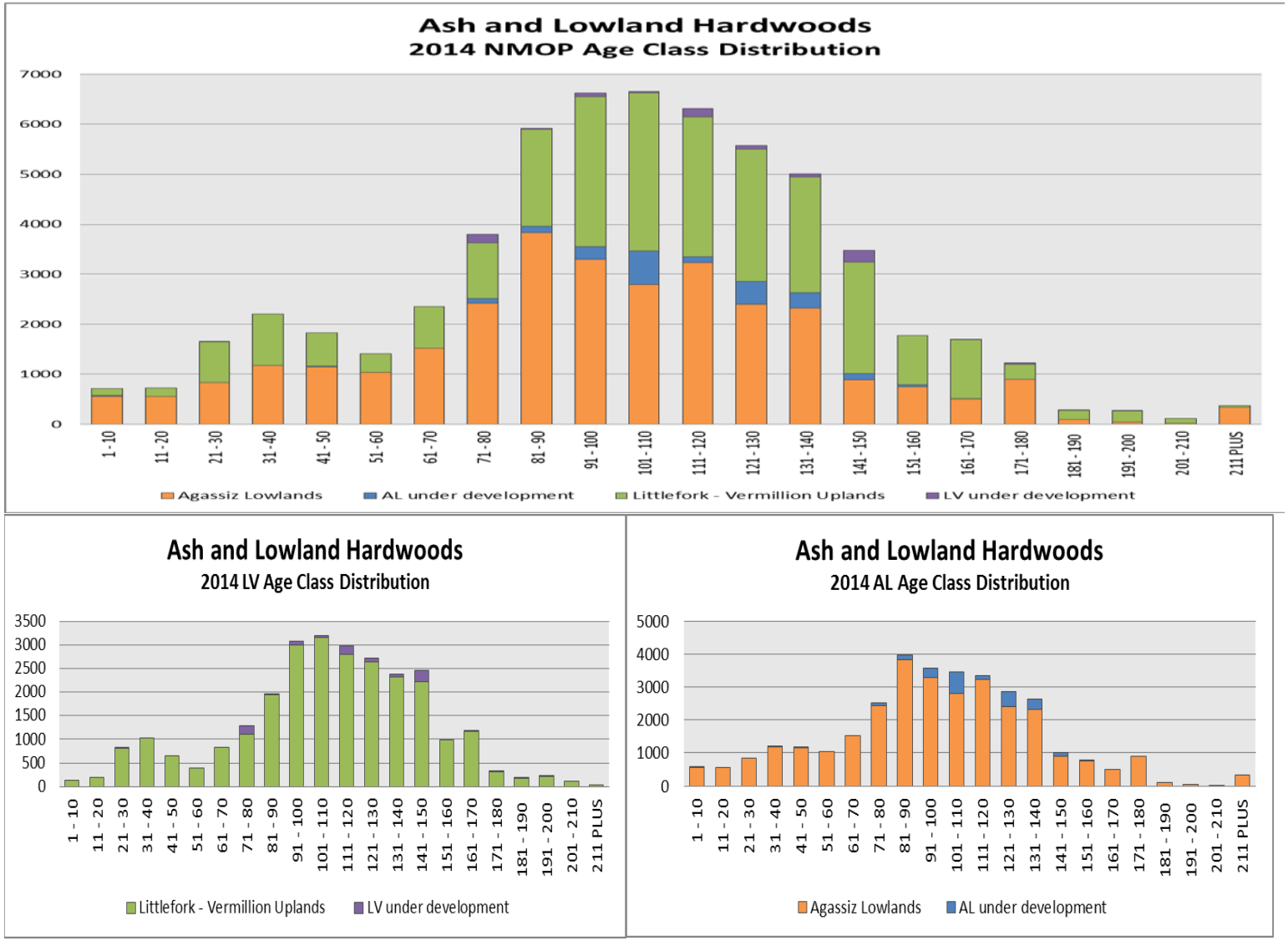
Chart 4.21 State Timberland Cover type acres (Age Class Distributions)





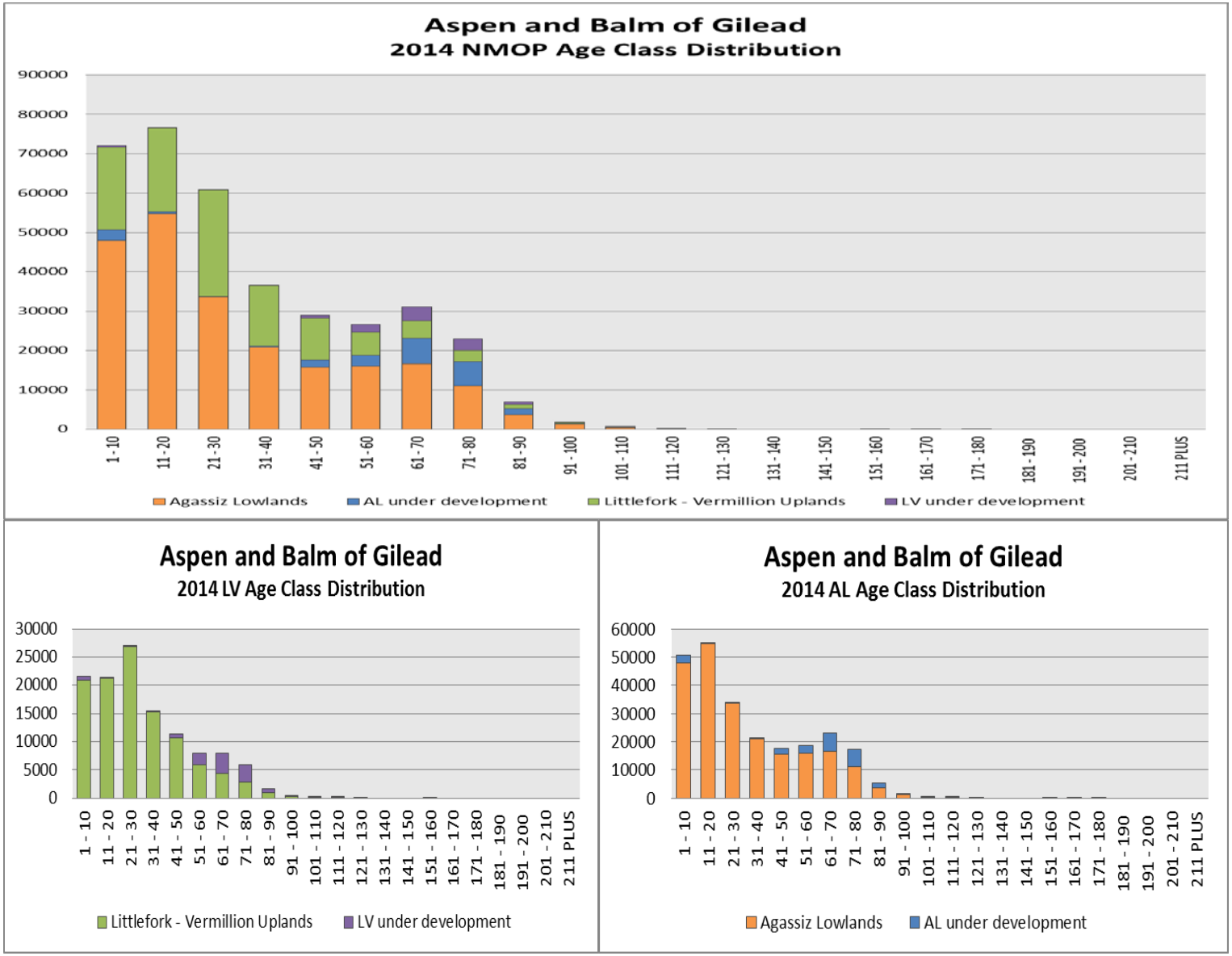


Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)



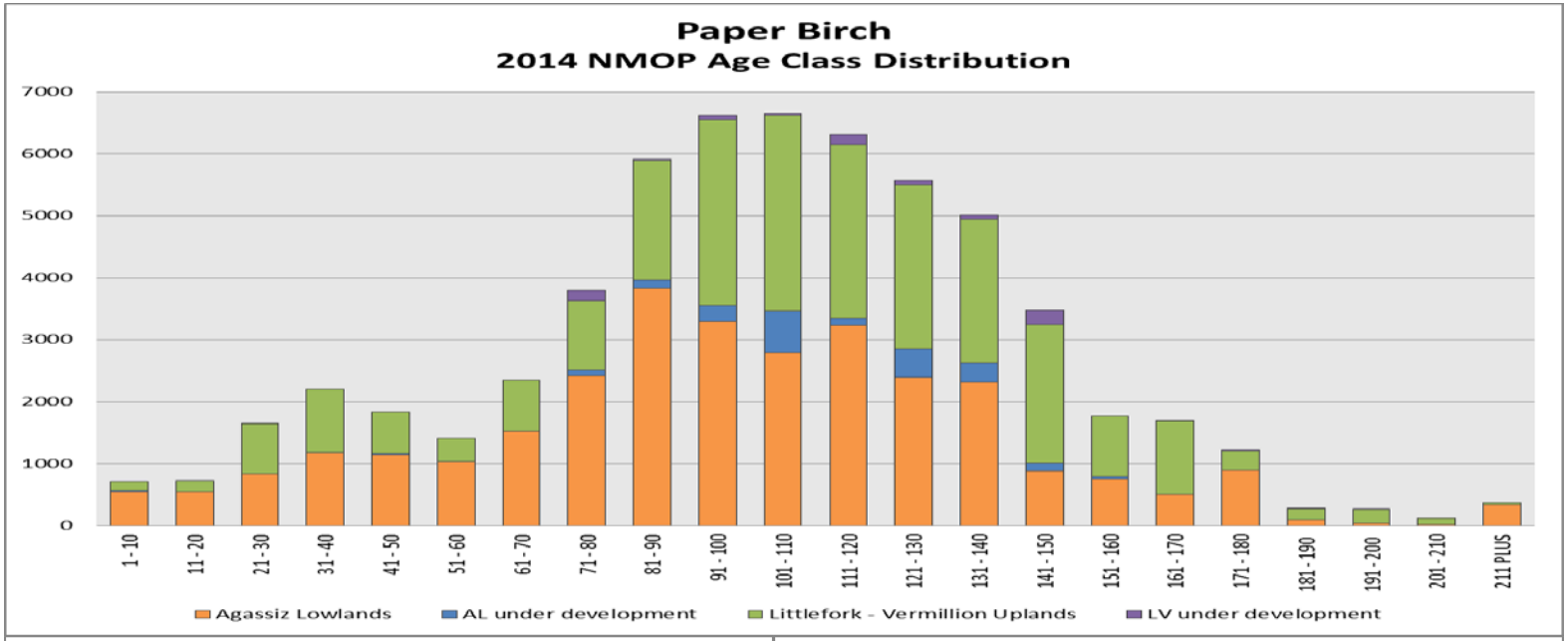
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

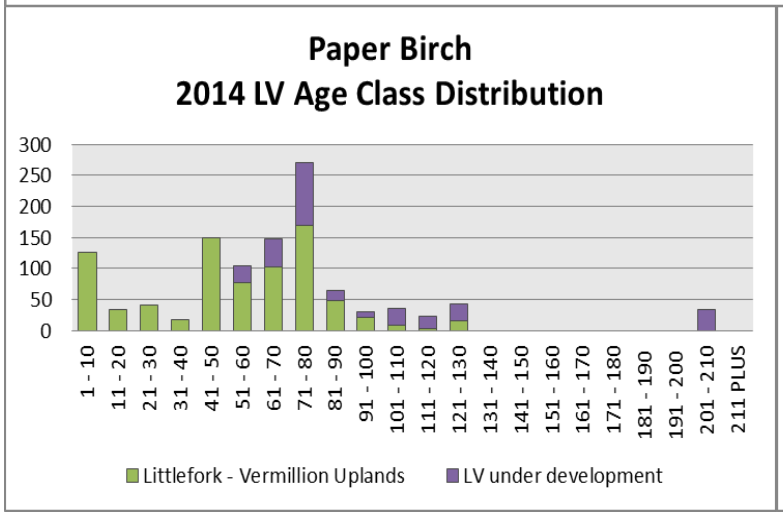
In 2014, the ash/lowland hardwood cover type amounted to 5.1 percent (60,054 acres) of the state-administered lands in the two subsections.

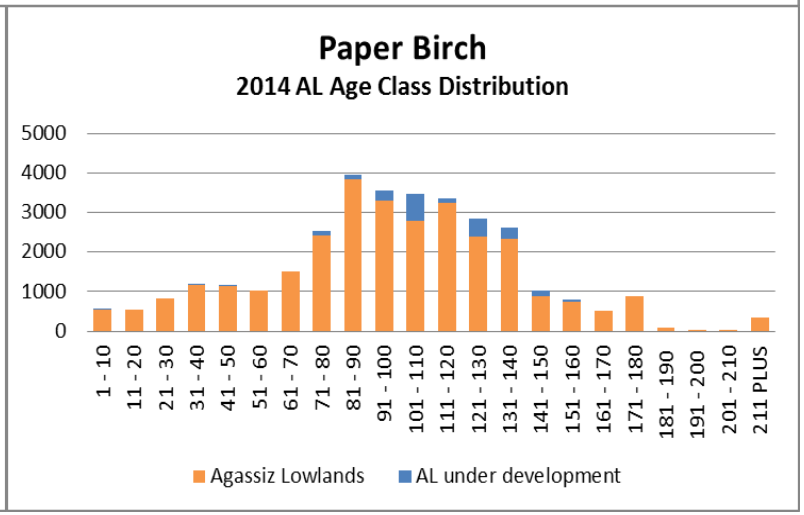


Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the aspen and Balm of Gilead cover types occupied 30.8 percent (365,721 acres) of state-administered lands in the two subsections.

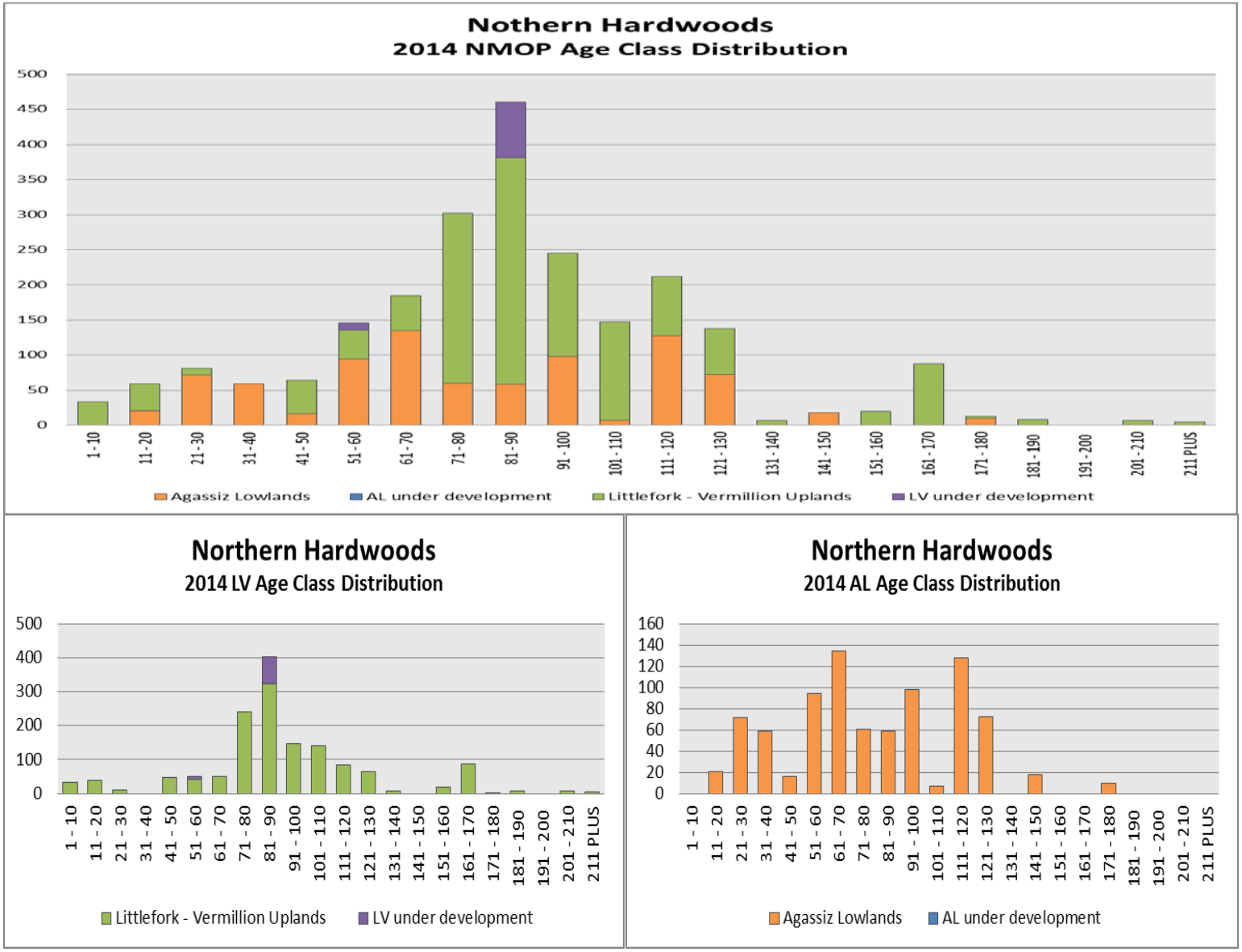






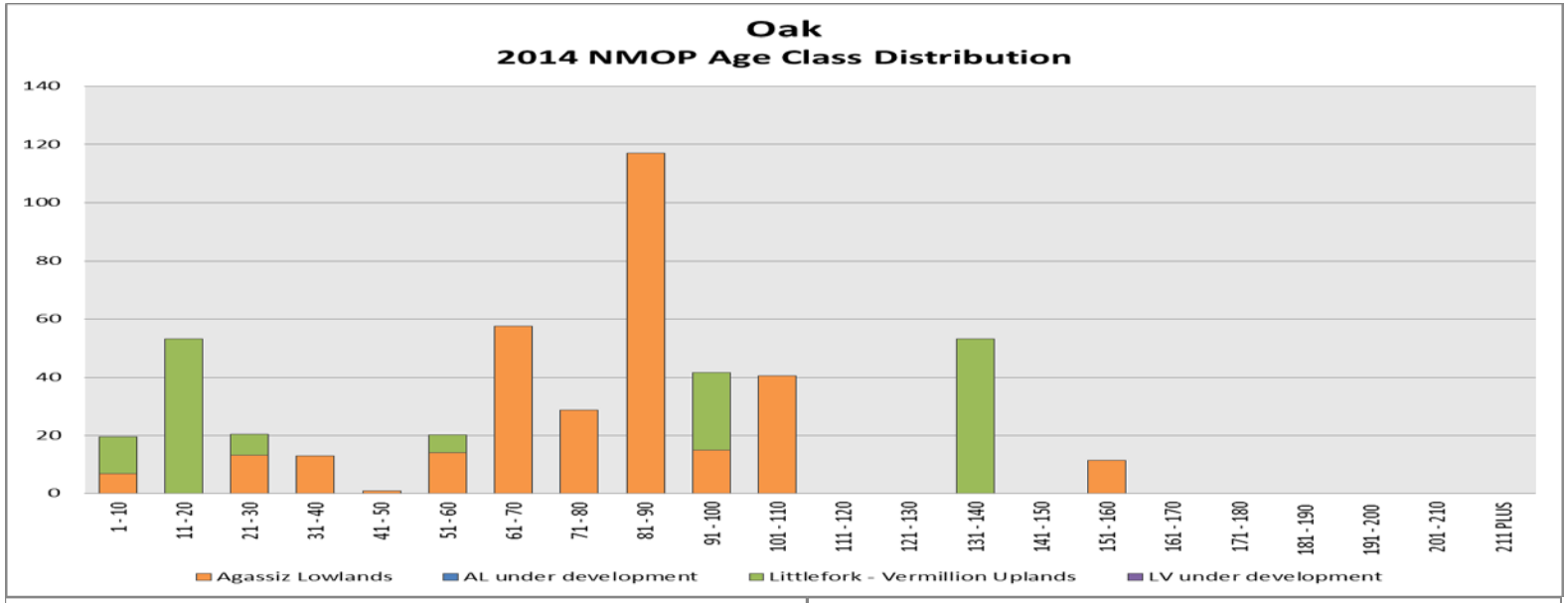
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

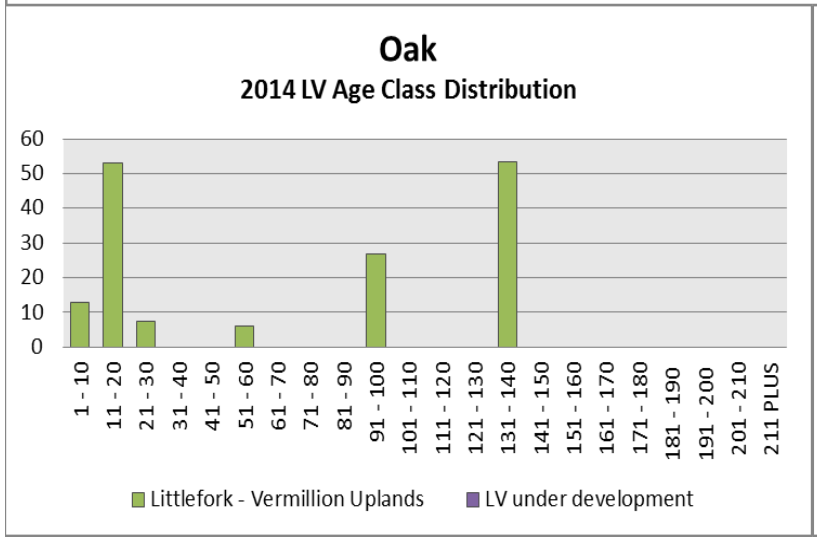
In 2014, the birch cover type occupied 0.50 percent (6,197 acres) of state- administered lands in the two subsections.

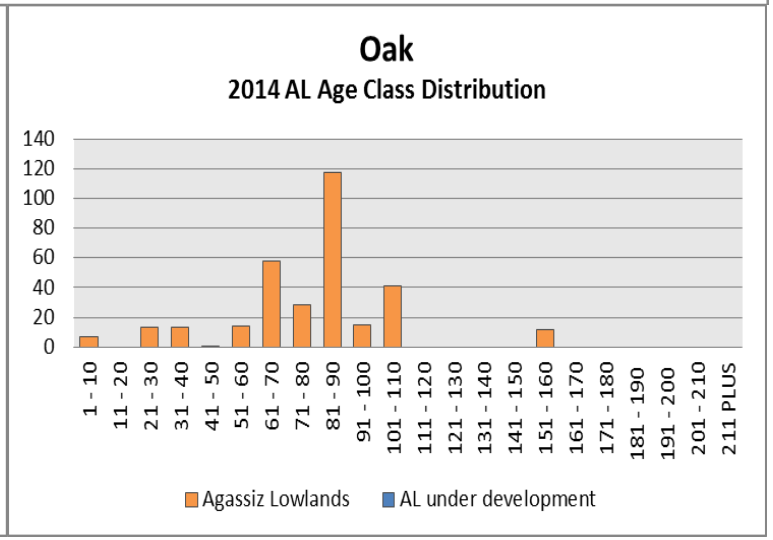


Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the northern hardwoods cover type occupied 0.2 percent (2,296 acres) of state- administered lands in the two subsections.

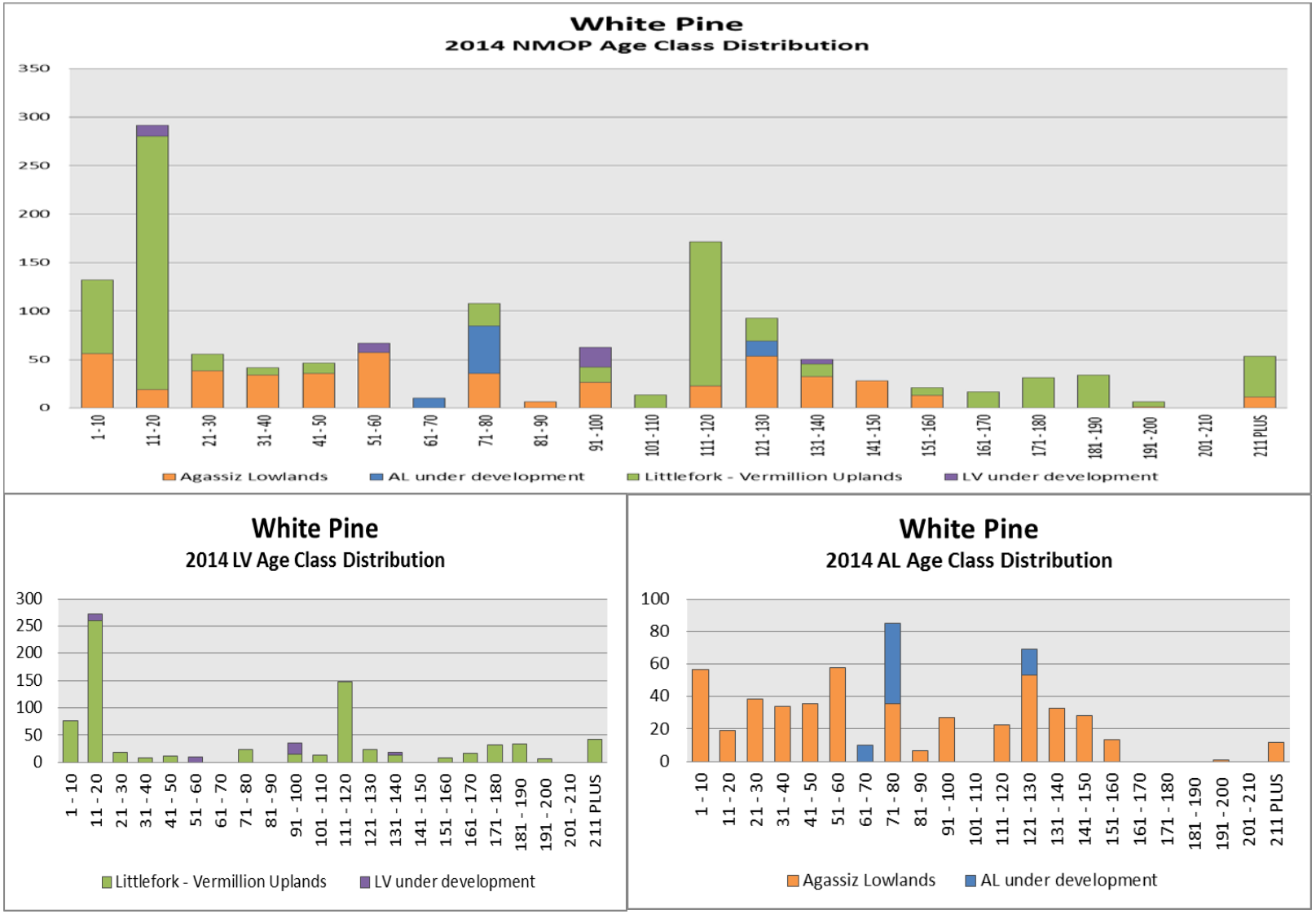






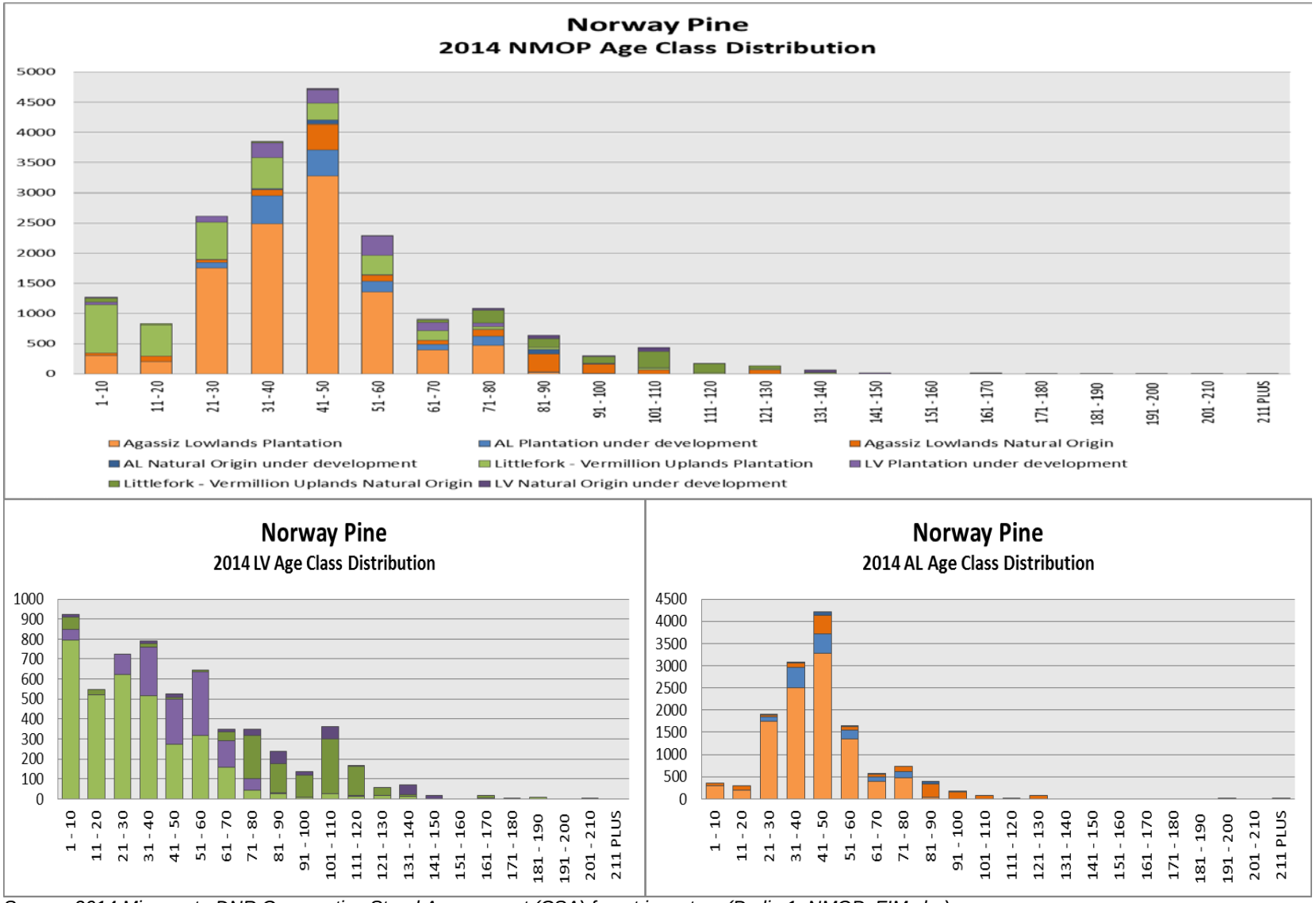
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) orest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the oak cover type occupied 0.04 percent (478 acres) of state-administered lands in the two subsections



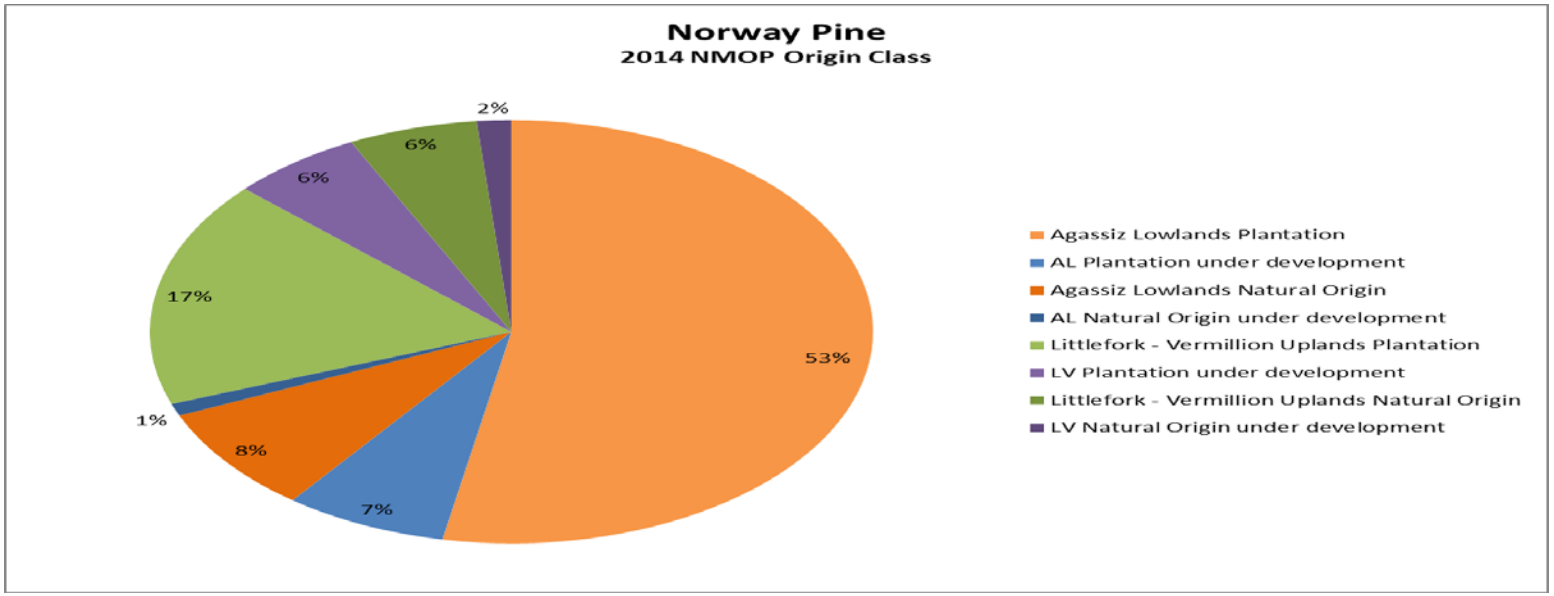
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

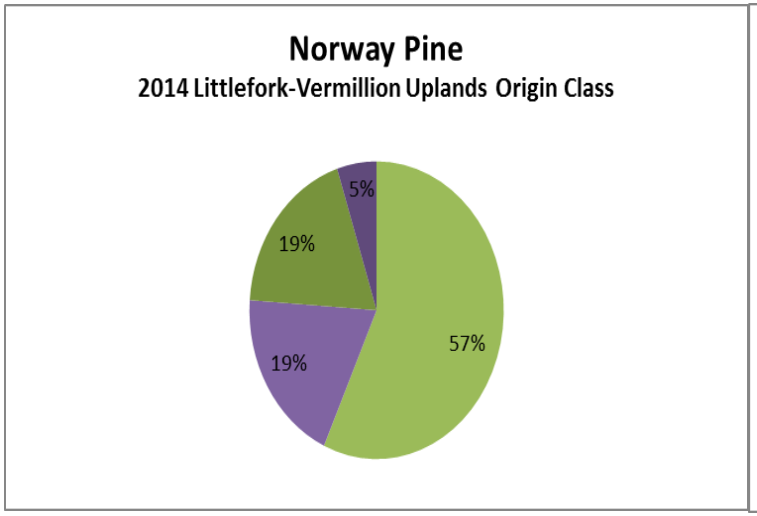
In 2014, the white pine cover type occupied 0.1 percent (1,344 acres) of state-administered lands in the two subsections.

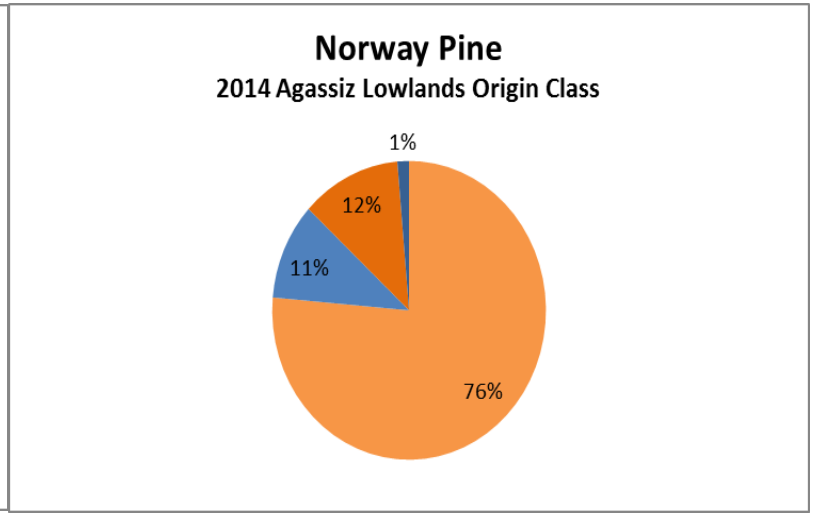


Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the red pine cover type was classified in inventory as 17% natural origin and 83% other on state-administered lands in the two subsections.

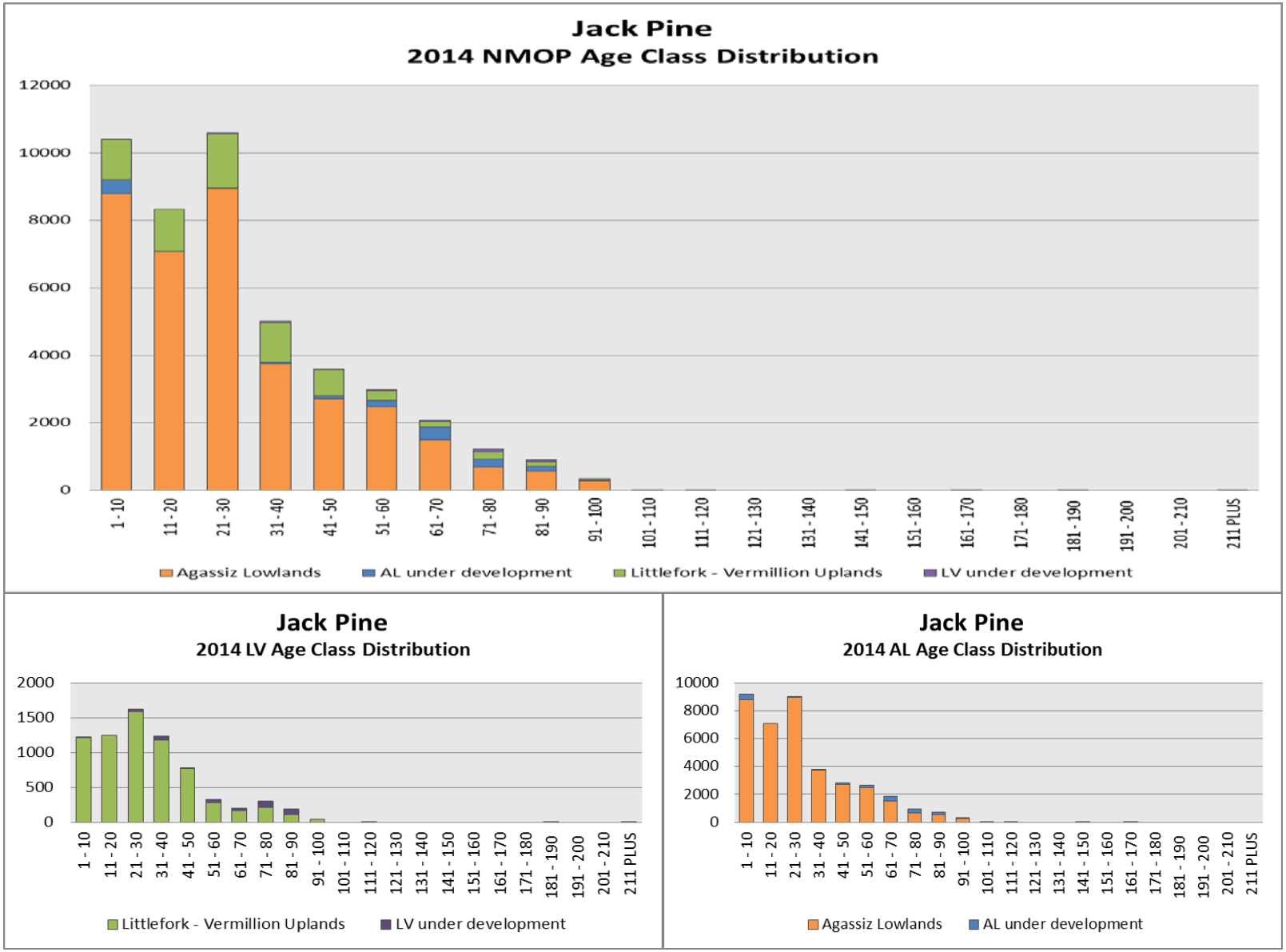






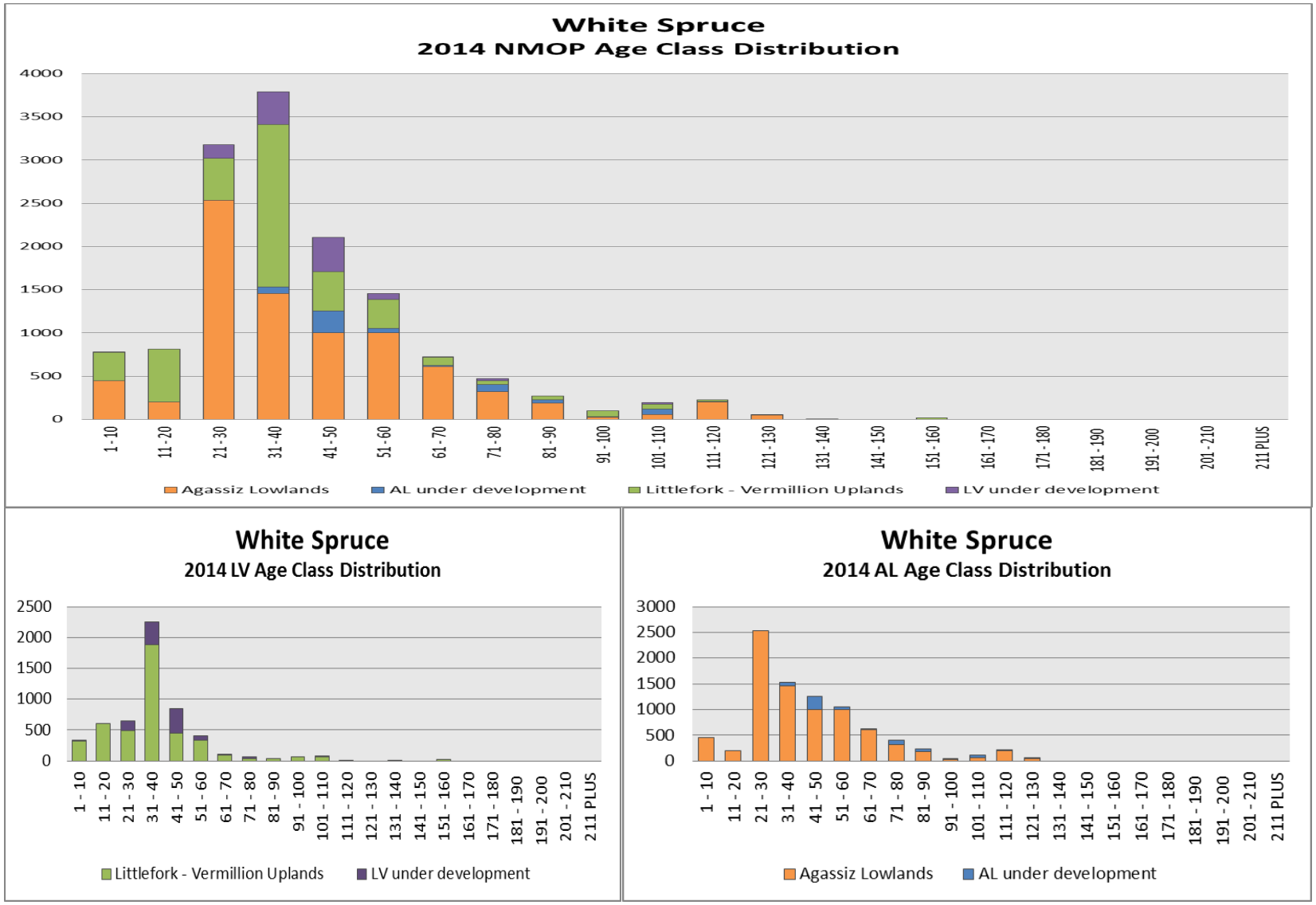
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the red pine cover type was classified in inventory as 17% natural origin and 83% other on state-administered lands in the two subsections.



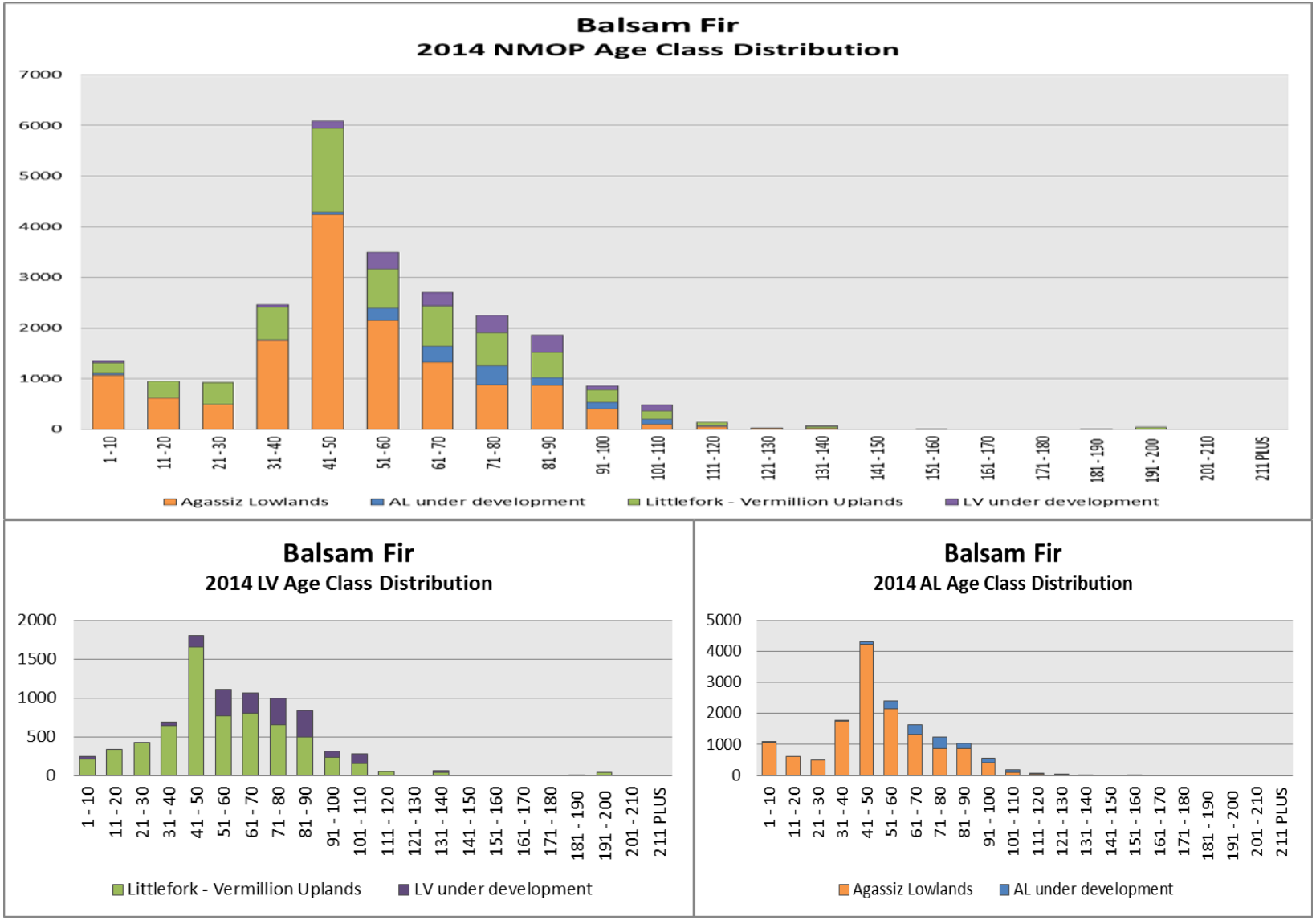
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the jack pine cover type occupied 3.8 percent (45,529 acres) of state-administered lands in the two subsections.



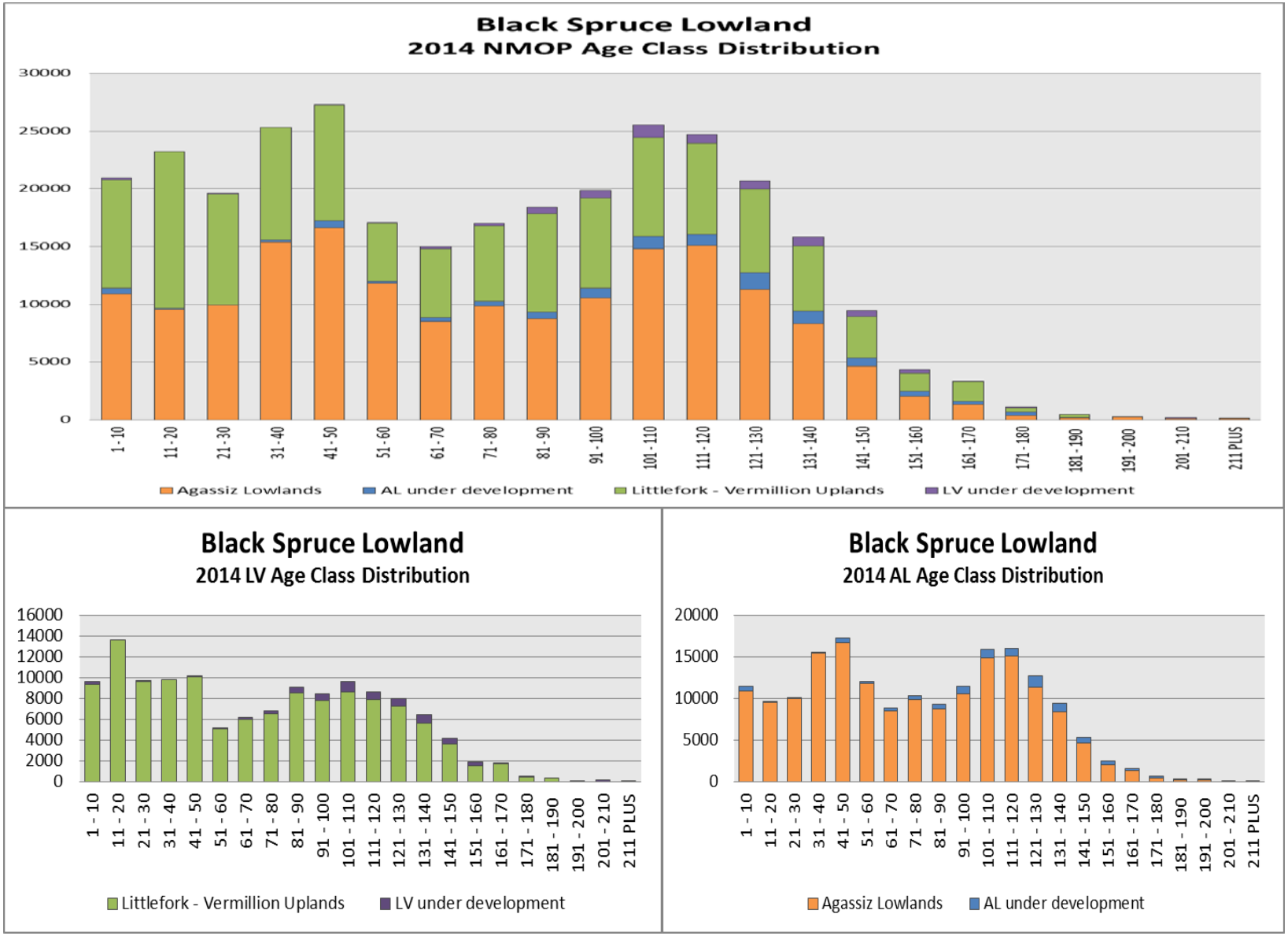
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the white spruce cover type occupied 1.2 percent (14,204 acres) of state- administered lands in the two subsections.



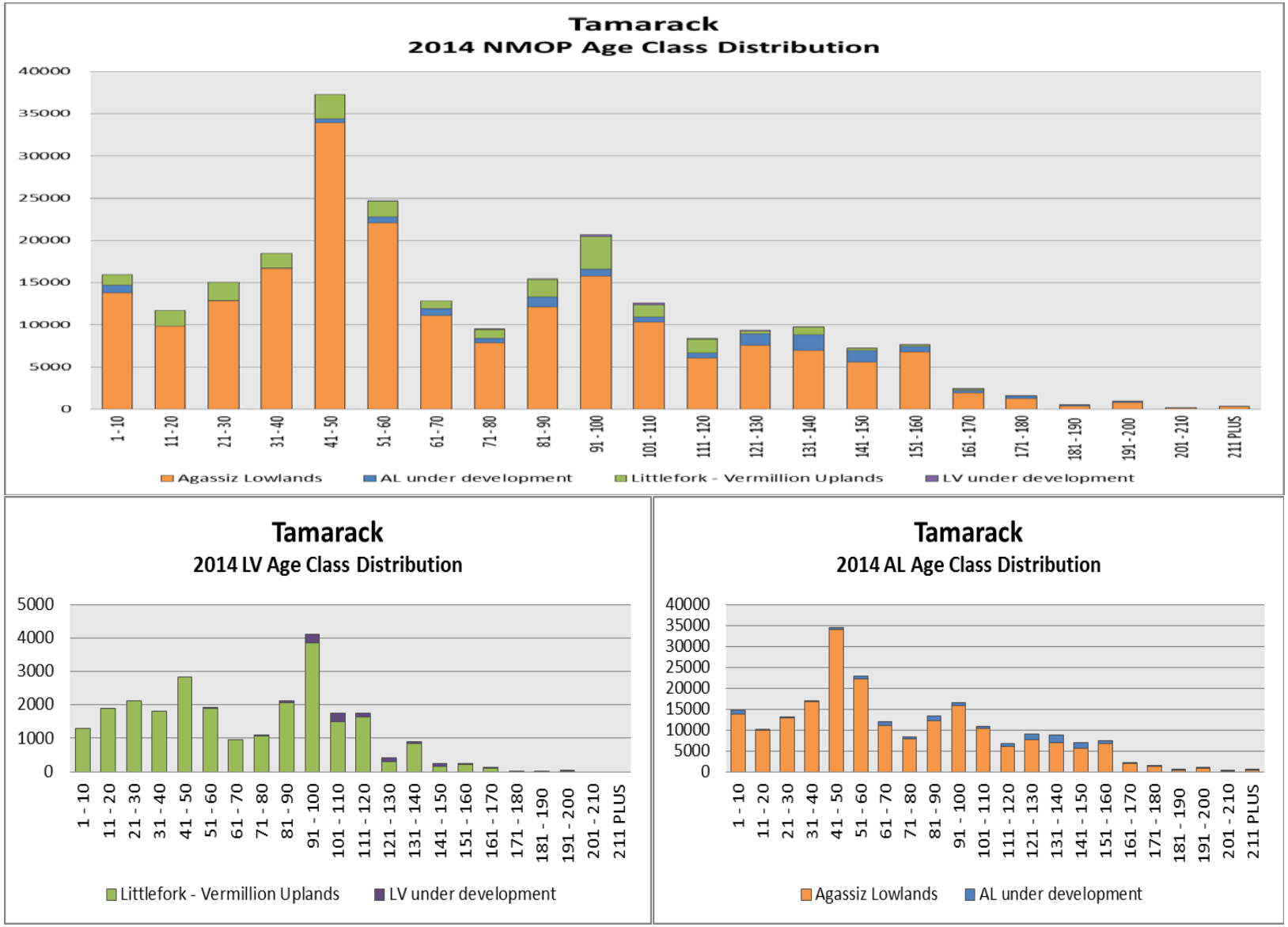
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest ventory (Prelim1_NMOP_FIM.shp)

In 2014, the balsam fir cover type occupied 2.0 percent (23,754 acres) of state-administered lands in the two subsections



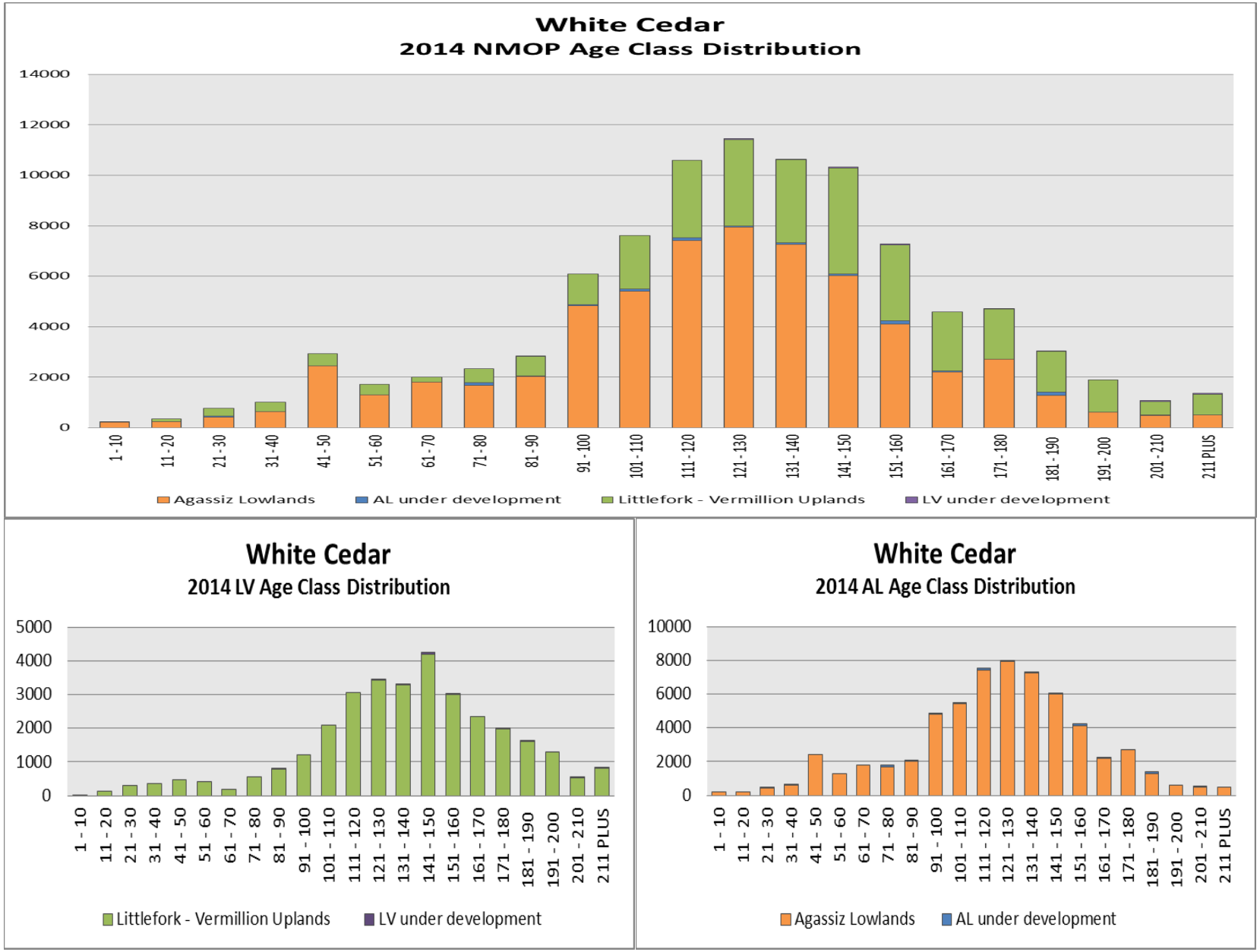
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the black spruce, lowland cover type occupied 26.1 percent (309,891 acres) of state-administered lands in the two subsections.



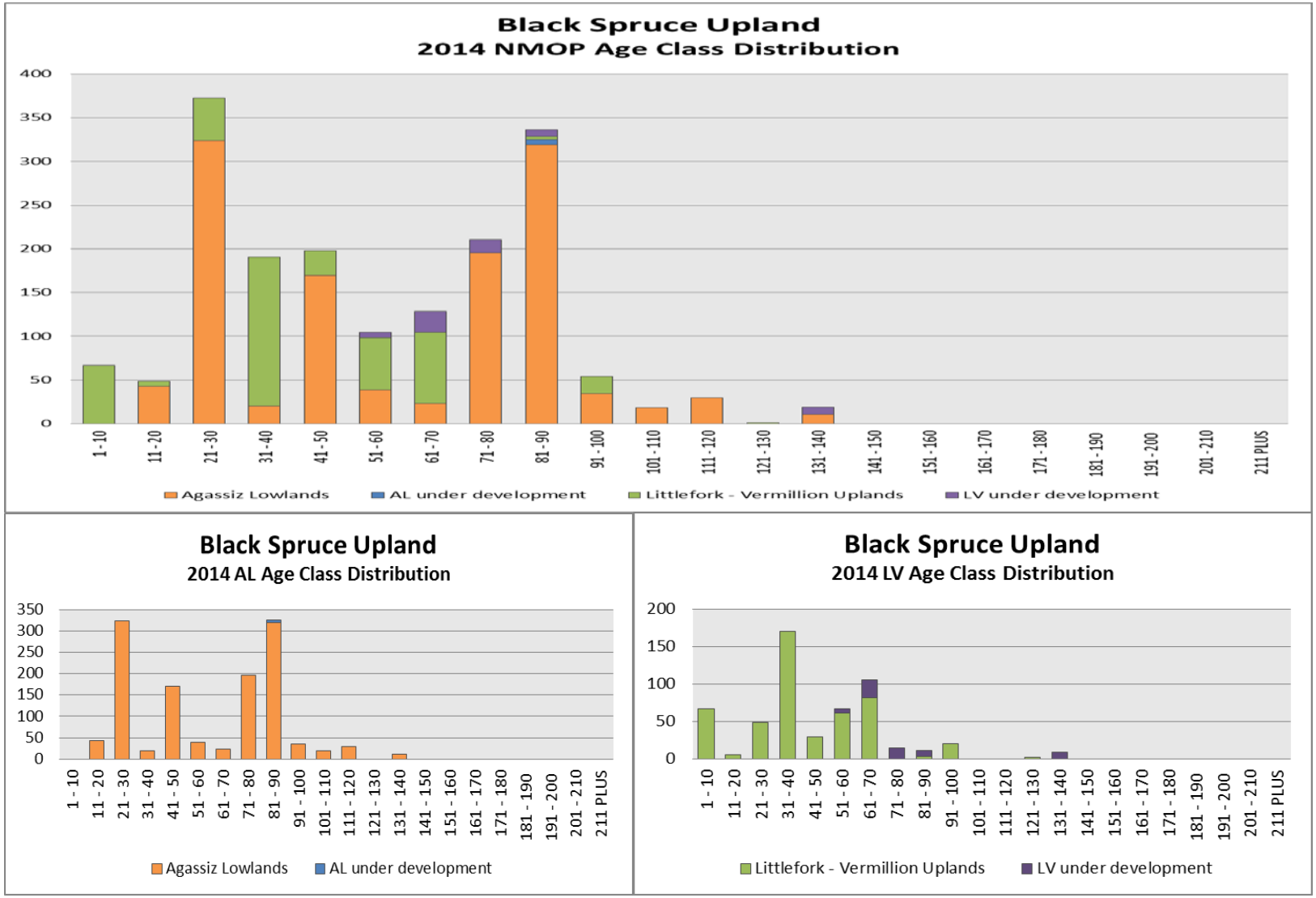
Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the tamarack cover type occupied 20.4 percent (242,804 acres) of state-administered lands in the two subsections. At this time, many acres of tamarack have been affected by the eastern larch beetle. The acreage of dead tamarack is not currently quantified in the inventory.



Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the northern white cedar cover type occupied 8.0 percent (94,905 acres) of state- administered lands in the two subsections.



Source: 2014 Minnesota DNR Cooperative Stand Assessment (CSA) forest inventory (Prelim1_NMOP_FIM.shp)

In 2014, the black spruce, upland cover type occupied 0.1 percent (1,779 acres) of state- administered lands in the two subsections.

4.3 Old Growth Forests

The DNR's old-growth management goal is to identify and protect the highest quality remaining natural old-growth forest communities on state-administered lands. Old-growth forest stands are defined by age, structural characteristics, and relative lack of human disturbance. These forests are essentially free from catastrophic disturbances and contain old trees (generally more than 120 years old), large snags, and downed trees.

Old-growth forest represents the latter stages of succession in forested ecosystems. Remaining old-growth forests are important for their scientific and educational values, as well as their aesthetic and spiritual appeal. Old-growth forests provide special habitats for native plants, important habitat features for wildlife, and examples of the maximum limits of individual tree and stand production. Because old-growth ecosystems developed for a long time without large-scale disturbance, the study of plants, animals, soils, and ecosystem processes in old-growth stands provides important insights into the natural function of forest ecosystems. Such insights can be crucial for future forest management and for maintenance of biological diversity.

Old-growth designations are based on the 1994 DNR Old-Growth Guidelines. Designation of old-growth stands in the North-4 Subsections was completed in 2000. Some of the subsection boundaries have changed since the 1994 goals were set due to revisions made in 1999. **The goals and designated acres provided in this assessment are based on the 1994 subsection boundaries.**

In some cases the 1994 old-growth goals for certain forest communities were not met because an adequate number of stands meeting old-growth criteria simply did not exist in the subsection. In other cases more high quality old growth was found than originally expected, so the designated acreage exceeded the target.

The 1994 goals for acreage and number of sites may be adjusted in the future. If new information becomes available on the extent, quality, and distribution of potential old-growth stands meeting prescribed selection criteria, the goals may be adjusted. If individual stands that appear to meet requirements are discovered on state land during the SFRMP process or in subsequent years, they may be evaluated and given official old-growth status if they qualify.

Lowland Conifer Old Growth

The Department is finalizing a process to identify lowland conifer old growth stands. It is anticipated that this process will be completed to the point that lowland conifer old growth stands will be identified by December of 2014. The draft process would include productive black spruce, tamarack, and white cedar stands over 90 years of age and nonproductive black spruce, tamarack, and white cedar of any age. Stands that were withdrawn from the harvest pool as ecologically important lowland conifers during the previous SFRMP plan will be added back once lowland conifer old growth stands are identified.

The following tables provide information on the 1994 goals and the designated acres in the subsections covered in this plan.

Table 4.2.1 identifies designated old growth and total acres designated by forest type.

Table 4.3.1 Designated Old Growth by Agassiz Lowlands and Littlefork-Vermilion Uplands

Agassiz Lowlands			Littlefork-Vermilion Uplands		
Forest Type	Old-Growth 1994 Acreage Goal	Old-Growth Acres 2014	Forest Type	Old-Growth 1994 Acreage Goal	Old-Growth Acres Designated / FOG
Black Ash	425	967	Black Ash	125	490
Lowland Hardwoods	1230	1006	Lowland Hardwoods	425	606
Northern Hardwoods	55	0	Northern Hardwoods	0	0
Oak	40	14	Oak	0	53
Red Pine	360	492	Red Pine	615	211
White Pine	230	195	White Pine	375	225
White Spruce	130	156	White Spruce	70	55
White Cedar (upland)	335	631	White Cedar (upland)	375	505
Total	2805	3461	Total	1985	2145

Source: drs\data\org\us_mn_state_dnr\biota_dnr_old_growth_forest\biota_dnr_old_growth_forest.gdb on 01/28/2014

Chart 4.3.1 Agassiz Lowlands Old Growth Acres

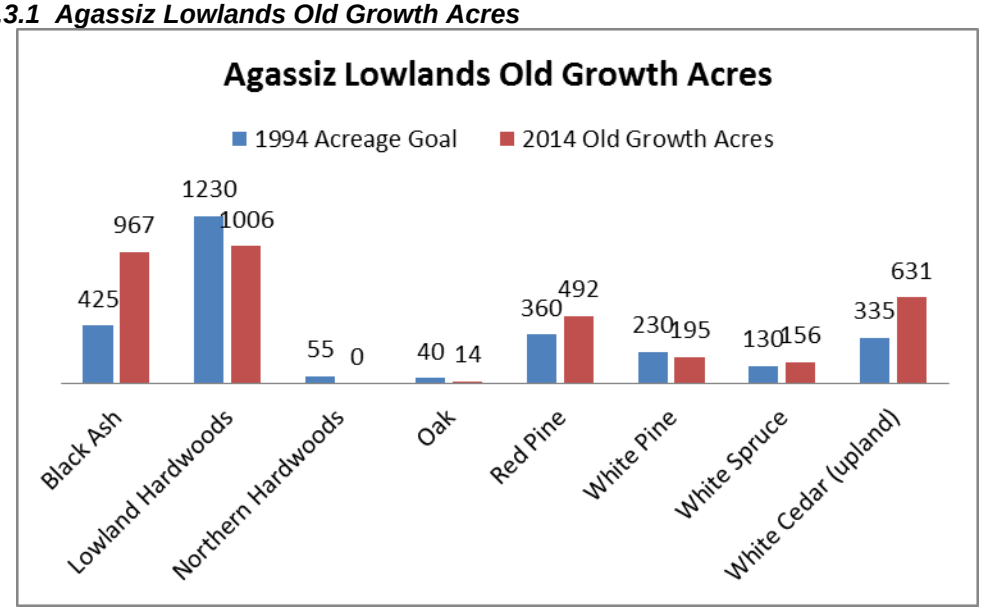
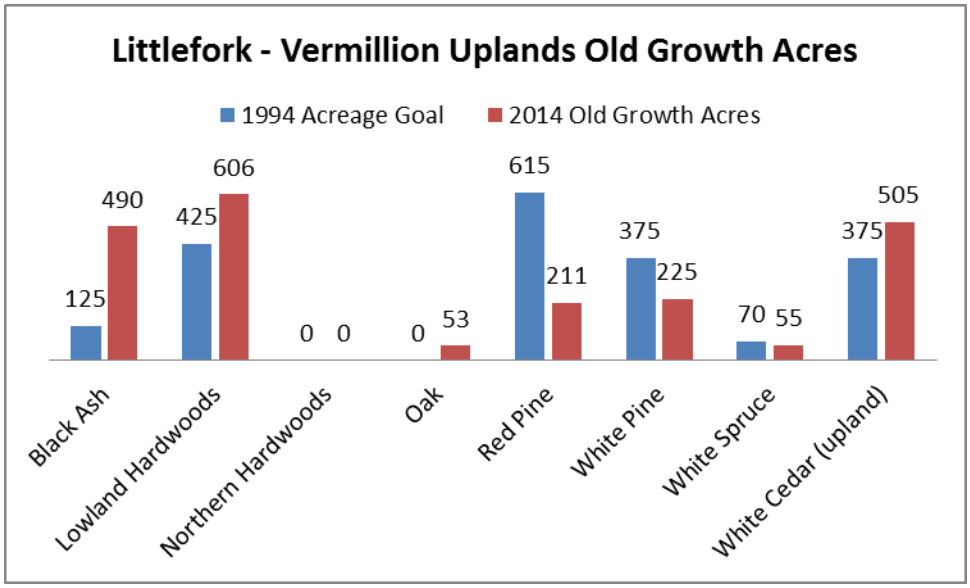


Chart 4.3.2 Littlefork Vermilion Old Growth Acres



4.4 Historical Forest Composition Compared to Today's Forest- An Estimate

Table 4.4.1 shows the relative abundance of public land survey (PLS) bearing tree (BT) species marked as witness trees in the mid-1800s compared to 1990 Forest Inventory and Analysis (FIA) tree species for extant forests in the section. Extant forests in this context are defined as areas that were initially forest at the time of the original public land survey and still were forest in the early 1990s. It provides an estimate of the abundance of certain kinds of tree species before the land was logged and settled, compared to today's forest. Magnitude of change was calculated by comparing FIA data to original bearing trees. For example, a -2.0 in this column represents a 2-fold decline of that tree species since the original public land survey was conducted, while 4.5 would represent a 4.5-fold increase.

Relative abundance of BT trees is the percent by tree species identified as BTs in the original land survey records in the subsection. Any general BT trees were apportioned based on known species proportions within the subsection then assigned to a specific species. FIA data were modified to mimic the establishment of a survey corner by recording only one tree in each quadrant of the FIA sampling point similar to the selection of BT trees in the past. The relative abundance of FIA tree species is based on this estimate. Relative abundance data have been produced at subsection and the LTA (land type association) levels. This assessment includes only the subsection data. The LTA level data can provide land managers more detailed information on where in the larger subsection the composition changes are greater. LTA data can be used to assist in determining where it would be appropriate to attempt restoration of a species, if that is desired, within a subsection.

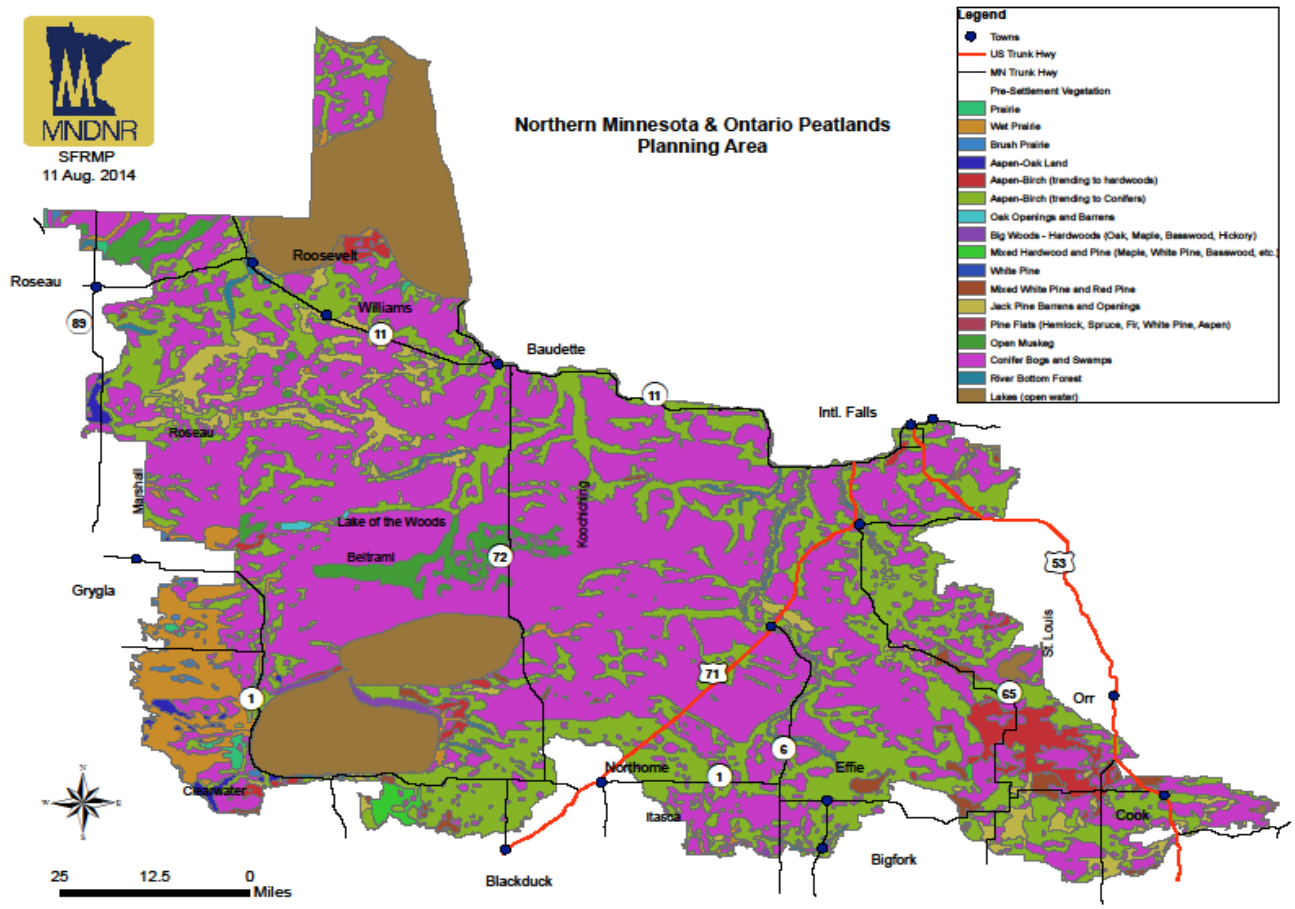
Subsection-level data for the NMOP Section should be interpreted with the understanding the data applies only to extant forests. Based on the available data, for the Agassiz Lowlands subsection, important species showing a significant increase were balm of Gilead, bur oak, red oak, and sugar maple. Decreases are seen in tamarack and white spruce. For the Littlefork-Vermilion Uplands increases are shown in bur oak, red maple, red oak, and sugar maple. Decreases are seen in cottonwood/willow, tamarack, white pine and white spruce. Some of these cover type changes may be explained by identification interpretations of the surveyors. It is also important to note that although individual tree compositions may not change dramatically, the community types (based on co-dominate species) may have changed much more drastically, as Friedman and Reich (2005)

found for northeastern Minnesota. *Note: Where a species is rare in the BT data, the data may not be as reliable.*

Table 4.4.1 Bearing Tree FIA Subsection Summaries: Agassiz Lowlands and Littlefork-Vermilion Uplands

	Agassiz Lowlands			Littlefork-Vermilion Uplands		
Species	**BT**	**FIA**	**Magnitude of Change**	**BT**	**FIA**	**Magnitude of Change**
Ash	1.2	4.6	3.9	2.1	7.4	3.6
Aspen	9.2	23.4	2.6	14.4	28.0	1.9
Balsam Fir	2.0	5.9	2.9	8.8	14.1	1.6
Balm of Gilead	0.7	9.3	12.6	1.5	8.2	5.5
Basswood	0.1	0.5	6.1	0.3	0.9	3.0
Black Spruce	13.4	15.9	1.2	16.4	13.9	-1.2
Box Elder	0.0	0.1	3.9	0.0	0.2	4.7
Bur Oak	0.0	0.5	31.1	0.0	0.5	10.9
Cottonwood/Willow	0.4	0.0		0.5	0.0	-38.4
Elm	0.6	1.2	2.1	1.8	2.4	1.4
Jack Pine	3.1	3.5	1.1	3.7	1.7	-2.2
Paper Birch	2.6	4.4	1.7	6.9	5.2	-1.3
Red Maple	0.0	0.2		0.0	0.9	60.8
Red Oak	0.0	0.1	17.3	0.0	0.1	16.9
Red Pine	0.6	0.8	1.3	1.2	1.4	1.2
Sugar Maple	0.0	0.2	53.9	0.0	0.6	129.0
Tamarack	49.0	11.3	-4.3	20.7	2.5	-8.4
White Cedar	5.8	16.8	2.9	9.0	9.8	1.1
White Pine	0.3	0.3	1.3	2.3	0.5	-4.9
White Spruce	4.6	0.9	-4.9	8.7	1.7	-5.1
Yellow Birch	0.0	0.0		0.0	0.1	

Map 4.4.1 Presettlement Vegetation- Marshner



Color maps may be viewed as PDF files on the Northern Minnesota & Ontario Peatlands Section Forest Resource Management Plan (SFRMP) Web site at:

NMOP_Forestry_Resource_Management_Plan

CHAPTER 5

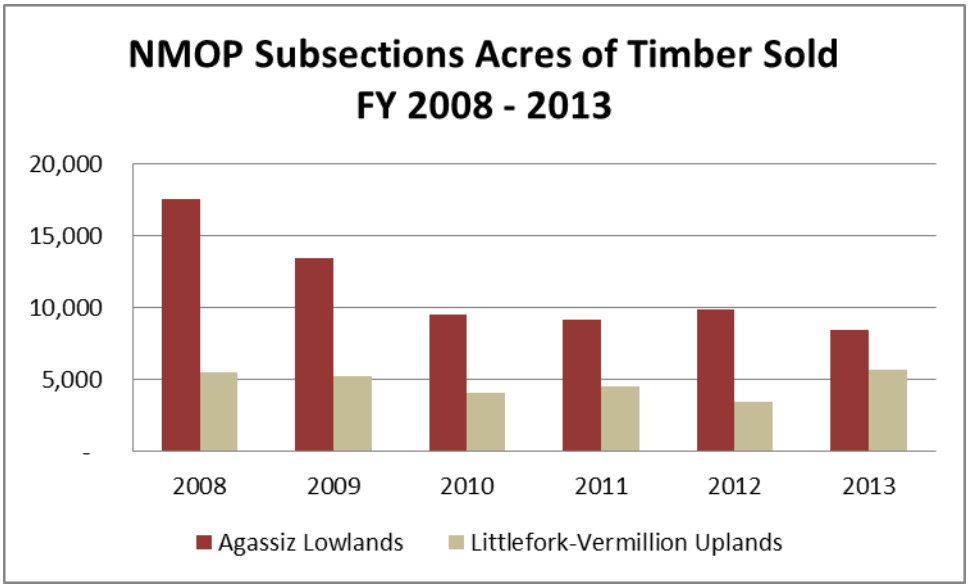
Timber Harvest

Northern Minnesota & Ontario Peatlands Section

5.1 Acres of Timber Sold on DNR Lands in the Subsections

The annual harvest on DNR lands is allocated and tracked in acres. One reason for differences in the yearly harvest level is the variation in timber markets and the resulting amount sold each fiscal year (i.e., July 1–June 30).

Chart 5.1.1 NMOP Section Acres of Timber Sold from DNR Lands



Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

An average of 16,045 acres of timber is sold from the NMOP subsections each year.

Table 5.1.1 NMOP Subsections Acres of Timber Sold from DNR Lands

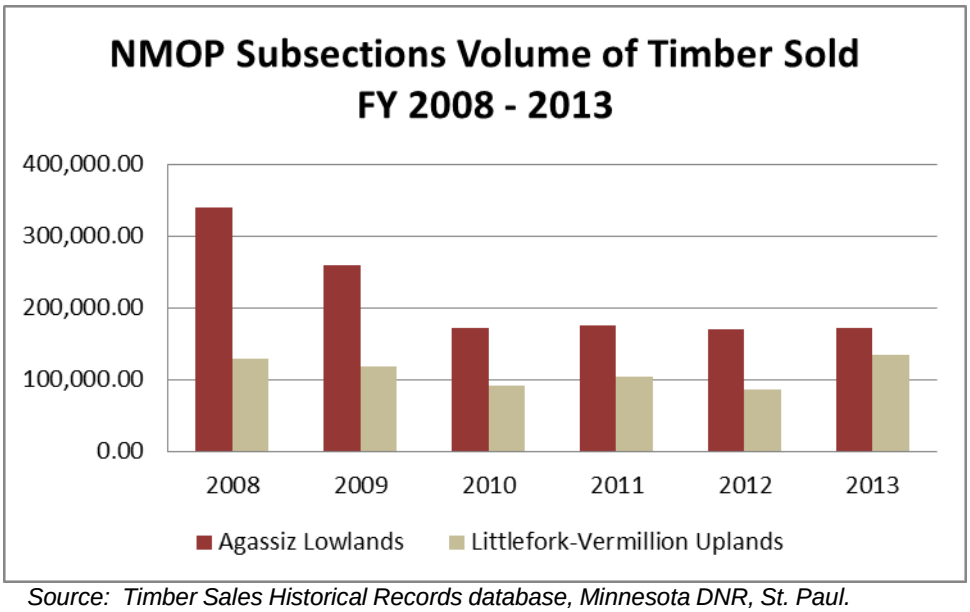
Fiscal Year	*Agassiz Lowlands*	*Littlefork-Vermillion Uplands*
2008	17,499	5,516
2009	13,441	5,195
2010	9,501	4,099
2011	9,130	4,507
2012	9,829	3,418
2013	8,465	5,667

Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

5.2 Volume of Timber Sold From DNR Lands in the Subsections

The annual harvest on DNR lands is allocated and tracked in acres. The following chart shows the total ***volume*** sold per year in cords for the four subsections.

Chart 5.2.1 Volume of Timber Sold From DNR Lands in Cords

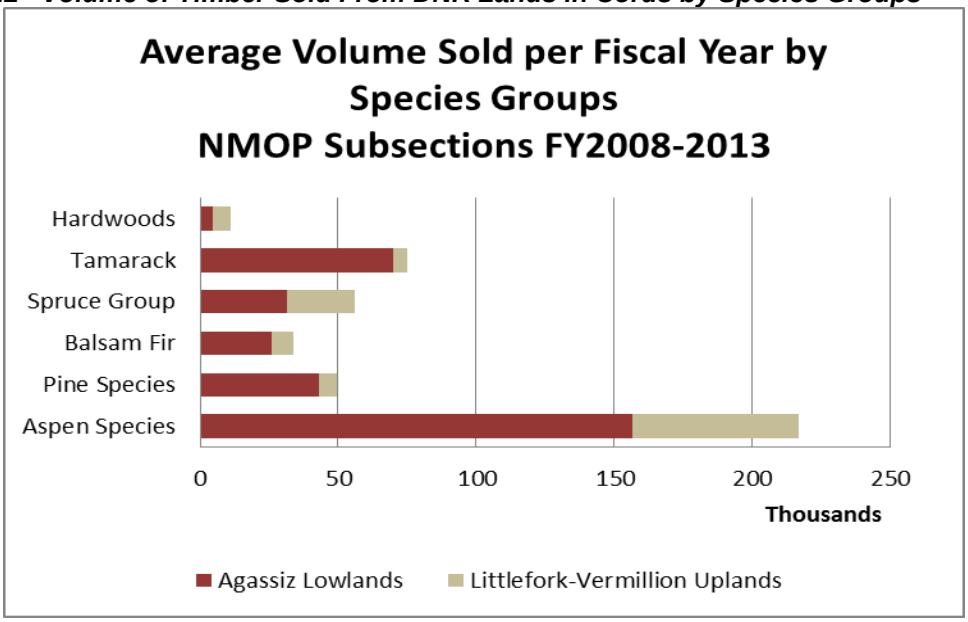


Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

An average of 326,198 cords per year were sold from DNR lands during FY 2008 – 2013 in the NMOP Subsections combined.

NMOP's contribution to wood offered annually from state lands is 38% of the total offered over the past six fiscal years.

Chart 5.2.2 Volume of Timber Sold From DNR Lands in Cords by Species Groups



Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

Hardwoods includes species sold as ash (40%), elm, red maple, sugar maple, basswood, boxelder,lowland hardwoods, northern hardwoods (41%), and mixed hardwoods (9%).

Spruce group includes species sold as black spruce (67%), white spruce (6%) and mixed spruce (27%).

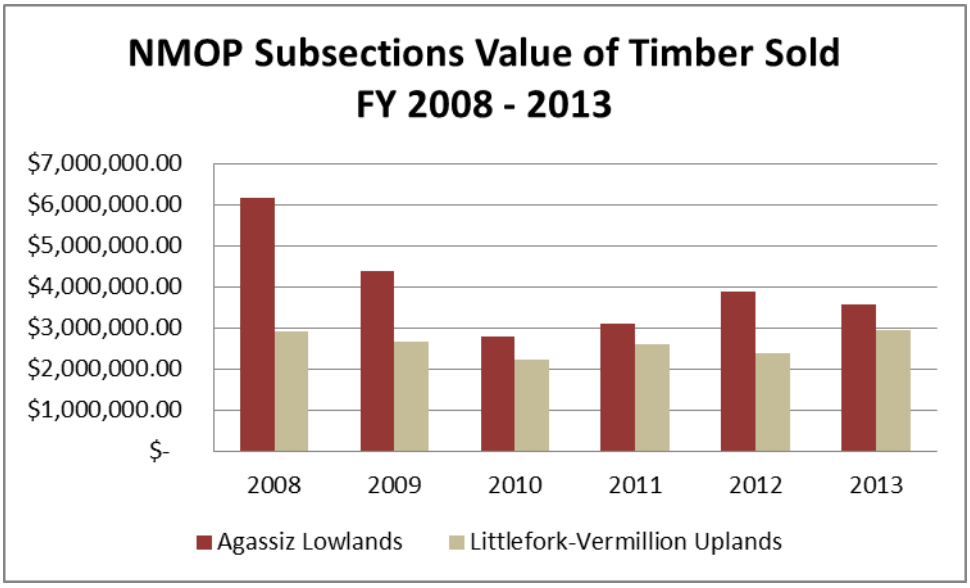
Pine species includes species sold as jack pine (71% of total), Norway pine (14%), white pine, and pine species (15%)

Aspen species includes species sold as trembling aspen (6%), Balm of Gilead (1%), largetooth aspen, paper birch (6%), and aspen species (62%).

5.3 Value of Timber Sold From DNR Lands Per Fiscal Year in the Subsections

The following chart shows the ***value*** of timber sold from DNR lands in the subsections during the past six fiscal years.

Chart 5.3.1 NMOP Subsections Value of Timber Sold from DNR Lands



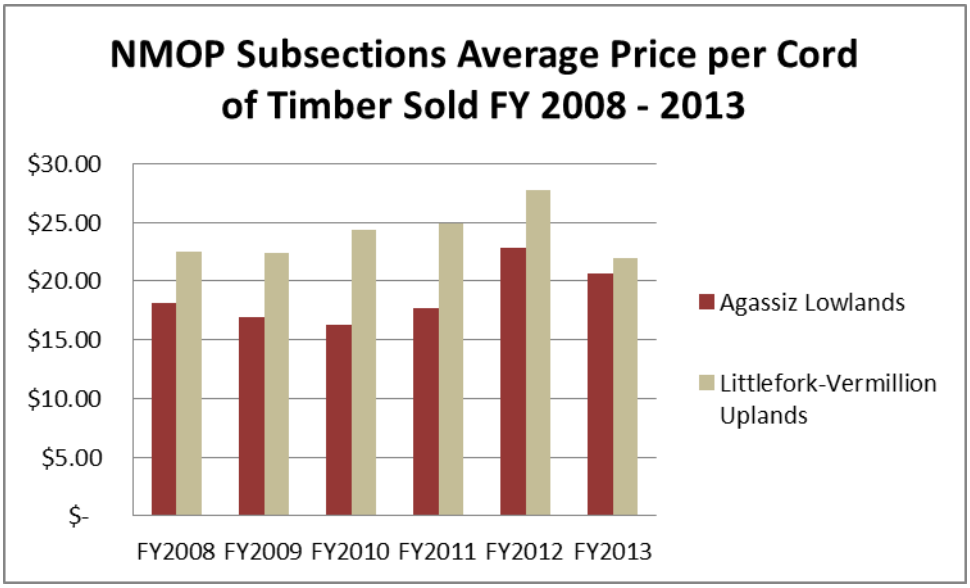
Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

An average value of $6.62 Million per year has been generated from sold timber sales in the NMOP over the last six fiscal years.

5.4 Average Price Per Cord for Timber From DNR Lands in the Subsections

The following chart shows how the stumpage value of timber sold from DNR lands in the subsections has changed from FY2008 – 2013 for all species and products converted to cords.

Chart 5.4.1 NMOP Subsections Average Price per Cord of Timber Sold from DNR Lands



Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

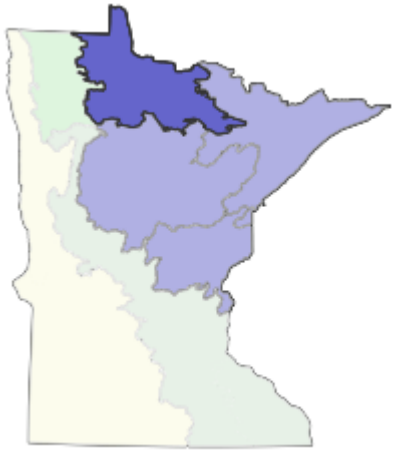
For all species and all products converted to cords, the average price per cord sold for the Agassiz Lowlands was $18.76 and for the Littlefork-Vermillion Uplands was $23.97.

CHAPTER 6

Ecological Information

Northern Minnesota & Ontario Peatlands Section

6.1 Ecological Description of the Section



The Northern Minnesota and Ontario Peatlands Section (NMOP) is flat and poorly drained. About half of the section consists of clayey deposits from Glacial Lake Agassiz. The lake deposits are covered primarily by bogs, swamps, fens, and other peatland vegetation. At the eastern edge of the NMOP, the peatlands are acidic, deep, and old (>4,000 years) and support extensive areas of acid peatland communities such as black spruce bogs and poor swamp forests. At the western edge of the section, the peatlands are richer in minerals, shallower, and younger (~1,000 years). Tamarack swamps, rich fens, and other rich peatland communities tend to be common in this part of the Section. Some areas, especially along the eastern and southern borders of the NMOP in the Littlefork Vermilion Uplands Subsection, have uplands formed of glacial till that was eroded and flattened by wave action from Glacial Lake Agassiz. Mesic and wet forests of aspen, paper birch, spruce, balsam fir, white cedar, and black ash are typical in these areas. Uplands formed of sandy shoreline deposits that mark recessional stages of Glacial Lake Agassiz are present across the NMOP. These low, sandy uplands are less extensive than either the peatlands or glacial till uplands. They are characterized by fire-dependent forests of jack pine or red pine. (Source: DNR Northern Minnesota and Ontario Peatlands Section)

Subsections are units within Sections that are defined using glacial deposition processes, surface bedrock formations, local climate, topographic relief, and the distribution of plants, especially trees. The two subsections that comprise the NMOP section are the Agassiz Lowlands Subsection (DNR Agassiz Lowland Subsection) and Littlefork-Vermillion Uplands Subsection (Littlefork - Vermilion Uplands Subsection). These subsection-specific websites provide additional ecological information which is applied during much of the land management planning within the subsections.

6.2 Land Type Associations of the NMOP Section

A Land Type Association (LTA) is an area of land with common characteristics such as glacial landform, depth to bedrock, bedrock type, topographic roughness, pre-European settlement vegetation, and surface water features (lakes, streams, and wetlands) or combinations of the above occurring in repeating

patterns. LTAs were delineated at a scale of 1:100,000. The size of map units ranges from 10,000 acres to 2,000,000 acres.

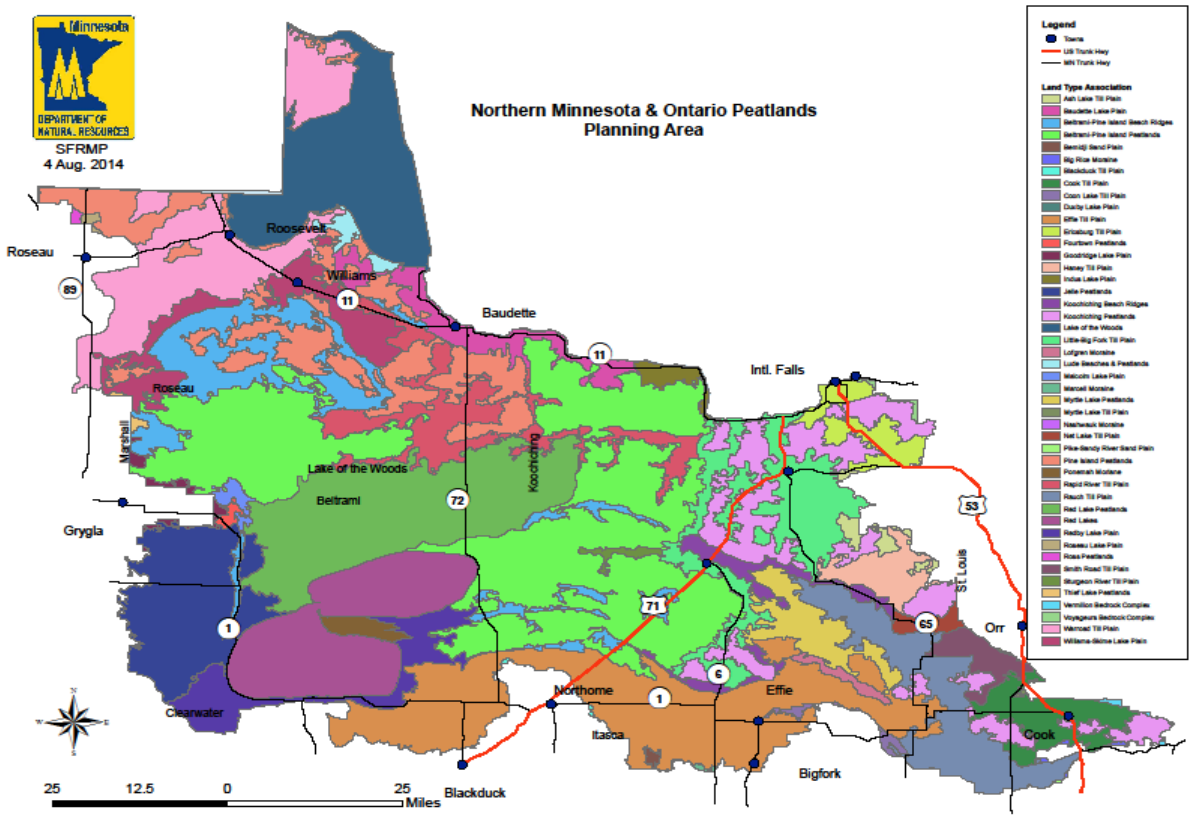
LTAs emphasize the interrelationships of biological and physical features. These interrelationships are discovered by overlaying single-theme maps of biotic and abiotic features and observing how patterns coincide. Landform maps are often a starting point for LTAs because they commonly integrate many of the individual features that show coincident pattern and reasonably explain spatial variations in physical characteristics of the landscape such as topography and soil material at this scale. These characteristics also strongly influence micro climate, surface and subsurface hydrologic characteristics, and historic disturbance regimes.

The Northern Minnesota & Ontario Peatlands Section has 27 described LTAs, see map 6.2.1 for LTA locations. Agassiz Lowlands Subsection has 14 described LTAs, see Table 6.3.1 for specifics regarding each LTA's acreage, cover types, soils information and other LTA specifics.

Littlefork-Vermillion Uplands Subsection has 13 described LTAs, see Table 6.4.1 for specifics regarding each LTA's acreage, cover types, soils information and other LTA specifics.

Because this material comes from multiple mapping layers, the percentages per topic will not always agree. The LTAs for this Section are not finalized. For further information and details on these draft LTAs, contact the DNR ECS program coordinator at 218-322-2509.

Map 6.2.1 Land Type Associations Northern Minnesota & Ontario Peatlands Section



Color maps found in this document may be viewed as PDF files on the Northern Minnesota & Ontario Peatlands Section Forest Resource Management Plan (SFRMP) Web site at:
http://www.dnr.state.mn.us/forestry/Subsection/nmop/index.html

6.3 Land Type Association (LTA) Descriptions for the Agassiz Lowlands

Table 6.3.1. Land Type Association Descriptions for the Agassiz Lowlands

Agassiz Lowlands Subsection LTA											
			Cover Groups - % cover in LTA						Historic Disturbance Regime- frequency (years)		Misc. Notes
ECS Land Type Association	**Total LTA acres**	**General Description**	**Lowland**	**Lake**	**Upland**	**Soil Formation**	**Common Upland Soil Textures**	**Dominant Presettlement Vegetation (Marschner)**	**Low Intensity Fires**	**High Intensity Fires**	
Baudette Lake Plain	92,299	lake plain with peatland inclusions	37	1	62	under forest	clay or silt	Upland: aspen-birch (trending to conifers); Lowland: conifer bog and swamp	25-100	150-350	
Beltrami - Pine Island Peatlands	934,631	large peatlands with minor upland islands	97	1	3	under forest	clay, loam, or sandy	Upland: aspen-birch (trending to conifer); Lowland: conifer bog and swamp	- -	- -	Bog more associated with loamy or clayey soils; fens with sandy material
Beltrami-Pine Island Beach Ridges	247,541	Glacial Lake Agassiz beach ridges	74	1	26	under forest	sand or gravel	Upland: jack pine barrens, aspen-birch (trending to conifers); Lowland: conifer bog and swamp	5-50	150-350	
Jelle Peatlands	249,150	large peatlands intermixed with upland islands	90	1	9	under forest, prairie-forest, prairie	sandy loam to clay loam	Upland: prairie, aspen-oakland, aspen-birch (trending to conifers); Lowland: conifer bog and swamp	- -	- -	

Indus Lake Plain	19,618	level to gently rolling lake plain w/isolated bedrock areas	32	1	68	under forest	clay	Upland: aspen-birch (trending to conifers); Lowland: conifer bog and swamp	- -	25-1000	
Pine Island Peatlands	314,845	large peatlands w/ minor upland mineral soil islands	91	1	9	under forest	sandy or clay loam	Upland: aspen-birch (trending to conifers); lowland: conifer bog and swamp	- -	- -	
Ponemah Moraine	19, 681	rolling to steep ice contact feature	22	1	78	under forest	loamy or sandy	Upland: Big Woods-hardwoods, aspen-birch (trending to conifers), mixed white and red pine	- -	150-350	landscape formed by Koochiching lobe; N Hardwoods attributed to microclimate
Rapid River Till Plain	187,480	level wave washed till plains and lake plains	68	1	32	under forest	clay loam to clay	Upland; aspen-birch (trending to hardwoods or conifers); conifer bog and swamp	25-100	15-350	
Red Lake Peatlands	415,554	large patterned peatlands with alter tracts, swamp forests and raised bogs	100	1	1	under forest	loamy or sandy	lowland: conifer bog and swamp; open muskeg	25-100	0	

Redby Lake Plain	113,214	nearly level lake plain formed in shallows of Glacial Lake Agassiz	47	1	52	under forest mainly; west edge under prairie and forest	fine sand	Upland; aspen-birch (trending to hardwoods or conifers), jack pine barrens, prairie, aspen-oakland; conifer bog and swamp	25-100	- -	
Sturgeon River Till Plain	9,248	lake-washed till adjacent to Sturgeon River	74	1	25	under forest	sand over clay	Upland: aspen-birch (trending to conifer)	25-100	- -	
Warroad Till Plain	305,718	Level wave washed till plains and lake plains	37	1	63	under forest	clayey, silty, to sandy loam	Upland: aspen-birch (trending to conifer); Lowland: conifer bog and swamp	25-100	- -	
Williams-Skime Lake Plain	130,503	level to gently rolling lake plain formed in shallows of Glacial Lake Agassiz	67	1	33	under forest	deep fine sand or fine sand over clay	Upland: aspen-birch (trending to conifer), jack pine barrens; Lowland: conifer bog and swamp	5-50	70-150	moderate to high intensity fires occurred every 250-1000 years

6.4 Land Type Associations (LTA) Descriptions for the Littlefork-Vermilion Uplands

Table 6.4.1 Land Type Association Descriptions for the Littlefork – Vermilion Uplands

Littlefork-Vermilion Uplands Subsection LTAs											
			Cover Groups - % cover in LTA						**Historic Disturbance Regime- frequency (years)**		
ECS Land Type Association	**Total LTA acres**	**General Description**	**Lowland**	**Lake**	**Uplan6d**	**Soil Formation**	**Common Upland Soil Textures**	**Dominant Presettlement Vegetation (Marschner)**	**Low Intensity Fires**	**High Intensity Fires**	**Misc. Notes**
Cook Till Plain	97,135	rolling wave-washed till plain dissected by Little Fork River and tributaries	35	1	65	under forest	clay; small scattered sandy or sandy over bedrock	Upland: aspen-birch (trending to conifer and hardwoods), mixed white and red pine, jack pine barrens; Lowland: conifer bog and swamp	- -	- -	ravines associated with post glacial erosion by streams are common
Effie Till Plain	517,076	nearly level Koochiching glacial lobe till plain	31	1	68	under forest	clay, sandy, or sand over loam	Upland: aspen-birch (trending to conifer); Lowland: conifer bog and swamp	- -	- -	
Ericsburg Till Plain	66,864	rolling till plain formed by Koochiching glacial lobe and smoothed by Glacial Lake Agassiz wave action	35	2	63	under forest	mainly clay; some range from sand to sandy loam over bedrock	Upland: aspen-birch (trending to conifer and hardwoods); Lowland: conifer bog and swamp	- -	- -	

Haney Till Plain	58,529	complex of rolling till plain and peatlands	56	1	44	under forest	clay, sand over loam or sandy textures	Upland: aspen-birch (trending to conifer and hardwoods); Lowland: conifer bog and swamp	- -	- -	clayey till deposited by Koochiching glacial lob and smoothed by Glacial Lake Agassiz waves
Koochiching Beach Ridges	54,698	beach ridges formed by Glacial Lake Agassiz	36	1	64	under forest	sand (on beach ridges), sand over loamy (edge of beach ridges), clay (areas between beach ridges)	Upland: aspen-birch (trending to conifer), jack pine barrens; Lowland: conifer bog and swamp	- -	- -	6.3 mi of streams per square mile
Koochiching Peatlands	265,052	large peatlands with minor inclusions of upland mineral soils	87	3	10	under forest	mainly clay; scattered small areas of sandy mineral soils	Upland: aspen-birch (trending to conifer); Lowland: conifer bog and swamp	- -	- -	0.4mi of streams per square mile
Little-Big Fork Till Plain	229,323	nearly level to rolling till plain dissected by rivers	36	1	64	under forest	clay, sandy, or sand over clay textures	Upland: aspen-birch (trending to conifer); Lowland: river bottom forest, conifer bog and swamp	- -	- -	clayey till deposited by Koochiching glacial lob and smoothed by Glacial Lake Agassiz waves; streams create landscape w/ high proportion of well drained soils

Lofgren Moraine	13,210	rolling moraine of coarse sediments formed by Rainy Lobe glacier	23	2	76	under forest	clay, sandy, or sand over loam	Upland: aspen-birch (trending to conifer), mixed white and red pine; Lowland: conifer bog and swamp	- -	- -	thin blanket of clayey Koochiching lob till covers much of surface; 0.1 mi of streams per square mile
Myrtle Lake Peatlands	85,003	flat landscape dominated by contiguous peatlands w/ isolated small islands of upland mineral soils	90	1	10	under forest	clay or sand over clay	Upland: aspen-birch (trending to conifer); Lowland: conifer bog and swamp	- -	- -	plant communities show distinct patterns in response to subtle gradients in water chemistry and movement; 0.1 mi of streams per square mile
Net Lake Till Plain	18,269	rolling till plain formed by Koochiching Lobe glacier	14	1	86	under forest	clay, sandy, or sand over bedrock	Upland: aspen-birch (trending to conifer and hardwoods), mixed white and red pine; Lowland: conifer bog and swamp	- -	- -	clayey till smoothed by Glacial Lake Agassiz waves
Rauch Till Plain	203,636	rolling wave-washed till plain dissected by Little Fork River and tributaries	33	1	67	under forest	clay, sandy, or sand over loamy	Upland: aspen-birch (trending to conifer and hardwoods), mixed white and red pine, jack pine barrens; Lowland: conifer bog and swamp	- -	- -	1.0 mi of streams per square mile

Smith Road Till Plain	40,273	rolling landscape w/ topography controlled by underlying bedrock	25	1	74	under forest	majority of soil = ?; smattered small sandy loam or sandy loam over bedrock	Upland: aspen-birch (trending to conifer and hardwoods); Lowland: conifer bog and swamp	- -	- -	thin blanket of wave washed Koochiching lobe till covers the bedrock

6.5 Water Resources of the NMOP section

Hydrology's role in this Section is more significant than in other sections of Minnesota due to the significant peat formations here and how the water moves through them. Hydrology controls soil formation and structure and thus the vegetation that grows here. This information is combined into the descriptions of the Land Type Associations (LTAs) (see 6.2). This combination of factors must be considered in almost all management activities. For more information about hydrology and ground water in particular, see: MN DNR Groundwater information

6.5.1 Hydrology and soils:

The Northern Minnesota and Ontario Peatlands were formed primarily over the Beltrami arm of the glacial Lake Agassiz. This ancient lake basin generally slopes to the north, rising only 2 to 10 feet per mile. This gentle slope, combined with a high water table has provided opportunity for deep peat formation. As the peat has accumulated, the water table has risen accordingly.

Over 60% of the Section is now dominated by these saturated soil systems. Thus activities, management, climate change, and natural disturbance events can cause significant shifts in the hydrologic flow and have large impacts over large acreages.

6.5.2 Saturated Soil Formation and Structure:

The types of peatlands found in NMOP are primarily based on the source of water. The two most common ones are ombrotrophic peatlands (such as raised bogs) and minerotrophic peatlands (such as fens). Ombrotrophic peatlands receive most of their water from precipitation. They tend to have a low pH and are poor in nutrients. This peat decomposes slowly, allowing for significant depths to build up. The deeper the peat, the poorer the site and the more stunted the vegetation. Roots cannot grow down far enough to get into the mineral soil below.

Minerotrophic peatlands receive most of their water from groundwater so they are not as acidic and tend to have pH values close to neutral. Environments with near neutral pH have more nutrients available, thus if the peat is shallow, plant roots get nutrients from the water as well as from the underlying mineral soil. If the peat is deep, the plants get their nutrients only from the water. But since the water is mineral rich, more nutrients are available and the vegetation is not as stunted as in bogs.

The ability of water to move through a peat soil varies immensely and is dependent on the degree of decomposition of the organic matter within the soil. Fibric peats have very little decomposition so water will move freely through this soil layer. Sapric peats are well decomposed and water will move through them very slowly. As such, groundwater movement, either vertically or horizontally, through peatland soils can be highly variable depending on the degree of decomposition of the peat in which the water is moving. Most of the peatlands within NMOP are minerotrophic, so they are generally well saturated with slowly moving groundwater.

There is interdependence between peatland features and the surrounding hydrologic regime in this landscape. Because of the sensitivity of the peatland ecosystem to changes in water level and water chemistry, the State set aside some of the more significant of these resources as Peatland Scientific and Natural Areas (SNA). Around these, the legislature also designated buffer areas called Watershed Protection Areas (WPSs). The WPAs were set aside to provide two types of protection – protection from direct, on-site, physical disturbance to the core areas (the SNAs), and protection of the hydrology of the surrounding area to maintain the ecological integrity of the features in the SNA.

6.6 Peatland Management Considerations from the aspect of Hydrology

There are three major issues to address when planning management activities in peatlands.

6.6.1 High Water table

NMOP has a high water table and management activities such as ditches and roads can have significant impacts through the compaction of soils and channeling of water. Deforestation (from logging or insects and disease), can also cause significant changes due to loss of photosynthesis, water uptake, and capillary action from trees and other vegetation.

6.6.2 Shallow Topographic Relief

NMOP has a very gradual topographic relief with long slow drainages. Any impairment to water flow along this gradient can possibly cause dramatic shifts in the hydrology and plant communities, causing some areas to be flooded out and others to dry out.

6.6.3 Landscape Location

NMOP is situated at the prairie/forest border thus the peatlands and their plant communities are at the western edge of their range. They are also on the margin relative to a favorable moisture balance for peat development, where evapotranspiration losses just equal precipitation. Climate change projections indicate this area is likely to become warmer and drier, raising concerns on forest cover type change, loss of peat, and increase in potential wildfires, amongst other things. Additionally due to these concerns management in NMOP needs to minimize activities that might make the peatlands less resilient and seek ways to reduce current negative impacts.

6.7 Watersheds of the NMOP Section

The NMOP section contains part or the entirety of 13 of Minnesota's 81 major watersheds (Table 6.3.1). The land management decisions made across this landscape can have important implications for the quality and quantity of water resources in the region. A suite of watershed health index scores have been calculated that represent many of the important ecological relationships within and between five different components (biology, connectivity, geomorphology, hydrology, and water quality). These scores are built on statewide GIS data that is compared consistently across Minnesota to provide a baseline health condition report for each of the major watersheds in the state. See the Watershed Health Assessment Framework website for more information Watershed Health Assessment Framework.

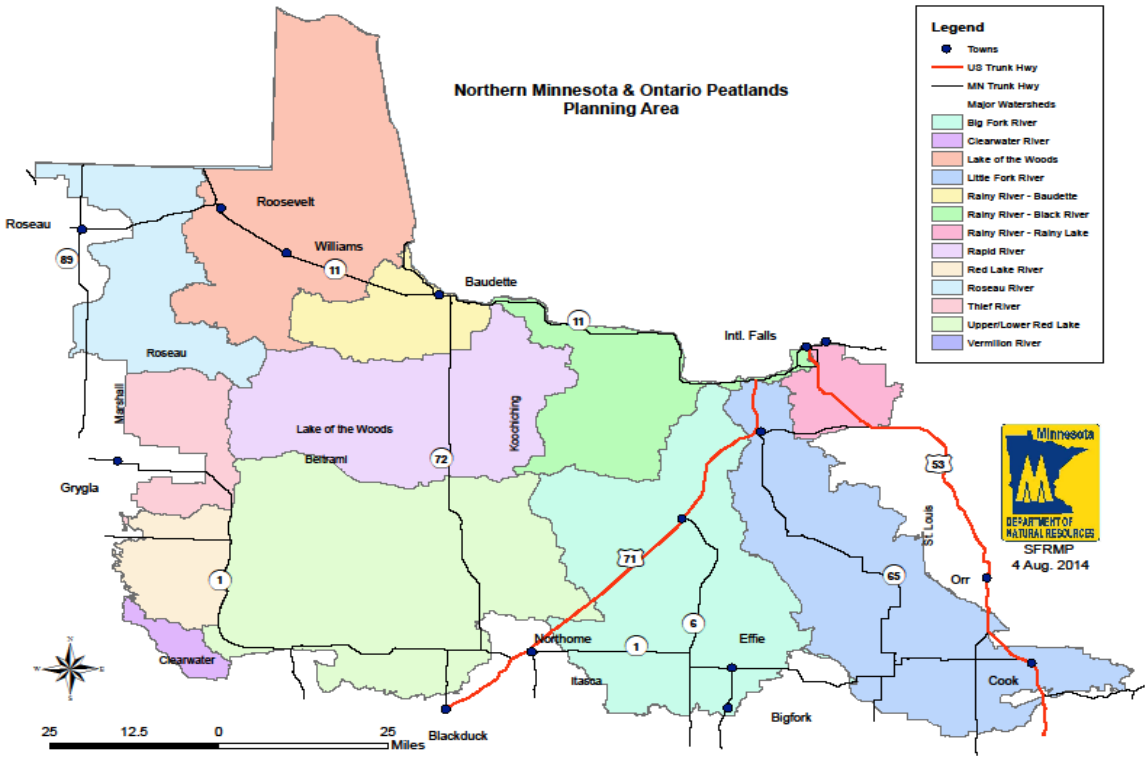
Table 6.7.1 Major Watersheds (HUC08) within the NMOP Section

Watershed name	Acres	Square miles	Mean Health Score[1]
Big Fork River	1,315,131	2,055	78
Clearwater River	869,460	1,359	60
Lake of the Woods	736,643	1,151	65
Little Fork River	1,198,291	1,872	69
Rainy River - Baudette	196,591	307	70
Rainy River - Manitou	329,206	514	79
Rainy River - Rainy Lake	582,763	911	68
Rapid River	603,841	944	84
Red Lake River	857,496	1,340	54
Roseau River	679,895	1,062	63
Thief River	671,021	1,048	64
Upper/Lower Red Lake	1,241,686	1,940	73
Vermilion River	661,296	1,033	63

[1] *Watershed health assessment scores scaled 0-100, ranking various aspects of ecological health.*

For additional information on watersheds, refer to Watersheds - what they are and why they are important, or for more information on individual watersheds within the NMOP section, see the Minnesota Pollution Control Agency watershed website: Minnesota Watersheds.

Map 6.7.1 Northern Minnesota & Ontario Peatlands Watersheds



Color maps found in this document may be viewed as PDF files on the Northern Minnesota & Ontario Peatlands Section Forest Resource Management Plan (SFRMP) Web site at:
http://www.dnr.state.mn.us/forestry/Subsection/nmop/index.html

6.8 Minnesota Biological Survey

The Minnesota Biological Survey (MBS) systematically collects, interprets, and delivers baseline data on the distribution and ecology of rare plants, rare animals, native plant communities, and functional landscapes needed to guide decision making.

Process for Conducting Minnesota Biological Survey Landscape Assessments

Minnesota Biological Survey (MBS) work has been completed for some counties within the NMOP section (see Table 6.1). Where MBS survey work is in progress, the SFRMP team will incorporate information into the planning process as it becomes available.

Table 6.8.1 Status of MBS in the NMOP Section

County	Overall Status	Field Data Collection	Site and NPC Mapping
Beltrami	In progress	In progress	Preliminary sites are digital
Clearwater	In progress	Complete	Preliminary sites are digital
Itasca	In progress	Complete	Preliminary sites are digital, NPC mapping is underway
Koochiching	In progress	In progress	Preliminary sites are digital
Lake of the Woods	In progress	In progress	Preliminary sites are digital
Marshall	Completed	Completed	Final sites and NPC maps are digital
St. Louis	In progress	In progress	Preliminary sites are digital
Roseau	In progress	Completed	Preliminary sites and NPC maps are digital

MBS Procedures – Site and native plant community surveys

Within each survey area, site and native plant community surveys are conducted with emphasis placed on important areas of native vegetation or habitat. More information on the survey procedures can be found at the following MN DNR website: Procedures - sites and native plant community surveys. See Section 6.4 for information on native plant communities specific to the NMOP section.

MBS Procedures – Rare Species Surveys

MBS field biologists also conduct surveys for rare plants and rare animals. Data gathered during these surveys inform decisions about the biodiversity importance of MBS sites in the survey area. Detailed descriptions of methods can be found at the following MN DNR websites:

Plants: Rare plant surveys

Animals: Rare animal surveys

See Section 6.5 for information on rare plant and animal species specific to the NMOP section. For further information on the MBS, refer to Minnesota Biological Survey, or contact the Unit of Monitoring and Inventory at (651) 259-5100.

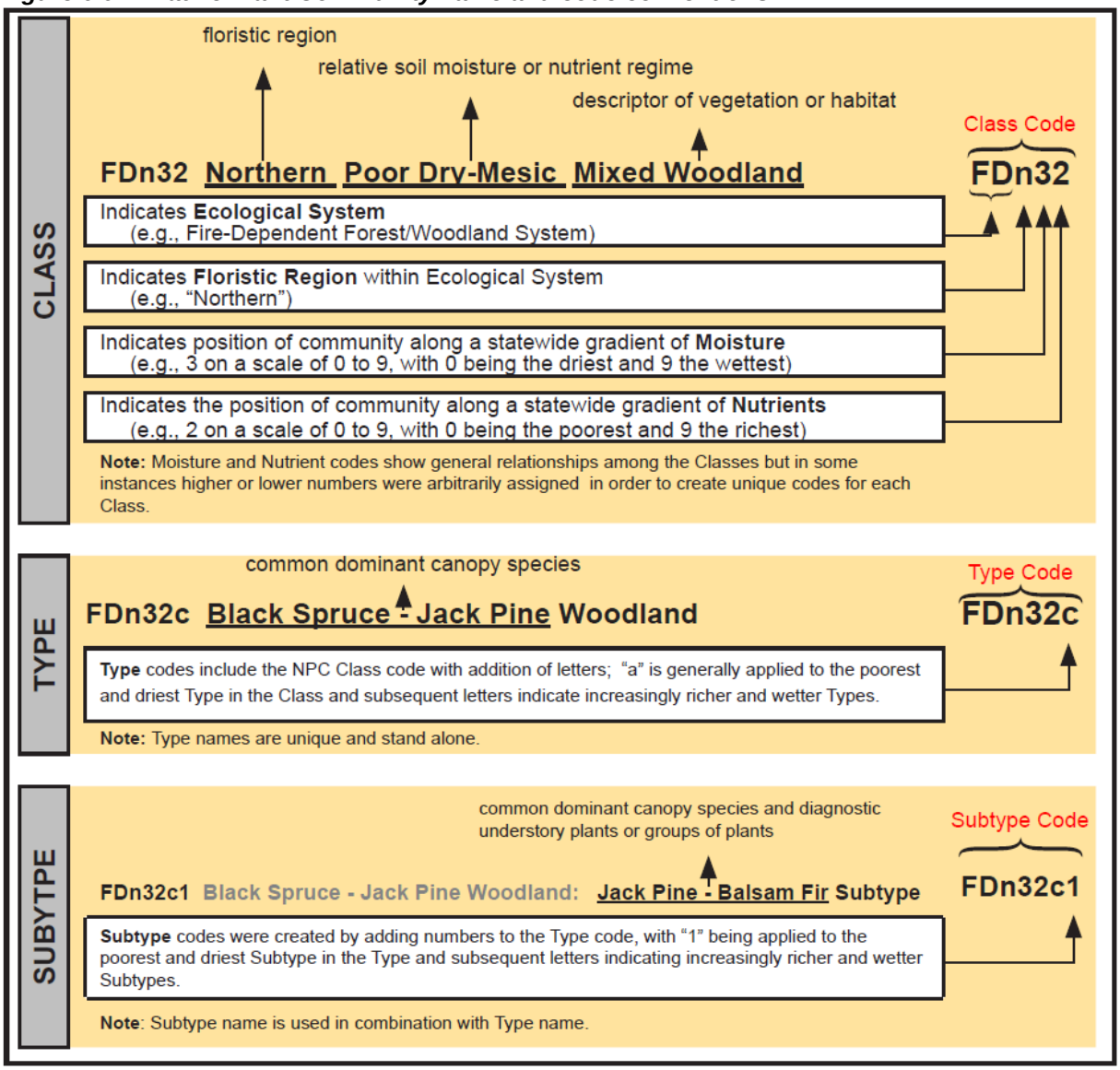
6.9 Native Plant Communities

Minnesota's Native Plant Community (NPC) Classification

A native plant community is a group of native plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by introduced organisms. These groups of native plant species form recognizable units, such as oak savannas, pine forests, or marshes, that tend to repeat over space and time. Native plant communities are classified and described by considering vegetation, hydrology, landforms, soils, and natural disturbance regimes. Examples of natural disturbances include wildfires, severe droughts, windstorms, and floods.

Sometimes referred to as native habitats or natural communities, native plant communities are named for the characteristic plant species within them or for characteristic environmental features. Native plant community classifications differ from forest cover types (such as those used in cooperative stand assessment forest inventory) in that they are based on all vascular plant species, not just the dominant canopy tree species. Figure 6.1 outlines the conventions used for naming NPC Classes, Types, and Subtypes and for developing codes for each of these levels.

Figure 6.9.1 Native Plant Community name and code conventions



(*from Field Guide to the Native Plant Communities of Minnesota: the Laurentian Mixed Forest Province.)*

Following is a list of the native plant community classes, types and subtypes known to occur in the NMOP Section (Table 6.5.1). Both the codes and their associated names are provided. Much more detailed information about each plant community in this section, including distribution maps, can be found in the *Field Guide to the Native Plant Communities of Minnesota* series of publications. These field guides are available through the Minnesota Bookstore at Minnesota Bookstore. Additional information on Minnesota's native plant communities can be found online at Minnesota's Native Plant Communities.

Table 6.9.1 Native Plant Community Classes, Types and Subtypes Documented in the NMOP Section with their Associated Conservation Rank

Native Plant Community Name	*Community Code*	*Ecological Subsection*		*Conservation Status Rank* [1]	*# of Observations* [2]
		Agassiz Lowlands	*Littlefork-Vermilion Uplands*		
Northern Spruce Bog	**APn80**	X	X		49
Black Spruce Bog	APn80a			S4	5
Treed Subtype	*APn80a1*			*S4*	8
Semi-Treed Subtype	*APn80a2*			*S4*	4
Northern Poor Conifer Swamp	**APn81**	X	X		46
Poor Black Spruce Swamp	APn81a			S5	7
Poor Tamarack - Black Spruce Swamp	APn81b			S4	2
Tamarack Subtype	*APn81b2*			*S4*	2
Northern Open Bog	**APn90**	X	X		28
Low Shrub Bog	APn90a			S4S5	3
Graminoid Bog	APn90b			S2 or S4	-
Typic Subtype	*APn90b1*			*S4*	1
Schlenke Subtype	*APn90b2*			*S2 / G2*	1
Northern Poor Fen	**APn91**	X	X		70
Low Shrub Poor Fen	APn91a			S5	2
Graminoid Poor Fen (Water Track)	APn91c			S3 or S4	2
Central Poor Dry Pine Woodland	**FDc12**	X			1
Central Dry-Mesic Pine-Hardwood Forest	**FDc34**		X		-
Red Pine - White Pine Forest	FDc34a			S2	1
Northern Dry-Sand Pine Woodland	**FDn12**	X	X		187
Jack Pine Woodland (Sand)	FDn12a			S2	162
Red Pine Woodland (Sand)	FDn12b			S2	27
Northern Dry-Bedrock Pine (Oak) Woodland	**FDn22**		X		2
Northern Poor Dry-Mesic Mixed Woodland	**FDn32**	X	X		162
Red Pine - White Pine Woodland (Canadian Shield)	FDn32a			S3	1
Black Spruce - Jack Pine Woodland	FDn32c			S2 or S3	3
Jack Pine - Balsam Fir Subtype	*FDn32c1*			S2	3
Black Spruce - Feathermoss Subtype	*FDn32c2*			S3	2
Jack Pine - Black Spruce Woodland (Sand)	FDn32d			S2	22
Spruce - Fir Woodland (North Shore)	FDn32e			S1	1
Northern Dry-Mesic Mixed Woodland	**FDn33**	X	X		199
Red Pine - White Pine Woodland	FDn33a			S3	7
Balsam Fir Subtype	*FDn33a1*			*S3*	32

Native Plant Community Name	*Community Code*	*Ecological Subsection*		*Conservation Status Rank* [1]	*# of Observations* [2]
Mountain Maple Subtype	*FDn33a2*			*S3*	2
Aspen - Birch Woodland	FDn33b			S5	25
Black Spruce Woodland	FDn33c			S2	9
Northern Mesic Mixed Forest	**FDn43**	X	X		166
White Pine - Red Pine Forest	FDn43a			S2	9
Aspen - Birch Forest	FDn43b			S5	14
Balsam Fir Subtype	*FDn43b1*			S5	25
Hardwood Subtype	*FDn43b2*			S5	6
Upland White Cedar Forest	FDn43c			S3	2
Northwestern Dry-Mesic Oak Woodland	**FDw24**	X			2
Northwestern Mesic Aspen-Oak Woodland	**FDw34**	X			-
Aspen - (Beaked Hazel) Woodland	FDw34b			S4	1
Northwestern Wet-Mesic Aspen Woodland	**FDw44**	X			2
Aspen - (Chokecherry) Woodland	FDw44b			S4	1
Northern Terrace Forest	**FFn57**	X	X		23
Black Ash - Silver Maple Terrace Forest	FFn57a			S3	5
Northern Floodplain Forest	**FFn67**	X	X		3
Northern Rich Spruce Swamp (Basin)	**FPn62**	X	X		12
Rich Black Spruce Swamp (Basin)	FPn62a			S3	6
Northern Cedar Swamp	**FPn63**	X	X		140
White Cedar Swamp (North central)	FPn63b			S3	3
White Cedar Swamp (Northwestern)	FPn63c			S3	20
Northern Rich Spruce Swamp (Water Track)	**FPn71**	X	X		38
Rich Black Spruce Swamp (Water Track)	FPn71a			S3	3
Northern Rich Tamarack Swamp (Eastern Basin)	**FPn72**		X		2
Northern Rich Alder Swamp	**FPn73**	X	X		20
Alder - (Maple - Loosestrife) Swamp	FPn73a			S5	5
Northern Rich Tamarack Swamp (Water Track)	**FPn81**	X	X		32
Rich Tamarack (Sundew - Pitcher Plant) Swamp	FPn81a			S4	1
Northern Rich Tamarack Swamp (Western Basin)	**FPn82**	X	X		46
Rich Tamarack - (Alder) Swamp	FPn82a			S5	3
Extremely Rich Tamarack Swamp	FPn82b			S4	5
Northwestern Rich Conifer Swamp	**FPw63**	X			12
Tamarack - Black Spruce Swamp (Aspen Parkland)	FPw63a			S3	5
Central Mesic Hardwood Forest (Western)	**MHc37**	X			1
Northern Mesic Hardwood Forest	**MHn35**	X	X		4
Aspen - Birch - Basswood Forest	MHn35a			S4	1

Native Plant Community Name	*Community Code*	*Ecological Subsection*		*Conservation Status Rank* [1]	*# of Observations* [2]
Northern Wet-Mesic Boreal Hardwood-Conifer Forest	**MHn44**	X	X		611
Aspen - Birch - Red Maple Forest	MHn44a			S4	26
White Pine - White Spruce - Paper Birch Forest	MHn44b			S2	4
Aspen - Fir Forest	MHn44c			S3S4	187
Aspen - Birch - Fir Forest	MHn44d			S3	6
Northern Wet-Mesic Hardwood Forest	**MHn46**	X	X		44
Aspen - Ash Forest	MHn46a			S4	20
Northern Rich Mesic Hardwood Forest	**MHn47**		X		2
Sugar Maple - Basswood - (Bluebead Lily) Forest	MHn47a			S3	1
Sugar Maple - Basswood - (Horsetail) Forest	MHn47b			S3	1
Southern Mesic Maple-Basswood Forest	**MHs39**	X			-
Sugar Maple Forest (Big Woods)	MHs39c			S2	2
Northwestern Wet-Mesic Hardwood Forest	**MHw36**	X			9
Northern Mixed Cattail Marsh	**MRn83**	X	X		4
Cattail - Sedge Marsh (Northern)	MRn83a			S2	1
Cattail Marsh (Northern)	MRn83b			S2	1
Northern Bulrush-Spikerush Marsh	**MRn93**	X			2
Prairie Mixed Cattail Marsh	**MRp83**	X			-
Spikerush - Bur Reed Marsh (Prairie)	MRp83b			S1	1
Northern Shrub Shore Fen	**OPn81**	X	X		7
Leatherleaf - Sweet Gale Short Fen	OPn81b			S5	1
Northern Rich Fen (Water Track)	**OPn91**	X	X		67
Shrub Rich Fen (Water Track)	OPn91a			S4	7
Graminoid Rich Fen (Water Track)	OPn91b			S2 or S3	5
Featureless Water Track Subtype	*OPn91b1*			S3	13
Flark Subtype	*OPn91b2*			S2	4
Northern Rich Fen (Basin)	**OPn92**	X	X		6
Graminoid Rich Fen (Basin)	OPn92a			S4	4
Northern Extremely Rich Fen	**OPn93**	X	X		10
Spring Fen	OPn93a			S2	5
Prairie Rich Fen	**OPp91**	X			4
Rich Fen (Mineral Soil)	OPp91a			S3	2
Rich Fen (Peatland)	OPp91b			S3	2
Rich Fen (Prairie Seepage)	OPp91c			S3	1
Northern Bedrock Outcrop	**ROn12**	X			-
Crystalline Bedrock Outcrop (Northern)	ROn12b			S4	1
Clay/Mud River Shore	**RVx54**		X		1

Native Plant Community Name	*Community Code*	*Ecological Subsection*		*Conservation Status Rank* [1]	*# of Observations* [2]
Northern Wet Cedar Forest	**WFn53**	X	X		81
Lowland White Cedar Forest (North Shore)	WFn53a			S4	1
Lowland White Cedar Forest (Northern)	WFn53b			S3	27
Northern Wet Ash Swamp	**WFn55**	X	X		80
Black Ash - Aspen - Balsam Poplar Swamp (Northeastern)	WFn55a			S4	19
Black Ash - Mountain Maple Swamp (Northern)	WFn55c			S4	11
Northern Very Wet Ash Swamp	**WFn64**	X	X		49
Black Ash - Conifer Swamp (Northeastern)	WFn64a			S4	6
Black Ash - Alder Swamp (Northern)	WFn64c			S4	7
Southern Wet Aspen Forest	**WFs55**	X			2
Northwestern Wet Aspen Forest	**WFw54**	X	X		84
Lowland Black Ash - Aspen - Balsam Poplar Forest	WFw54a			S4	4
Northern Wet Meadow/Carr	**WMn82**	X	X		39
Willow - Dogwood Shrub Swamp	WMn82a			S5	7
Sedge Meadow	WMn82b			S4 or S5	10
Bluejoint Subtype	*WMn82b1*			S5	3
Tussock Sedge Subtype	*WMn82b2*			S4	2
Southern Basin Wet Meadow/Carr	**WMs92**	X			-
Basin Meadow/Carr	WMs92a			S2	1

[1] *Conservation status ranks are assigned to NPC types and subtypes as follows:*

Native Plant Community Heritage Conservation Status Ranks (state rank: S, global rank: G):	
S1 / G1	Critically imperiled
S2 / G2	Imperiled
S3 / G3	Vulnerable to extirpation
S4 / G4	Apparently secure, uncommon but not rare
S5 / G5	Secure, common, widespread, and abundant

[2] *Number of occurrences based on data collected by MN DNR and collaborators. These occurrence numbers do not reflect a community's actual abundance within this section, but offer a measure of how often they have been documented during field surveys by the time of this printing. NPC classes without documented occurrences have been included when corresponding types/subtypes have been observed.*

The information listed in Table 6.7.1 is currently incomplete; however, as MBS surveys are completed, additional information on NPCs within the NMOP section will become available and be incorporated into management plans. For a complete list of Minnesota's native plant communities and more information on conservation status ranks, refer to: Minnesota's native plant communities - status and rankings

6.10 Minnesota's List of Endangered, Threatened, and Special Concern Species

Purpose, Scope, and Relationships to Federal Laws

Minnesota's Endangered Species Statute (Minnesota Statutes, Section 84.0895, Revisor of statutes 84.0895 Protection of Threatened and Endangered Species) requires the Minnesota DNR to adopt rules designating species meeting the statutory definitions of endangered, threatened, or species of special concern (ETS). The resulting List of Endangered, Threatened, and Special Concern Species (Minnesota Rare Species Guide) is codified as Minnesota Rules, Chapter 6134. The Endangered Species Statute also authorizes the DNR to adopt rules that regulate treatment of species designated as endangered and threatened. These regulations are codified as Minnesota Rules, Parts 6212.1800 to 6212.2300 (Revisor of statutes 6212.1800 General Restrictions for permits to possess threated and endangered species, Revisor of statutes 6212.2300 Emergency Taking).

Minnesota's Endangered Species Statute and the associated rules impose a variety of restrictions, a permit program, and several exemptions pertaining to species designated as endangered or threatened. A person may not take, import, transport, or sell any portion of an endangered or threatened species. However, these acts 1) may be allowed by a permit issued by the DNR, 2) exempt plants on certain agricultural lands and plants destroyed in consequence of certain agricultural practices, and 3) exempt the accidental, unknowing destruction of designated plants. Minnesota's Endangered Species Statute or the associated rules do not protect species of special concern. Persons are advised to read the full text of the statute and rules in order to understand all regulations pertaining to species that are designated as endangered, threatened, or species of special concern.

Note that the federal Endangered Species Act of 1973, as amended (16 USC 1531 _ 1544; see U.S. Fish & Wildlife Service - Endangered Species) requires the U.S. Department of the Interior to identify species as endangered or threatened according to a separate set of definitions, and imposes a separate set of restrictions for those species. Within the NMOP section there are currently two species with federal designations (Piping plover - Endangered, Canada lynx - Threatened) and one under review (Northern long-eared bat – Proposed Endangered).

Minnesota Natural Heritage Information System

Records of known locations of listed species and other rare features are maintained in the Minnesota Natural Heritage Information System (NHIS). All DNR offices have this information available for review prior to forest management activities to determine if a known location of a rare species is in the vicinity of a stand. When reviewing forest stands for management activities during the planning process, this information will be available when assigning stand prescriptions. If an ETS species is known to exist or found on a site, management activities are modified to protect, promote, or enhance the ETS species on the site.

Survey Methods

Much of the information about rare features in the Minnesota Natural Heritage Information System is the result of rare features survey work done since the 1970s. While survey processes and protocols for plants, animals, and other features are necessarily different in some ways, methods common to both include:

- Review of existing information;
- Selection of targeted species and survey sites;
- Field survey using techniques appropriate to the species; and,
- Information management.

A more detailed description of rare plant and animal survey procedures can be found in the MBS page of the MN DNR website at Minnesota Biological Survey

Minnesota Listed Species

The rare feature products prepared for the NMOP section plan include information on species of plants and animals listed as endangered, threatened, and special concern. *Minnesota's List of Endangered, Threatened, and Special Concern Species* was created in 1984 and was last revised in 2013. The list, created under Minnesota's Endangered and Threatened Species Statute, draws attention to species that are at greatest risk of extinction within the state and applies special regulations to species listed as endangered or threatened. By alerting resource managers and the public to species in jeopardy, activities can be reviewed and prioritized to help preserve the diversity and abundance of Minnesota's flora and fauna.

Information on the ETS species documented within the NMOP section is presented below in Tables 6.10.1 and 6.10.2. To understand the tables it is useful to know what the state ranking of endangered, threatened, and special concern mean.

Rank Key for Tables 6.6.1 and 6.6.2.
END – Endangered. A species is considered **endangered** if the species is threatened with extinction throughout all or a significant portion of its range within Minnesota.
THR – Threatened. A species is considered **threatened** if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range within Minnesota.
SPC – Special Concern. A species is considered a **species of special concern** if, although the species is not endangered or threatened, it is extremely uncommon in Minnesota or has unique or highly specific habitat requirements and deserves careful monitoring of its status. Species on the periphery of their range not listed as threatened may be included in this category, along with those species that were once threatened or endangered but now have increasing or protected, stable populations.

Additional information on the conservation status ranks (S-rank, G-rank) used in Tables 6.3 and 6.4 can be found online at NatureServe Conservation Status

Table 6.10.1 Minnesota Listed Species in the NMOP section – Animals

Group	Latin Name	Common Name	State Rank	S-Rank	G-Rank
Bird	*Accipiter gentilis*	Northern Goshawk	SPC	SNRB,SNRN	G5
Bird	*Ammodramus nelsoni*	Nelson's Sparrow	SPC	S3B	G5
Bird	*Anthus spragueii*	Sprague's Pipit	END	S1B,SNRM	G4
Bird	*Asio flammeus*	Short-eared Owl	SPC	S3B	G5
Bird	*Charadrius melodus*	Piping Plover	END	S1B	G3
Bird	*Coturnicops noveboracensis*	Yellow Rail	SPC	S3B	G4
Bird	*Cygnus buccinator*	Trumpeter Swan	SPC	S2B,SNRN	G4
Bird	*Limosa fedoa*	Marbled Godwit	SPC	S3B	G5
Bird	*Pelecanus erythrorhynchos*	American White Pelican	SPC	S3B	G4
Bird	*Phalaropus tricolor*	Wilson's Phalarope	THR	S2B	G5
Bird	*Sterna hirundo*	Common Tern	THR	S2B	G5

Group	Latin Name	Common Name	State Rank	S-Rank	G-Rank
Fish	*Acipenser fulvescens*	Lake Sturgeon	SPC	S3	G3G4
Fish	*Ichthyomyzon fossor*	Northern Brook Lamprey	SPC	S3	G4
Insect	*Cicindela denikei*	Laurentian Tiger Beetle	SPC	S2	G3G4
Insect	*Hesperia leonardus leonardus*	Leonard's Skipper	SPC	S3	G4T4
Insect	*Oxyethira itascae*	a Caddisfly	SPC	S3	G3
Mammal	*Mustela nivalis*	Least Weasel	SPC	S3	G5
Mammal	*Synaptomys borealis*	Northern Bog Lemming	SPC	S3	G5
Mussel	*Lasmigona compressa*	Creek Heelsplitter	SPC	S3	G5
Mussel	*Ligumia recta*	Black Sandshell	SPC	S3	G4G5

Table 6.10.1 continued: Minnesota Listed Species in the NMOP section – Plants

Group	Latin Name	Common Name	State Rank	S-Rank	G-Rank
Lichen	*Ahtiana aurescens*	Eastern candlewax lichen	SPC	S3	G3G5
Vascular Plant	*Achillea alpina*	Siberian Yarrow	THR	S2	G5?
Vascular Plant	*Androsace septentrionalis*	Northern Androsace	SPC	S3	G5
Vascular Plant	*Antennaria parvifolia*	Small-leaved Pussytoes	SPC	S3	G5
Vascular Plant	*Botrychium ascendens*	Upward-lobed Moonwort	END	SNR	G3
Vascular Plant	*Botrychium campestre*	Prairie Moonwort	SPC	S3	G3G4
Vascular Plant	*Botrychium lunaria*	Common Moonwort	THR	S2	G5
Vascular Plant	*Botrychium minganense*	Mingan Moonwort	SPC	S3	G4G5
Vascular Plant	*Botrychium mormo*	Goblin Fern	THR	S3	G3
Vascular Plant	*Botrychium pallidum*	Pale Moonwort	SPC	S1	G3
Vascular Plant	*Botrychium rugulosum*	St. Lawrence Grapefern	SPC	S2	G3
Vascular Plant	*Botrychium simplex*	Least Moonwort	SPC	S3	G5
Vascular Plant	*Caltha natans*	Floating Marsh-marigold	END	S1	G5
Vascular Plant	*Carex exilis*	Coastal Sedge	SPC	S3	G5
Vascular Plant	*Carex sterilis*	Sterile Sedge	THR	S2	G4
Vascular Plant	*Cladium mariscoides*	Twig-rush	SPC	S3	G5
Vascular Plant	*Cypripedium arietinum*	Ram's-head Lady's-slipper	THR	S2	G3
Vascular Plant	*Drosera anglica*	English Sundew	SPC	S3	G5
Vascular Plant	*Drosera linearis*	Linear-leaved Sundew	SPC	S3	G4
Vascular Plant	*Eleocharis quinqueflora*	Few-flowered Spike-rush	SPC	S3	G5
Vascular Plant	*Eleocharis rostellata*	Beaked Spike-rush	THR	S2	G5
Vascular Plant	*Gentianella amarella*	Felwort	SPC	S3	G5

Group	Latin Name	Common Name	State Rank	S-Rank	G-Rank
Vascular Plant	*Gymnocarpium robertianum*	Limestone Oak Fern	SPC	SNR	G5
Vascular Plant	*Helianthus nuttallii ssp. rydbergii*	Nuttall's Sunflower	SPC	S3	G5T5
Vascular Plant	*Juncus stygius var. americanus*	Bog Rush	SPC	S3	G5T5
Vascular Plant	*Juniperus horizontalis*	Creeping Juniper	SPC	S3	G5
Vascular Plant	*Malaxis monophyllos var. brachypoda*	White Adder's-mouth	SPC	S3	G4Q
Vascular Plant	*Minuartia dawsonensis*	Rock Sandwort	THR	S3	G5
Vascular Plant	*Najas gracillima*	Thread-like Naiad	SPC	S3	G5?
Vascular Plant	*Nymphaea leibergii*	Small White Water-lily	THR	S2	G5
Vascular Plant	*Platanthera clavellata*	Club-spur Orchid	SPC	S3	G5
Vascular Plant	*Polemonium occidentale ssp. lacustre*	Western Jacob's Ladder	END	S1	G5?T1Q
Vascular Plant	*Ranunculus lapponicus*	Lapland Buttercup	SPC	S3	G5
Vascular Plant	*Rhynchospora capillacea*	Hair-like Beak-rush	THR	S2	G4
Vascular Plant	*Salix maccalliana*	McCalla's Willow	SPC	S3	G5?
Vascular Plant	*Torreyochloa pallida*	Torrey's Manna-grass	SPC	S3	G5
Vascular Plant	*Tsuga canadensis*	Eastern Hemlock	END	S3	G5
Vascular Plant	*Xyris montana*	Montane Yellow-eyed Grass	SPC	S3	G4

Additional Species Data

In addition to listed species, the NMOP section contains species labeled as 'Watchlist' and 'Species of Greatest Conservation Need' (SGCNs).

'Watchlist' species (previously referred to 'NON's) are defined as a plant or animal species with no legal status, but for which data are being compiled in the Natural Heritage Information System because the species falls into one of the following categories:

- The species is being considered for addition to the state list.
- The species was removed from the state list but records for the species are still entered and maintained as a precautionary measure.
- The species has been recently discovered in the state.
- The species is presumed extirpated from the state.

Table 6.10.2 Minnesota 'Watchlist' species in the NMOP Section – Animals

Group	Latin Name	Common Name
Insect	*Hydroptila novicola*	a Caddisfly
Insect	*Lycaena epixanthe michiganensis*	Bog Copper
Bird	*Bartramia longicauda*	Upland Sandpiper
Bird	*Botaurus lentiginosus*	American Bittern
Bird	*Grus canadensis*	Sandhill Crane
Bird	*Haliaeetus leucocephalus*	Bald Eagle

Table 6.10.2 Minnesota 'Watchlist' species in the NMOP section – Plants

Group	Latin Name	Common Name
Moss	*Tomenthypnum falcifolium*	Curved-leaved Golden Moss
Vascular Plant	*Arethusa bulbosa*	Dragon's-mouth
Vascular Plant	*Botrychium matricariifolium*	Matricary Grapefern
Vascular Plant	*Botrychium michiganense*	Michigan Moonwort
Vascular Plant	*Carex capillaris*	Hair-like Sedge
Vascular Plant	*Ceratophyllum echinatum*	Spiny Hornwort
Vascular Plant	*Geocaulon lividum*	Northern Comandra
Vascular Plant	*Ranunculus gmelinii*	Small Yellow Water Crowfoot
Vascular Plant	*Rhynchospora fusca*	Sooty-colored Beak-rush
Vascular Plant	*Scirpus pedicellatus*	Woolgrass
Vascular Plant	*Sparganium glomeratum*	Clustered Bur-reed
Vascular Plant	*Triglochin palustris*	Marsh Arrow-grass
Vascular Plant	*Utricularia gibba*	Humped Bladderwort

Species of Greatest Conservation Need (SGCNs)

Species of greatest conservation need are animal species whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability. These species may also be present on state or federal ETS lists. More information is available online at Minnesota's State Wildlife Action Plan. The current SGCN list is in the process of being updated; therefore Table 6.6.4 is based on existing information available for the NMOP section.

Table 6.10.3 Minnesota Species of Greatest Conservation Need in the NMOP section

Group	Latin Name	Common Name
Bird	*Accipiter gentilis*	Northern Goshawk
Fish	*Acipenser fulvescens*	Lake Sturgeon
Bird	*Ammodramus leconteii*	Le Conte's Sparrow
Bird	*Ammodramus nelsoni*	Nelson's Sharp-tailed Sparrow
Bird	*Anthus spragueii*	Sprague's Pipit
Bird	*Asio flammeus*	Short-eared Owl
Bird	*Bartramia longicauda*	Upland Sandpiper
Bird	*Botaurus lentiginosus*	American Bittern
Bird	*Caprimulgus vociferus*	Whip-poor-will
Bird	*Catharus fuscescens*	Veery
Bird	*Charadrius melodus*	Piping Plover
Bird	*Chlidonias niger*	Black Tern
Insect	*Cicindela denikei*	A Tiger Beetle
Bird	*Circus cyaneus*	Northern Harrier
Bird	*Cistothorus palustris*	Marsh Wren
Bird	*Cistothorus platensis*	Sedge Wren
Bird	*Coccyzus erythropthalmus*	Black-billed Cuckoo
Bird	*Contopus cooperi*	Olive-sided Flycatcher
Bird	*Contopus virens*	Eastern Wood-Pewee

Bird	*Coturnicops noveboracensis*	Yellow Rail
Bird	*Cygnus buccinator*	Trumpeter Swan
Bird	*Dolichonyx oryzivorus*	Bobolink
Bird	*Empidonax minimus*	Least Flycatcher
Insect	*Epidemia epixanthe michiganensis*	Bog Copper
Bird	*Falcipennis canadensis*	Spruce Grouse
Bird	*Gavia immer*	Common Loon
Bird	*Grus canadensis*	Sandhill Crane
Bird	*Haliaeetus leucocephalus*	Bald Eagle
Insect	*Hesperia leonardus leonardus*	Leonard's Skipper
Fish	*Ichthyomyzon fossor*	Northern Brook Lamprey
Bird	*Larus pipixcan*	Franklin's Gull
Mussel	*Lasmigona compressa*	Creek Heelsplitter
Mussel	*Ligumia recta*	Black Sandshell
Bird	*Limosa fedoa*	Marbled Godwit
Bird	*Melospiza georgiana*	Swamp Sparrow
Fish	*Moxostoma valenciennesi*	Greater Redhorse
Mammal	*Mustela nivalis*	Least Weasel
Bird	*Nycticorax nycticorax*	Black-crowned Night-Heron
Bird	*Oporornis agilis*	Connecticut Warbler
Insect	*Oxyethira itascae*	a Caddisfly
Bird	*Pelecanus erythrorhynchos*	American White Pelican
Bird	*Phalaropus tricolor*	Wilson's Phalarope
Bird	*Pheucticus ludovicianus*	Rose-breasted Grosbeak
Bird	*Picoides arcticus*	Black-backed Woodpecker
Bird	*Podiceps grisegena*	Red-necked Grebe
Bird	*Rallus limicola*	Virginia Rail
Bird	*Scolopax minor*	American Woodcock
Bird	*Seiurus aurocapilla*	Ovenbird
Bird	*Sphyrapicus varius*	Yellow-bellied Sapsucker
Bird	*Sterna forsteri*	Forster's Tern
Bird	*Sterna hirundo*	Common Tern
Mammal	*Synaptomys borealis*	Northern Bog Lemming
Bird	*Troglodytes troglodytes*	Winter Wren
Bird	*Tympanuchus phasianellus*	Sharp-tailed Grouse
Bird	*Zonotrichia albicollis*	White-throated Sparrow

Natural Heritage and Nongame Research Program Rare Species Fact Sheets

The Natural Heritage and Nongame Research Program have created fact sheets about each of Minnesota's listed species. The information on these species is web-based and available at Rare Species Guide. It uses an interactive database approach that allows users to search on selected fields and create customized reports. Users are also able to perform alphabetical searches and generate standard printouts of rare species accounts.

Sources for Additional Rare Species Information

1. NatureServe. A network connecting science with conservation that includes an online encyclopedia of rare plants and animals. NatureServe home page.
2. U.S. Department of Agriculture – Forest Service Region 9. Regional Forester Sensitive Species Conservation Assessment Documents (also on the Web at: United States Department of Agriculture - native plant program).

6.11 Wildlife and Forestry Areas of Unique Resources and Values

As a Department, DNR is committed and required by statute (MS 89, Revisor of Statutes - State Forests; Tree Planting; Forest Roads & MS89A, Revisor of Statutes - Sustainable Forest Resources) to manage for a broad set of objectives and forest resources, including the management and protection of rare species, communities, features, and values across the landscape. In fulfillment of this commitment, DNR obtained dual certification (Forest Stewardship Council, FSC, Forest Stewardship Council home page, and Sustainable Forestry Initiative, SFI, Sustainable Forestry Initiative) of 4.96 million acres, covering all state forests and most wildlife management areas.

This commitment coincides in particular with Principles 6 and 9 in the FSC Forest Management Standard (Forest Stewarship Council - Mission and Vision). Principle 9 requires certificate holders to identify "High Conservation Value Forests" (HCVFs) and manage such sites to "maintain or enhance" identified High Conservation Values (HCVs). FSC broadly defines HCVFs as "areas of outstanding biological or cultural significance." Certificate holders are required to develop a practical definition and process for implementing the HCVF concept, relative to their scope and scale of operations. All decisions regarding DNR's HCVF approach have been based on the interpretation that most sites managed as HCVFs will remain working forests. This interpretation and expectation was based on a careful review of Principle 9 in the FSC-US National Forest Management Standard and FSC's HCVF Assessment Framework. The DNR's HCVF Fact Sheet (MN DNR High Conservation Value Forests (HCVFs) Fact Sheet) more thoroughly explains the HCVF concept and DNR's approach to management of HCVFs. This fact sheet also lists additional resources and contacts. Additional information on the selection and review process used to identify candidate HCVFs can be found at: Forest Certification - High Conservation Value Forests (HCVF).

Within the NMOP section, four candidate HCVFs have been identified and are described below:

Pine Creek Peatland HCVF
This site is one of 18 ecologically significant patterned peatlands identified in the state. It contains the best example of the spring fen landform, which has extremely rich fen channels flowing through a rich forested swamp. A large undisturbed northern rich fen occurs downslope that has well-defined ribbed patterns. Three state threatened species have been recorded: *Cypripedium arietinum*, *Carex sterilis*, and *Drosera linearis*.

Sprague Creek Peatland HCVF
This site is one of 18 ecologically significant patterned peatlands identified in the state. This peatland contains a good example of one of only five spring fen landforms in the state. It contains

extremely rich fen channels flowing through a rich forested swamp. Numerous rare plant species are present including *Cypripedium arietinum*, *Rhynchospora capillaris*, *Drosera anglica*, *Cladium mariscoides*, and *Malaxis monophylla*.

Bemis Swamp HCVF
This site is dominated by a large seepage-fed peatland at base of a prominent beach ridge. Numerous rare plants and orchids occur through much of the area. This site has one of most species rich and abundant orchid populations in the state and probably includes one of the largest, if not the largest, populations of *Cypripedium arietinum*. Ditches, road, and a gravel pit occur within site but are located downstream of most important features. Good and extensive examples of wet forest and rich peatland forest communities are present. This site is also unique setting for two calcareous spring fens.

Luxemberg Peatland HCVF
This peatland complex is one of 18 ecologically significant patterned peatlands identified in the state. It contains a good example of an extensive water track dominated by northern rich fen and well-defined ribbed fen pattern. Rare plants include *Drosera anglica* and *Nymphaea leibergii* and rare animals include short-eared owl and yellow rail.

MN DNR will apply the "Precautionary Principle" within these Candidate HCVF sites while developing management decisions. This principle establishes that a lack of information does not justify the absence of management measures to conserve the resource.

Another special management designation established through Principle 6 of the FCS-US Standard is the "Representative Sample Area" (RSA). RSAs are ecologically-viable representative samples of native plant communities designated to serve one or more of three purposes:
1) To establish and/or maintain an ecological reference condition; or
2) To create or maintain an under-represented ecological condition; or
3) To serve as a set of protected areas or refugia for species, communities and community types not captured in other criteria of this standard.

One of the primary provisions in this designation is to ensure that examples of ecosystem types that are not protected elsewhere in this Standard are protected in their natural state within the landscape. While there are not currently any identified RSAs within the NMOP section, the ongoing collection of NPC data by DNR Ecological and Water Resources staff, other DNR divisions and cooperators will facilitate the identification of potential RSA sites in the future if necessary to meet DNR's Long-Term RSA Goals.

MBS identifies High and Outstanding Biodiversity Significance Sites and rare NPC types as part of their survey work. While this information was used during the identification of candidate HCVFs and potential RSA sites, the surveys are not complete for the NMOP section and only preliminary information is currently available. See Section 6.5 for more information.

6.12 Climate Change as a Forest Management Issue

Forest management plans will consider the effects of climate change on forest management activities. Efforts will be made to be aware of the specific cover types that are projected to do better in what are anticipated to be future climate trends. Because forest management is implemented over relatively long terms (50 plus years) drastic forest management activities reacting to climate change will not be undertaken. Rather efforts will be made to introduce some cover type conversions and specific Strategies that are consistent with the Department's recommendations concerning how to react to climate change as the SFRMP is prepared and

implemented. Climate change impacts are identified in the Department's Strategic Conservation Agenda. See for more information:

DNRs Strategic Direction - Climate change mitigation and adaptation

Research has been prepared by the MNDNR's Climate and Renewable Energy Steering Team (CREST). In brief, CREST provides department-wide coordination, guidance, and conflict resolution on natural resource-based climate change and renewable energy strategies. Four interdisciplinary work teams support CREST including: Climate Change Adaptation, Carbon Sequestration, Biofuels, and Energy Efficiency Teams. An "Integration Team" ensures integration and coordination of work across teams.

More comprehensive research on impacts of climate change has been prepared by the Northern Institute of Applied Climate Science. See research and further information on NIACS at:

Northern Institute of Applied Climate Science

Climate change adaptation activities help human and natural systems prepare for and adjust to climate change. More formally, they "reduce the vulnerability of natural and human systems against actual or expected climate change effects" (IPCC 2007b). Adaptation strategies are typically grouped into three broad categories: resistance, resilience and facilitation (Millar et al. 2007, Galatowitsch et al. 2009). The actions that DNR can take to prepare for and adapt to the effects of climate change on Minnesota's natural resources can be grouped into these categories.

Resistance

Resistance strategies attempt to help species, communities, or systems to remain unchanged in the face of climate change (Lawler, 2009). For example, constructing seawalls to hold back rising sea levels is a resistance strategy. Resistance strategies that are (or could be) implemented in Minnesota include maintaining firebreaks around high value forests which could be at increased fire risk due to a warmer/drier climate, and aerating lakes to address hypoxia resulting from warmer waters. Resistance strategies are useful when climate change impacts are expected to be minimal or as a stopgap measure to provide time for resilience or facilitation strategies to be put into place, such as when managing an endangered species occurring within a small area.

Resilience

Resilience strategies increase the ability of species or ecosystems to absorb or adapt to the effects of climate change. Resilient systems will continue to function in the face of climate change, although possibly in different ways or with a different suite of species than in a prior state (Lawler, 2009). Systems which lack resilience will likely undergo abrupt transformations, causing disruption or loss of ecosystem functions, population declines or even loss of species. Reducing the impact of non-climate stressors such as invasive species or nutrient pollution are commonly used resilience strategies. Other resilience strategies include enlarging the sizes and numbers of protected areas through restoration or acquisition (especially those considered climate refuges, see cisco case study); increasing or maintaining the natural diversity of sites at both at the species and genetic levels, and managing for multi-age forest structure. Resilience strategies are best implemented when climate change effects are not expected to be severe, when there is a high degree of uncertainty regarding the direction of change, or as interim measures.

Facilitation

Facilitation strategies use active management to encourage adaptation toward a predicted direction of climate change. These strategies can "mimic, assist, or enable on-going natural adaptive processes such as species dispersal and migration, population mortality and colonization, changes in species dominances and community composition, and changing disturbance regimes" (Millar et al., 2007). The goal is to facilitate incremental change so as to minimize the number and scale of catastrophic "threshold" conversions of natural communities. Facilitation can be risky because it involves encouraging change toward an uncertain outcome; however, the gradual nature of facilitation may allow for redirection if necessary. Examples of facilitation strategies include establishing travel corridors in the expected direction of changes in species ranges, deliberately moving young or adults in that same direction, or introducing native species beyond their current range but within the boundaries of expected change.

CHAPTER 7

Stand Damage and Mortality

Northern Minnesota & Ontario Peatlands Section

7.1 Introduction

This an assessment of forest insects and diseases known to cause tree mortality, growth loss, and quality reduction in forest stands in the Minnesota - Ontario Peatlands Section. The presence of forest insect and disease agents, as well as animal and abiotic agents, have been documented in reports by the Minnesota Department of Natural Resources (MN DNR), Forest Health Team; University of Minnesota; USDA Forest Service, State and Private Forestry; and North Central Forest Experiment Station.

7.2 Role of Insects and Pathogens

Native forest insects and disease organisms influence forest ecosystem dynamics as pests and agents of stress, but also play a beneficial role in the natural processes. Many native insects and diseases are an essential natural component of healthy forests and may contribute to compositional, structural, and functional diversity. By selectively affecting tree growth and mortality rates, they alter forest composition, structure, and succession. They thin and prune host populations, reducing density and competition. They can slow or stall the process of succession, or they can accelerate it. Through decay and biomass decomposition, they contribute significantly to carbon cycling, nutrient cycling, and energy flow in forest ecosystems. Insect and disease organisms serve as food for many invertebrates and vertebrates. Of vertebrates, birds consume the most tree-feeding insects, but many mammals consume insects to some degree as well. Insects and diseases create structural habitat for shelter and nesting. Many species of woodpeckers are attracted to trees with decay where they excavate cavities for nesting. Many animals use dead wood to roost, nest, or forage.

These same native forest insect and diseases are perceived as problems or pests when occurring at a level or on a site where they interfere with human goals, plans, and desires for trees and forests. Native insects and diseases can reduce timber productivity, lumber grade, site aesthetics, wildlife habitat, and water quality, and can increase the hazard of falling trees and branches and the occurrence of fire hazards, etc. Data from the 1990 Forest Inventory and Analysis for Minnesota indicate that 37 percent of the wood volume produced by all tree species annually is lost due to mortality. Insects and disease organisms account for more than 53 percent of this loss or more than 143 million cubic feet of wood. (Miles, Chen, Leatherberry, 1995). Surveys conducted by the MN DNR, Division of Forestry of oak and birch mortality triggered by drought and attacks by boring insects and root rot organisms, found in excess of 300,000 oaks and 200 million birch dying during the late 1980s and early 1990s (Albers, 1998). More than 40 percent of the birch type in Minnesota was affected.

What is perceived to be beneficial from one perspective may be viewed as detrimental from another. A very low level of decay would be required on a site being managed for high timber productivity, a higher level of decay may be acceptable on a site being managed under extended rotation, while any level may be acceptable on an old-growth site. Some level of decay will occur on every site regardless of the level of management. A forest tent caterpillar outbreak might be viewed as both beneficial and detrimental. The outbreak may benefit some birds that eat them but, be detrimental to others by leaving nests exposed to predators and bright sunlight, which can overheat, dehydrate, and kill young birds in nests.

A forest tent caterpillar outbreak may increase the growth of shade-tolerant understory trees due to increased nutrients from insect droppings and dead caterpillars, and due to increased sunlight getting through the defoliated overstory canopy. The same outbreak is detrimental to the overstory aspen due to slower growth and increased mortality caused by the loss of leaves.

While native insect and disease organisms have co-evolved with native trees and forests, exotic insects and disease organisms have not. Exotics do not have a natural ”role” in our native ecosystems and have

and will continue to alter forest ecosystem diversity, function, and productivity. Exotics historically have caused intensive and severe disturbances over large areas. In extreme cases they have virtually eliminated their host species. The elm resource has been devastated by introduction of the Dutch elm disease fungus and its bark beetle vector. The white pine blister rust fungus, accidentally introduced near the start of the 20th century, has played an important role in reducing the amount of white pine in Minnesota. Gypsy moth, while not yet established in Minnesota, is established in Wisconsin and Michigan and will become established here. While future impacts of gypsy moth in Minnesota are difficult to predict, especially in the northern aspen-birch forest, the insect has the potential to cause widespread mortality and will alter the composition and structure of the forest.

An ecosystem perspective requires that strategies to maintain the health of individual stands consider the beneficial, as well as the detrimental effects of insects and disease organisms. Forests must be considered as an ecosystem and manipulation to one part of that ecosystem affects the other parts. Pests have long influenced forest management, but forest management also affects pest populations. Vigorous trees tend to suffer less damage from these agents. Forest management aims to promote stand vigor and productivity by matching tree species to the planting site; manipulating rotation age, stand density, and species composition; avoiding wounding and root damage during thinning and harvesting; removing diseased and infested trees during harvesting operations, etc. Forest management does not attempt to eliminate native insect and diseases or their processes, but rather to control their activity and impact to a level that allows goals for timber production, water quality, aesthetics, recreation, wildlife, etc. to be realized.

In contrast, a much more aggressive approach is needed with exotic (non-native) organisms. It is important to avoid the introduction of exotics and attempt to contain and eradicate them when first found. Often it is not possible to eradicate or contain exotics once they are established. Attempts to slow their spread and management techniques to minimize their damage are then needed. Dutch elm disease and white pine blister rust are exotics that have become permanent components of the ecosystem. This will also happen with gypsy moth and Emerald ash borer after they become established in Minnesota.

7.3 Specific Insects, Pathogens and Declines Known to Cause Volume Reductions or Mortality, by Cover Type

Table 7.3.1 Insects, Pathogens and Declines Known to Cause Volume Reductions or Mortality Losses, by Cover Type.

Cover type	Agents that cause mortality	Agents that cause volume reductions
All species	Armillaria root disease US Department of Agriculture Forest Service Forest Insect & Disease Leaflet 78 Storm damage Landowner information for storm damage of forests	Stem decay and root rot fungi US Department of Agriculture Forest Service tree decay US Department of Agriculture forest service decay and discoloration of Aspen
Aspen	Aspen decline Forest Ecology and Management aspen declines in North America Hypoxylon canker Hypoxylon Canker Bronze poplar borer Bronze Poplar Borer	White trunk rot White trunk rot in aspen Forest tent caterpillar DNR tree care forest health forest tent caterpillar Gypsy moth * DNR Invasive species-terrestrial invasive species-gypsy moth
Ash	Ash decline Assessment of Black Ash decline in Minnesota Emerald ash borer * US Forestry guidelines for Ash to address emeral ash borer	
Birch	Bronze birch borer US Department of Agriculture Forest Service - Bronze Birch Borer	Gypsy moth * DNR Invasive species - terestrial invasive speices - gypsy moth
Oak	Two-lined chestnut borer DNR Tree care - forest health - two-lined chestnut borer	Gypsy moth * DNR Invasive Species-terestrial invasive species-gypsy moth
Tamarack	Eastern larch beetle DNR Tamarack Assessment Project - Eastern Larch Beetle	Larch casebearer US Department of Agriculture-ForestService-Larch Casebearer
Jack pine	Jack pine budworm US Department of Agriculture Forest Service Jack Pine Budworm DNR Forest health annual reports 2012 for 2012	Red rot Red Rot information_Wikipedia
Red pine	*Ips* bark beetles DNR how to identify and manage pine bark beetles	Red rot Red Rot information_Wikipedia
White pine	White pine blister rust * US Department of Agriculture Forest Service White Pine blister rust	Red rot Red Rot information_Wikipedia
Black spruce	Eastern dwarf mistletoe US Department of Agriculture Forest Service Eastern Spruce Dwarf Mistletoe	
White	Spruce budworm	

spruce	US_Department_of_Agriculture_Forest Service_Spruce Budworm	
White cedar		Red rot Red Rot information_Wikipedia
Balsam fir	Spruce budworm US_Department_of_Agriculture_Forest Service_Spruce Budworm	
* = Exotic insect or disease		

7.4 Implications for Forest Management for Selected Agents

Eastern dwarf mistletoe

Eastern dwarf mistletoe (DMT) is a native parasitic flowering plant that causes the most serious disease of black spruce throughout its range. Black spruce is primarily a lowland species and is often the only commercially important species that can grow on those sites. Therefore it is important to protect black spruce from dwarf mistletoe infection (Baker et al 2006). DMT can reduce the volume of infested stands so much that a harvest is not economically feasible. Anderson (1949) estimated that up to 11% of the black spruce type in the Big Falls Management Unit was out of production because of dwarf mistletoe. The area of mortality was up to 19% in his survey. A recent study Baker et al (2012) reported that the FIA survey grossly underestimates the amount of DMT in Minnesota. FIA data lists 11% of plots as infested with DMT. In Baker's study they found that up to 55% of FIA plots actually were infested and that 20% of stand areas was infested and volume losses were at least 14% of the rotation volume.

The acreage of black spruce infested with DMT in Minnesota is increasing over time, as pockets of infection continue to expand. The spread rate through a stand, as indicated by the enlargement of mortality centers, is 4.7 feet per year on average. Birds and other animals spread the sticky mistletoe seeds to new sites creating new mortality centers. Dwarf mistletoe kills black spruce trees quickly often within 15 years of infection. Once DMT infests a stand, it remains infested as long as live black spruce trees (of any size) remain on the site. There are no effective insects or diseases of DMT that serve as natural control agents, so DMT is not eliminated from infested sites naturally. Therefore the amount of DMT in black spruce in Minnesota is increasing.

It is important to try to protect black spruce from DMT infection in order for stands to produce enough volume so that harvest is economically feasible. Elimination of DMT from infested sites can only be accomplished if all black spruce on the site are killed at the time of harvest. This is difficult if not impossible to accomplish. In most stands DMT infections remain on sites after harvest. Even prescribed burning of a site following harvest leave areas unburned where potentially infected live black spruce are left to continue the infection of the regenerating stand. The larger the trees and the more trees left on harvest sites the more likely DMT is being left of the site and the faster infection will spread to the regenerating black trees, the faster mortality centers will develop and the greater the reduction in volume of wood produced on the site.

The 5 foot cutting rule requiring loggers to cut or kill all black spruce trees 5 feet tall or taller was instituted as a means of reducing dwarf mistletoe and its spread within a stand knowing it would seldom eliminate DMT from the site and that follow up treatment would often be necessary to further reduce DMT infection on the site. Hand felling as well as shearing after the harvest has sometimes been used to reduce DMT infection in an attempt to ensure production of an adequate volume to allow commercial harvest. A survey of sites should be conducted one year or so after harvest, to determine if follow-up treatment is necessary. Leaving infected trees standing on or next to harvested sites will ensure that the regenerating stand is infected by mistletoe. If dwarf mistletoe is not aggressively controlled in black spruce stands when harvesting and regenerating the stands, the total merchantable acreage of this cover type will decline over time.
US Forest Disease survey of dwarf mistletoe in Minnesota Black Spruce Stands

Eastern larch beetle

Currently, Minnesota and Canada are experiencing an outbreak of eastern larch beetle (ELB), a native insect that has been previously categorized as a "secondary pest", a pest that is only successful on a weakened or stressed tree. Following outbreaks in the 1970s and 1980s in Canada and elsewhere in the US, eastern larch beetle has been acting as a "primary pest", killing otherwise healthy trees. Mortality from the current Minnesota outbreak started to be mapped in 2000 and has accelerated at a steady pace since then. By 2013, most tamarack trees larger than 4 inches DBH have been killed on 180,000 acres. Mortality has occurred on lowland sites, upland sites, and in pure and mixed stands of tamarack. Multi-year flooding beginning in the early 1990s and a winter warming trend since 2005 have been suggested as possible tamarack health stressors that allowed an inroad for eastern larch beetle populations in the northwestern part of the state.

At this time, the pace of mortality is still increasing and a silvicultural solution to this insect outbreak is not apparent. Entomologists at the University of Minnesota are investigating the biology and population dynamics of eastern larch beetle in order to offer insights on the causes of the outbreak, why it is perpetuating itself, and possible silvicultural solutions. Faced with thousands of acres of dead and dying tamarack, poor markets and limited experience regenerating this species, the development of silvicultural systems to enhance and maintain this resource will remain a challenge for foresters well into the future. Given the lack of research results, it is prudent to manage and salvage as much of the tamarack as possible.

Emerald ash borer

See Guidelines for ash management on Forestry-Administered lands at:
DNR Guidelines for Ash management to address threat of Emerald Ash Borer

Landscape perspective:
Manage ash populations in the landscape to protect sensitive wetland ecotypes, reduce outbreak costs, and restrict emerald ash borer introduction and spread without eliminating ash within forest ecosystems.

Stand perspective:
Create conditions that will reduce potential impacts and increase the resiliency of forested stands by keeping forested sites forested, maintaining an ash component but reducing the size and number of ash in the stand and increasing tree species diversity.

Management objectives:
Objectives should focus on ecosystem health and management, not on the emerald ash borer. The intent is to limit habitat attractiveness to EAB.

Gypsy moth

Defoliation of the aspen/birch and oak/basswood stands in the eastern portions of the Section are likely to occur in the next fifteen to twenty years. That gives us some time to manage the high quality stands during the next two planning periods to prevent defoliation or to prevent mortality. See Gypsy moth silvicultural for Minnesota and Gypsy Moth silvicultural Considerations for Minnesota TATUM GUIDE . There are two broad strategies to consider in forest stand management. When and where you apply these strategies depends on your land use objectives, stand composition, and site-specific conditions. The combination will determine which practices are feasible for individual stands.

Managing for stand diversity is the best means of limiting any insect defoliation. Encourage a mix of tree species, forest types, ages, and sizes. Managing for tree health and vitality is the best means of limiting tree mortality associated with defoliation (no matter how diverse your stand, some defoliation still may occur). Thin overly-dense stands to reduce competition. Where consistent with management objectives, harvest and regenerate oak and aspen stands growing beyond their normal rotation age. Remove suppressed trees likely to die anyway and create growing space for seed and crop trees. Maintain oak as an important component of the stand, but

encourage other species where possible. See Minnesota DNR silvicultural tipsheet: minimizing gypsy moth damage.

Prolonged drought

Midwestern forests result from a variety of interacting factors, including, climate, soils, landform, post-glacial vegetation migration, fire and wind events, and human management. Climate is the biggest driver that dictates whether a forest can exist in a given area and what species occur, and both temperature and precipitation patterns have an important influence. Forests occur within a range of suitably warm and wet conditions, with conifer forests more common in drier and cooler environments and broadleaf forests more common in warmer and wetter environments.

Apart from long-term climate, precipitation patterns over shorter time scales can have a big influence on forest health and productivity. Droughts have been shown to affect forests in a variety of ways. Seasonal droughts can cause trees to prematurely shut down photosynthesis or even drop their leaves early during the growing season. Moisture stress can be particularly damaging for seedlings and young trees, though mature trees can still be affected by multi-year droughts. Droughts can also disrupt the reproduction of tree species with particular moisture and timing requirements for germination.

Drought can have a major impact on tree health and survival by effectively slowing and reducing growth. If drought is severe enough or lasts for a prolonged period of time, it also can cause death to all or portions of a tree. More common, however, is the effect drought has on a tree's ability to withstand insects and diseases.

Prolonged drought also provides an ideal environment for insect and pathogen populations to build up and then kill pockets of trees or most of the trees in a stand. Examples of these pests are Armillaria root disease, *Ips* bark beetles of pines, bronze birch borer, two-lined chestnut borer on oak, bronze poplar borer and eastern larch beetle. See the table in Section 3 to find the internet link for each of these pests.

How climate change affects specific forests will depend on a variety of factors, including site conditions, forest health, and management. We will not be able to fully anticipate all of the consequences of climate change, particularly the interactions among stressors like drought and forest pests. Forest managers can be proactive in adapting to climate change, however, even in the face of future uncertainty.

In this context, “adapting” means taking action to enhance the ability of forests to thrive in future conditions. There is no single best answer of how to adapt to climate change, because adaptation responses will vary by forest type, site conditions, landowner goals, and other factors. Often, the adaptation process will begin with an assessment of risk or vulnerability across a range of future climates. Foresters are beginning to test adaptation practices in the real world, such as: planting species anticipated to tolerate future conditions, thinning forests to reduce moisture stress and fire risk, and encouraging greater diversity. See: Drought and forest impacts in the midwest

White spruce plantation decline

When white spruce plantations with a high basal area reach age 30 -40, they are losing vigor, growth is slowed and trees have low percent live crown ratios. To compound this, they are increasingly susceptible to damage from pests like spruce budworm, Rhizosphaera needlecast, spruce weevils and decay fungi. Thinning has been used to reverse this trend.

Thin young plantations to lower BA and increase live crown ratios. Thin healthy 35-45 year old plantations down to 275-350 stems/ac to increase LCR and growth of residual trees. If plantations are >55 years and haven’ t ever been thinned or if they are showing signs of pest problems, they are unlikely to do well after thinning. In this case, consider clearcutting.

Thinning in white spruce plantations is not a panacea for their problems. After thinning, it is still common to get tree mortality in spruce plantations. Also present are serious root injuries, debarking, cracking and breakage near the root collar, because roots grow right on the surface of the soil. These injuries are caused by heavy equipment operation. Thinning often leads to windthrow and root and butt decays. In fact, where there have been multiple entries, root damage builds up, productivity decreases and decayed stem volume increases.

White spruce plantation decline	
Reasoning	White spruce trees with LCR > 40% are productive and healthy. Pre-commercial thinnings should aim at creating trees with >40%LCR. Commercial thinning should always retain trees with> 40% LCR. Old, unthinned or pest infested stands will not benefit from thinning and may do worse if thinned.
Threshold	Pre-commercial thinning: In plantations where stem density is high (>800 stems/ac), remove number of stems by about 50% to increase live crown ratios (LCR). Retain trees with LCR > 40%. Trees with >40% live crown ratios (LCR) are still vigorous and healthy and those plantations may benefit from thinning by a careful operator. Commercially thin healthy 35-45 year old plantations down to 90-110 sq ft. or 50% of BA. If plantations are >55 years and haven't ever been thinned or if they are older and showing signs of pest problems, they are unlikely to do well after thinning. In this case, consider clearcutting.
Sales Design	Select trees with LCR > 40% for retention. Avoid thinning from above, WS with larger diameter have larger LCR, are more vigorous and are likely to fare better after thinning. Skid trails perpendicular to rows of trees are not constrained by row width and allow equipment to stay farther from the base of the tree and large, exposed roots. Leave 3 feet or more between equipment and trees on both sides of the skid trail to prevent root damage. Do not allow any work when soils are wet. Preferred option for operations are on frozen soils with snow cover.

Ash Management Guidelines under Operation Order 119

Operational Order 119 directs each landed division to develop discipline specific guidelines for ash management. The purpose is to encourage adaptive ash management where that is feasible and where possible, to help ensure forest sustainability as emerald ash borer populations spread to occupy the state. In light of research that indicates ash mortality is likely to approach 99% in areas dominated by ash, managing for an ash cover type is no longer feasible. Instead, the goal is to maintain forest structure and function where management options exist. This plan will consider those management options and where they are feasible.

In the wetter forested communities dominated by ash, black ash regulates stand hydrology. Tree evapotranspiration is responsible for keeping water levels stable during the growing season, without which these stands are likely to convert of non-forested types. The absence of other tree species capable of surviving on these wet sites, renders effective forest management nearly impossible.

In the dryer forested communities dominated by ash, ash species tend to be of less importance and the presence of other tree species provides harvest opportunities able to sustain forest cover. Where ash occurs in dry upland to somewhat moist forested plant communities, other tree species will likely replace the ash component over time.

Where attention is needed and management is feasible are the moderately wet site classified as WFn55 and those with similar hydrology. Other tree species are able to thrive on these sites. So management practices that gradually reduce the ash component and increase the component of other tree species is advised. However, current market conditions limit where these ash dominated forests can be managed. To encourage timber management on these sites, the Operation Order oversight committee recommends that forest managers select WFn55 stands for management on the basis of adjacency, i.e. next to or near other stands on the stand exam list. By grouping these ash dominated stands in with other timber sales, the hope is to get more of them harvested and maintained as forest cover.

Invasive Species Guidelines under Operation Order 113

Operation Order 113 directs each division to develop discipline specific guidelines to prevent the spread of invasive species on state administered lands. Practices designed to prevent the spread of invasive species are not addressed in this document. Rather prevention will be addressed in the context of daily work activities and in contract specifications for work on DNR administered lands.

The Operation Order also gives invasive species management a high priority and that will be addressed in the context of this plan. However, invasive species management is not an end to itself. Instead, invasive species management needs to focus on those infestations capable of impacting forest sustainability. In that context, infestations known to occur in areas covered by this plan will be considered in light of desired future conditions. Where the species present is capable of derailing land use objectives, harvest schedules and practices will be designed to help ensure forest regeneration.

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CHAPTER 8

Wildlife Species Status & Trends
Northern Minnesota & Ontario Peatlands Section

8.1 Wildlife Habitats and Species of Greatest Conservation Need Within the NMOP Section

The NMOP Section provides a variety of wildlife habitats ranging from open brush and sedge wetlands to forest comprising lowland conifers dominated by black spruce, tamarack and white cedar; upland conifers that are mostly jack and Norway pine with some upland white spruce; upland deciduous forest dominated by aspen; and floodplain forest dominated by black ash and cedar. Wetland shrub also covers large areas especially in the Agassiz Lowlands Subsection. Other nonforest habitat includes rivers, lakes, rock outcrops, shoreline, talus slopes, wet meadow, and upland fields. Row crop agriculture is insignificant in this section.

The NMOP Section is located toward the center of the state east to west near northern border with Canada and includes 2 of the 28 subsections that cover Minnesota. Subsections are land units that occur at one level between the Section and Land Type Association levels in a hierarchical ecological classification system that consists of 8 levels: Domain, Division, Province, Section, Subsection, Landtype Association, Landtype and Landtype phase Natioanl Hierachical Framework for Ecological Units

The hierarchical classification system was developed jointly by the MNDNR and the U.S. Forest Service for the purpose of classifying land units into progressively similar ecological features that incorporate information on climate, geology, topography, soils, hydrology, local climate, and vegetation. The 2 subsections (Agassiz Lowlands and Littlefork-Vermilion Uplands) differ in glacial deposition processes and topographic relief, differences that result in somewhat different wildlife habitat composition.

The Agassiz Lowlands Subsection **encompasses** the portion of Glacial Lake Agassiz plain where peatlands are dominant and is bordered to the south by the southern edge of the lake plain where it abuts Des Moines Lobe ground moraines and end moraines. The western boundary is where lands dominated by conifer bog can be distinguished from lands dominated by wet prairie and the eastern boundary separates the lake plain that is primarily peatland from wet to dry mineral sediments Agassiz Lowlands Subsection

Agassiz Lowlands has large wetland complexes that cover thousands of acres. This subsection also has 3 large lakes: Upper and Lower Red lakes and Lake of the Woods. These wetland complexes developed in the lake plain left by the retreat of Glacial Lake Agassiz. On the sand ridges that formed during the retreat, aspen and pine dominate the upland forest that developed.

The Little Fork-Vermilion Uplands Subsection is bounded by the Big Fork River on its western edge and the Vermilion River on its eastern edge, and the topography varies from level to gently rolling. Forest in the Littlefork-Vermilion Uplands covers 70% of the land area. Upland deciduous forest is dominated by aspen and birch; lowland forest includes lowland deciduous forest dominated by black ash and white cedar, and lowland conifer forest dominated by black spruce, tamarack and white cedar.

The first Comprehesive Wildlife Conservation Strategy (CWCS) for Minnesota was completed in 2006 as a requirement to continue to receive Federal aid for wildlife management. This effort resulted in the publication '*Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife*' DNR action plan for Minnesota habitat for the wild and rare . The CWCS focused on developing plans for wildlife species that are deemed to be Species in Greatest Conservation Need (SGCN). All species listed as threatened, endangered, or as species of special concern were automatically considered SGGN. Additionally, species were included as SGCN if they were rare because they declined historically, were declining, were vulnerable to identified threats, or occurred in habitats that have historically declined or that were facing current or potential threats. Of the 292 species that were considered SGCN in the 2006 CWCS, 90 are found in the NMOP Section (Table 1); Agassiz Lowlands Subsection had 88 SGCN (2

amphibians, 63 birds, 3 fish, 9 insects, 7 mammals, 3 mollusks, and 1 reptile) and Littlefork-Vermilion Uplands had 67 SGCN (1 amphibian, 48 birds, 3 fish, 8 insects, 4 mammals, 2 mollusks, and 1 reptile). At least 33 SGCN are directly associated with forest (Table 1). The CWCS is currently being revised and the SGCN list updated; however, a new list of SGCN has not yet been finalized for inclusion in this plan.

Key habitats defined as those habitats that are most important to SGCN in Minnesota were identified in the CWCS by assessing those habitats that were used by the greatest number of SGCN, experienced the most alteration over the past 100 years, contained high percentages of SGCN that are habitat specialists, or were designated by The Nature Conservancy as important stream segments. A total of 16 key habitats in three landscape types (forests, open landscapes, and aquatic) were identified. The intent of these key habitats was to serve as a coarse-filter for the application of system-level ecological concepts such as structure, function and process for the conservation of these species. Of these 16 key habitats, 2 are not found in the NMOP Section (Prairie and Shrub/Woodland-Upland). Of the 14 key habitats found in the NMOP Section (Table 2), the CWCS recognized 4 key habitats to be important in the Agassiz Lowlands Subsection for SGCN: Lowland Coniferous Forest, Non–Forested Wetlands, Shoreline-Dunes-Cliff/Talus and Rivers-Headwaters to Large. The CWCS recognized 3 key habitats to be especially important in the Littlefork–Vermilion Uplands Subsection: Upland Coniferous Forest, Lowland Coniferous Forest, and Rivers-Headwater to Large.

Key habitats in the CWCS were related (crosswalked) to the Minnesota Native Plant Communities (MDNR 2003), where applicable to more accurately describe the breadth of conditions in the key habitats. This crosswalking to native plant communities captures the great amount of variability in various aspects of the habitats and microhabitats within each of the key habitats. Aquatic communities were not addressed in Minnesota's Native Plant Community classification so they are not included in the table below. Note that many SGCN are not closely associated with forest habitat but with lake shore, rock outcrops, lake and river habitats. Since the Section Forest Resources Management Planning Plan (SFRMP) is an assessment specifically for forest planning, the main focus will remain on wildlife species associated with forested habitats or with habitats that may be impacted by forest management activities, but recognize that these non-forest habitats often occur in a matrix of forested landscapes.

8.2 Issues Identified in the CWCS in Forested Key Habitats

The first major goal identified in the CWCS for all SGCN is to stabilize populations. Habitat loss and habitat degradation are identified as the most important underlying causes of species vulnerability in Agassiz Lowlands and Littlefork- Vermilion Uplands subsections affecting nearly 90 % of SGCN species. Of 33 SCGN that are associated with the Key Habitat of lowland coniferous forest in the combined Agassiz Lowlands Subsection and the Littlefork-Vermilion Uplands Subsection (page 120 and page 150 of CWCS), roughly a quarter of the species is specialist of this habitat type. The priority conservation action for stabilizing SGCN in Lowland Coniferous Forest is to incorporate habitat needs in the planning of forest management (page 122 and page 152 of CWCS). Recommended conservation practices for lowland conifers include simulating landscape disturbance patterns with timber harvest and considering disturbance return intervals to guide rotation periods. The natural disturbance regime in lowland conifers includes small scale blow downs that occur every 40 to 80 years. Catastrophic fire is rare, occurring every 360 to 1,000 years in much of the lowland coniferous forest. In small basins that are surrounded by fire-prone forest types, the frequency of catastrophic fire could have a reoccurring interval as low as 220 years (see Pages 191-230 in MNDNR 2003; CWCS page 241; Friedman and Reich 2005).

Although Upland Deciduous Forest is not an important key habitat in NMOP subsections, about 21 SGCN utilize this habitat but none are specialists for this habitat type. The Upland Deciduous Forest in the 2 NMOP subsections is largely of the aspen covertype. Structural diversity of upland aspen forest in managed forest is lower than it was under natural disturbance regimes. In pre- settlement forest, there was a stronger coniferous component in upland deciduous forest, and the aspen forest was also older (CWCS- Page 249). Structural diversity increases with age as snags, large trees, coarse woody debris and canopy gaps accumulate. Conservation practices that will benefit a number of SGCNs that use this

key habitat include mimicking landscape disturbance patterns in forest management such as managing for large patches, simulating more closely natural disturbance return intervals of mesic and fire dependent forest stands, and managing stands to retain biological legacies such as green trees, surviving propagules and organisms, dead wood, and certain aspects of soil chemistry and structure.

Upland Coniferous Forest is a key habitat in the Littlefork-Vermilion Subsection but not in the Agassiz Lowlands Subsection. About 30 SGCN use this habitat of which 27% is specialist for this habitat type. The dominant natural disturbance factor in this habitat type is wildfire, which historically recurred every 20 to 100 years. In managed forests, clear-cutting has replaced wildfire as the dominant disturbance factor. Forests originating from clear-cuts have less structural diversity than stands originating from a wildfire. Conservation practices that would benefit SGCN and many other species using this habitat type include using prescribed fire, using natural disturbance return intervals to guide rotation periods, mimicking landscape disturbance patterns such as management in large patches, and retaining biological legacies within stands.

8.3 Information Needs for SGCNs in NMOP

A second goal identified in the CWCS was to improve knowledge about SGCN. Much of the NMOP Section has not been surveyed by the Minnesota Biological Survey (MBS). Among the information needs that were identified for the 2 subsections in NMOP are the need for 1) specific and detailed information on the habitat requirements of SGCN in relation to key habitats, 2) researching conservation actions and developing best management practices for enhancing key habitats; and 3) researching emerging SGCN habitat management issues such as climate change.

The distribution of most species, specifically birds, small mammals, and insects are affected by the structure and composition of the habitat at various scales. Some examples of parameters that affect habitat structure would be canopy closure, size and density of canopy gaps, canopy height, shrub layer development, and dead and down materials such as fallen logs and trees on the ground. At landscape scales the distribution and abundance of species would be affected by lowland conifer forest size, juxtaposition to other forest types, and distance from other lowland conifer patches. These relationships that exist between species and habitat structure at various scales have been most studied for bird and small mammal communities.

The North American Bird Conservation Initiative (NABCI) North American Bird Conservation Initiative_US was formed to facilitate bird conservation across different regions in North America. To identify priorities in bird conservation, the plan divides North America into progressively more similar ecological regions in a hierarchy of 4 spatial scales. The two subsections within the Minnesota-Ontario Peatlands fall within Bird Conservation Region 12 North_American_Bird_Conservation_Initiative_US_Boreal_Hardwood_Transition The USGS Breeding Bird Survey North American Breeding Bird Survey provides a large database for the NABCI. This survey with established 25-mile route surveys across the continent provides long-term monitoring by tracking the status and trends of many breeding landbirds in North America. A large percentage of bird species using Lowland Coniferous forest are boreal species with distributional ranges extending into Canada. It is noteworthy to recognize that because of the remoteness of boreal ecosystems relative to human population centers and because of accessibility issues in extensive wetlands, surveys and research on boreal species have been more limited than those on species using other habitats. Abundance and population trend data on several bird species that are specialists for Lowland Coniferous forest and species associated with this key habitat are inadequate. These species might not have received the management attention that other species of more southern distributions or those using other habitats have. More information however should be available when the analysis of data collected through the 2011-2013 MN Breeding Bird Atlas, and through the ongoing research on bird species in lowland coniferous forest being conducted by the Natural Resources Research Institute in 2013-2014 are completed. Boreal forest bird species that are at the southern edge of their distribution in NMOP however have come in recent years into public focus, especially in Canada because of concerns

about increasing human pressures on the boreal forest, from logging, mining, energy development activities, and recreation (Boreal Songbird Initiative).

The variability that exists within the Lowland Coniferous Forest key habitat is huge when considering the range of canopy cover, height of the canopy and sub canopy, shrub development and ground cover. The variability in these parameters could probably explain the distribution of nesting birds and invertebrates that are SGCN. An important goal would then be to identify how SGCN are responding to this variability that is somewhat captured and described for the different Native Plant Communities falling within a key habitat. Another important variability is the land cover composition at larger area scales (landscape scale above the stand level). How this landscape level variability affects the distribution of SGCN is also an important goal. It should be recognized that land management together with natural disturbance events such as fire, windthrow and disease affect both the structure within the forest stand as well as the forest composition at the landscape scale.

The CWCS recognized the need for long term monitoring of SGCN and key habitats. Long term monitoring is necessary for assessing how species are responding to landscape and stand level changes that are affected by land management activities, natural disturbances as well as climate change. Table 3 lists past and ongoing surveys and monitoring efforts in NMOP that also include surveys of SGCNs. Information from all the combined surveys should however provide a good monitoring base to address emergent issues and the need for adaptive management. The boreal coniferous forest is at the extreme southern edge of its distribution within the NMOP Section. Climate change models show lowland conifer cover types to be at highest risk of disappearing from Minnesota, shifting north USDA Forest Service Climate Change Tree Atlas). For this reason, long term monitoring and adaptive management in response to climate induced changes that are occurring over all of Minnesota are most pressing in the NMOP Section. The 2006 CWCS is a ten year plan and is currently being reviewed. Climate change will likely receive more focus in the new plan. Moose is a species that has a declining trend in Minnesota and for which climate change might be a concern. Moose is present in low numbers in the 2 subsections of NMOP. This species is likely to be listed as SGCN in the new CWCS. While not monitored specifically in NMOP, moose is monitored elsewhere in Northern Minnesota

8.4 Human Dimensions in Conservation of SGCN and Key Habitats in NMOP

The CWCS recognized the need for involving the citizenry in the conservation of SGCN and their habitats. A major goal was to enhance people's appreciation and enjoyment of SGCN. Developing information on SGCN, their habitats, and opportunities for wildlife-related recreation within the NMOP Section would align with this goal. Many of the bird species found in the NMOP Section are boreal species that are at their most southern distribution and in some cases; this is the only place in the United States where these species are easily found. Boreal bird species, while abundant in the NMOP Section, are rare elsewhere in Minnesota except perhaps in the Tamarack Lowlands Subsection, which also has large complexes of Lowland Coniferous forest. The Connecticut warbler, boreal chickadee, black-backed woodpecker, northern goshawk, boreal owl, northern hawk owl and great gray owl are species that are highly desired by birders. The uniqueness of the Agassiz Lowlands Subsection for boreal bird habitat has recently been recognized through the establishment of an Important Bird Area (IBA). Audubon Minnesota in partnership with the MN DNR has identified and established these areas defined as areas providing essential habitat for one or more breeding, wintering and/or migrating bird species. The Big Bog Important Bird Area is over 1.7 million acres in the Red Lake Peatlands area along a transitional zone between prairie, deciduous forest and northern boreal forest and at least 289 bird species have been detected in this area (http://netapp.audubon.org/iba/Site/2911).

The remoteness and natural settings that still remain prevalent over much of the NMOP Section, the opportunity to view large mammals such as moose, wolf, black bear, lynx, and the unique assembly of boreal bird species suggest that there is great potential for expansion of non-consumptive wildlife recreation. At this time, the potential for wildlife-related recreation, other than hunting and fishing, has not been realized in the NMOP Section. One birding trail, the Pine to Prairie Birding Trail, has 6 birding sites

that fall within the Agassiz Lowlands Subsection (Pine to Prairie Birding Trail). A national survey of fishing, hunting and wildlife recreation conducted in 2011 by the U.S. Fish and Wildlife Service (2011 National Survey of Fishing, Hunting, and Wildlife-associated recreation) shows increasing trends of time spent and expenditures by Americans on non- consumptive wildlife recreation. Sax-Zim Bog organization (Sax-zimbog) was formed to promote birding activity in the Tamarack Lowlands Subsection which is the only other subsection in Minnesota that comprises extensive Lowland Coniferous Forest habitat. The success of this effort is reflected in the yearly bird festivals held in the area and the increasing number of visitors to it. It is expected that a similar positive potential for wildlife- related recreation would also exist in NMOP. In recent years, there has also been an increase in public interest in invertebrates and in citizen science participation in these surveys. The peatland habitats ranging from open peatlands to rich forest peatlands provide unbounded opportunities for discovering the presence of species of moths, butterflies, dragonflies, and beetles. Dragonfly surveys were held in 2013 and 2014 at Norris Camp in which several new county species records were picked up (Minnesota Dragonfly Society). It is expected that interest in similar survey activities would continue to increase.

Table 8.4.1. Species of Greatest Conservation Need found within the Agassiz Lowlands and Littlefork- Vermilion Uplands subsections along with the key habitats these species use.

Species names in **bold letters** represent species that are highly associated with forest.

Common Name	Scientific Name	Agassiz Lowlands	Littlefork–Vermilion	Key Habitat/ or Habitat used
AMPHIBIANS				
Common Mudpuppy	*Necturus maculosus*	x		River
Eastern Red-backed Salamander	*Plethodon cinereus*	x	x	Upland Mesic Forest
BIRDS				
Northern Goshawk	*Accipiter gentilis*	x	x	Upland Coniferous & Deciduous Forest
Boreal Owl	*Aegolius funereus*	x		Upland Deciduous Forest
Le Conte's Sparrow	*Ammodramus leconteii*	x	x	Grassy wetlands, fields
Nelson's Sharptail Sparrow	*Ammodramus nelson*	x		Non- forested Wetlands
American Black Duck	*Anas rubripes*	x	x	Lake
Ruddy Turnstone	*Arenaria interpres*	x	x	Lake Shoreline
Short-eared Owl	*Asio flammeus*	x		Non forested Wetlands
Upland Sandpiper	*Bartramis longicauda*	x		Surrogate Grassland
American Bittern	*Botaurus lentiginosus*	x	x	Non- forested Wetlands
Dunlin	*Calidris alpina*	x	x	Non- forested Wetlands
Semipalmated Sandpiper	*Calidris pusilla*	x	x	Non- forested Wetlands
White-rumped Sandpiper	*Callidris fuscicollis*	x		Non- forested Wetlands
Whip-poor-will	*Caprimulgus vociferus*	x	x	Dry woodlands oak and pine
Veery	*Catharus fuscensus*	x	x	Upland Deciduous Forest
Piping Plover	*Charadrius melodus*	x		Shoreline-Dunes; Lake- Large
Black Tern	*Chlidonias niger*	x		Non- forested Wetlands
Common Nighthawk	*Chordeiles minor*	x	x	Shoreline-Dunes-Cliff/ Talus – Open habitats
Northern Harrier	*Circus cyaneus*	x	x	Non- forested Wetlands
Marsh Wren	*Cistothorus palustris*	x		Non- forested

				Wetlands
Sedge Wren	*Cistothorus platensis*	x	x	Non- forested Wetlands
Black-billed Cuckoo	*Coccyzuz erythropthalmus*	x	x	Woodland edges
Olive-sided Flycatcher	*Contopus cooperi*	x	x	Lowland Coniferous Forest
Eastern Wood Pewee	*Contopus virens*	x	x	Upland deciduous Forest
Yellow Rail	*Conturnicops noveboracensis*	x	x	Non- forested Wetlands
Trumpeter Swan	*Cygnus buccinator*	x	x	Non- forested Wetlands
Bay-breasted Warbler	*Dendroica castanea*	x	x	Lowland Coniferous Forest
Cape-May Warbler	*Dendroica tigrina*	x	x	Lowland Coniferous Forest
Bobolink	*Dolichonyx oryzivorus*	x	x	Sedge meadows, hayfields
Least Flycatcher	*Empidonax minimus*	x	x	Upland Deciduous Forest
Spruce Grouse	*Falcipennis Canadensis*	x	x	Lowland Coniferous Forest
Common Loon	*Gavia immer*	x	x	Non- forested Wetlands
Bald Eagle	*Haliaeetus leucocephalus*	x	x	Edges of lakes, rivers
Wood Thrush	*Hylocichla mustelina*		x	Upland Deciduous Forest
Least Bittern	*Ixobrychus exilis*	x		Non- forested Wetlands
Short-billed Dowitcher	*Limnodromus griseus*	x	x	Non- forested Wetlands Mudflats
Marbled Godwit	*Limosa fidoa*	x		Non- forested Wetlands Shallow pools- Mudflats
Hudsonian Godwit	*Limosa haemastica*	x		Non- forested Wetlands Mudflats
Red-headed Woodpecker	*Melanerpes erythrocephalus*	x	x	Upland
Swamp Sparrow	*Melospiza georgina*	x	x	Lowland Shrub
Whimbrel	*Numenius phaeopus*	x		Non- forested Wetlands
Connecticut Warbler	*Oporornis agilis*	x	x	Lowland Coniferous Forest
American White Pelican	*Pelecanus erythrorhynchos*	x		Non- forested Wetlands
Wilson's Phalarope	*Phalaropus tricolor*	x		Non- forested Wetlands

Rose-breasted Grosbeak	*Pheucticus ludovicianus*	x	x	Upland Deciduous Forest
Black-backed Woodpecker	*Picoides arcticus*	x	x	Lowland Coniferous Forest
American Golden-plover	*Pluvialis dominica*	x	x	Non- forested Wetlands
Red-necked Grebe	*Podiceps grisegena*	x	x	Lake
Boreal Chickadee	*Poecile hudsonicus*	x	x	Lowland Coniferous Forest
Virginia Rail	*Rallus limicola*	x	x	Lakes – Shallow
American Avocet	*Scolopax minor*	x		Lake
American Woodcock	*Scolopax minor*	x	x	Wet woods, wood edges
Ovenbird	*Seiurus aurocapillus*	x	x	Upland Deciduous Forest
Yellow-bellied Sapsucker	*Sphyrapicus varius*	x	x	Upland Deciduous Forest
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	x	x	Shoreline-Dunes-Cliff/ Talus
Forster's Tern	*Sterna forsteri*	x		Lake –Shallow Large Open water
Common Tern	*Sterna hirundo*	x		Lake
Eastern Meadowlark	*Sturnella magna*		x	Fields
Brown Thrasher	*Toxostoma rufum*	x	x	Upland Forest edge – open shrub
Greater Yellowlegs	*Tringa melanoleuca*	x	x	Lake shallows , mud flats
Winter Wren	*Troglodytes troglodytes*	x	x	Riparian and Upland Forest
Buff-breasted Sandpiper	*Tryngites subruficollis*	x	x	Margins of wetlands
Sharp-tailed Grouse	*Tympanuchus phasianellus*	x	x	Lowland Shrub-Muskeg and Variety of open habitat
Golden-winged Warbler	*Vermivora chrysoptera*	x	x	Lowland Shrub-Forest Edge
Canada Warbler	*Wilsonia Canadensis*	x	x	Upland Deciduous Forest
White-throated Sparrow	*Zonotrichia albicollis*	x	x	Upland Deciduous Forest
FISH				
Lake Sturgeon	*Acipenser fulvesdcens*	x	x	River
Northern Brook Lamprey	*Ichthyomyzon fossor*	x	x	River
Greater Redhorse	*Moxostoma valenciennesi*	x	x	River
INSECTS				
A Tiger Beetle	*Cicindela denikei*	x	x	Shoreline-Dunes-

				Cliff/ Talus (sandy uplands and shield outcrops within 25 miles of CA border)
Bog Copper	*Epidemia epixanthe michiganensis*	x	x	Lowland Coniferous Forest
Disa Alpine	*Erebia disa mancinus*	x	x	Lowland Coniferous Forest
Leonard's Skipper	*Hesperia leonardus leonardus*	x		Dry, short and mid-height prairie
Nabokov's Blue	*Lycaeides idas nabokovi*	x	x	Dwarf bilberry, usually in sandy outwash
Macoun's Arctic	*Oeneis macounii*	x	x	Jack pine forests
A Caddisfly	*Oxyethira itascae*	x	x	Lakes and streams
Tawny Crescent	*Phyciodes batesii*	x	x	dry or moist forest openings and sandy barrens
Grizzled Skipper	*Pyrgus centaureae freija*	x	x	Sandy clearings with grasses, bilberry, alder, willow and blueberry w/ lowland conifers adjacent
MAMMALS				
Canada Lynx	*Lynx canadensis*	x	x	Mosaic of habitats
Gray Wolf	*Canis lupus*	x	x	Forested landscape-Mosaic of habitats
Elk	*Cervus elaphus*	x		Forested landscape-Mosaic of habitats
Least Weasel	*Mustila nivalis*	x		Old fields, open-woodland edge
Franklin's Ground Squirrel	*Spermophilus franklinii*	x		Open habitat
Northern Bog Lemming	*Synaptomis borealis*	x	x	Lowland coniferous forest
American Badger	*Taxidea taxus*	x	x	Open; semi open landscapes
MOLLUSKS				
Creek Heelsplitter	*Lasmigona compressa*	x	x	River
Fluted-shell	*Lasmigona costata*	x		River
Black Sandshell	*Ligumia recta*	x	x	River
REPTILES				
Common snapping turtle	*Chyledra serpentina*	x	x	Lake, River, Wetlands

Table 8.4.2. Relationship between key habitats identified in the Comprehensive Wildlife Conservation Strategy and Native Plant Communities (NPC) that are possible in the NMOP Section with Species of Greatest Conservation Need (SGCN) that are obligate to these habitats.

Key Habitat	Ecological System	Native Plant Community	NPC Code	SGCN
FORESTS				
Lowland Deciduous	**Wet Forest**	Black Ash - Aspen - Balsam Poplar Swamp (Northeastern)	WFn55a	No SGCN in NMOP are obligate for this key habitat, but many of the species using the upland mesic forest could use this key habitat
		Black Ash - Mountain Maple Swamp (Northern)	WFn55c	
		Black Ash - Conifer Swamp (Northeastern)	WFn64a	
		Black Ash - Alder Swamp (Northern)	WFn64c	
		Lowland Black Ash - Aspen - Balsam Poplar Forest	WFw54a	
	Floodplain Forest	Black Ash - Silver Maple Terrace Forest	FFn57a	
		Silver Maple-(Sensitive Fern) Floodplain Forest	FFn67a	
Lowland Coniferous	**Forested Rich Peatland**	Rich Black Spruce Swamp (Basin)	FPn62a	Northern Bog Lemming, Olive-sided Flycatcher, Bay-breasted Warlber, Cape May Warbler Spruce Grouse, Black-backed Woodpecker, Boreal Chickadee, Bog Copper, Disa Alpine, Connecticut Warbler
		White Cedar Swamp (Northcentral)	FPn63b	
		White Cedar Swamp (Northwestern)	FPn63c	
		Rich Black Spruce Swamp (Water Track)	FPn71a	
		Rich Tamarack Swamp (Eastcentral)	FPn72a	
		Rich Tamarack (Sundew - Pitcher Plant) Swamp	FPn81a	
		Rich Tamarack - (Alder) Swamp	FPn82a	
		Extremely Rich Tamarack Swamp	FPn82b	
		Tamarack - Black Spruce Swamp (Aspen Parkland)	FPw63a	
	Acid Peatlands	Black Spruce Bog	APn80a	
		Poor Black Spruce Swamp	APn81a	
		Poor Tamarack - Black Spruce Swamp	APn81b	
	Wet Forest	Lowland White Cedar Forest (North Shore)	WFn53a	
		Lowland White Cedar Forest (Northern)	WFn53b	
Upland Coniferous	**Fire-dependent Forest**	Jack Pine Woodland (Sand)	FDn12a	Northern Goshawk, Black-backed Woodpecker, Olive-sided Flycatcher, Spruce Grouse
		Red Pine Woodland (Sand)	FDn12b	
		Red Pine - White Pine Woodland (Canadian Shield)	FDn32a	
		Black Spruce - Jack Pine Woodland	FDn32c	
		Jack Pine - Black Spruce Woodland (Sand)	FDn32d	
		Spruce - Fir Woodland (North Shore)	FDn32e	
		Red Pine - White Pine Woodland	FDn33a	
		Black Spruce Woodland	FDn33c	
		White Pine - Red Pine Forest	FDn43a	
		Upland White Cedar Forest	FDn43c	
FORESTS				
Upland Coniferous	**Fire-dependent Forest**	Red Pine - White Pine Forest	FDc34a	Northern Goshawk, Eastern Wood Pewee, Wood Thrush, Boreal Owl
	Mesic Hardwood Forest	White Pine - White Spruce - Paper Birch Forest	MHn44b	
Upland Deciduous (Aspen)	**Fire-dependent Forest**	Aspen - Birch Woodland	FDn33b	
		Aspen - Birch Forest	FDn43b	
		Aspen - (Beaked Hazel) Woodland	FDw34b	

		Aspen - (Chokecherry) Woodland	FDw44b	
	Mesic Hardwood Forest	Aspen - Birch - Basswood Forest	MHn35a	
		Aspen - Fir Forest	MHn44c	
		Aspen - (Sugar Maple – Basswood) Forest	MHc37a	
Upland Deciduous (Hardwood)	**Mesic Hardwood Forest**	Sugar Maple - Basswood - (Bluebead Lily) Forest	MHn47a	
		Sugar Maple - Basswood - (Horsetail) Forest	MHn47b	
		Sugar Maple – Basswood – (Aspen) Forest	MHc37b	
Upland Deciduous (Oak)	**Mesic Hardwood Forest**	Green Ash – Bur Oak – Elm Forest	MHw36a	
OPEN LANDSCAPE				
Shoreline – Dunes-Cliff/Talus	**Lake Shore**	Sand Beach (Inland Lake)	LKi32a	Ruddy Turnstone, Whimbrel, American Avocet, White-rumped Sandpiper, Semipalmated Sandpiper, Greater Yellowlegs
		Gravel/Cobble Beach (Inland Lake)	LKi32b	
		Boulder Shore (Inland Lake)	LKi43a	
		Bedrock Shore (Inland Lake)	LKi43b	
		Clay/Mud Shore (Inland Lake)	LKi54a	
		Mud Flat (Inland Lake)	LKi54b	
	River Shore	Willow Sandbar Shrubland (River)	RVx32a	
		Sand Beach/Sandbar (River)	RVx32b	
		Gravel/Cobble Beach (River)	RVx32c	
		Bedrock/Boulder Shore (River)	RVx43a	
		Slumping Clay/Mud River Slope	RVx54a	
		Clay/Mud River Shore	RVx54b	
	Cliff and Talus	Dry Mafic Cliff (Northern)	CTn11a	
		Dry Rove Cliff (Northern)	CTn11b	
		Dry Thomson Cliff (Northern)	CTn11c	
		Dry Felsic Cliff (Northern)	CTn11d	
		Dry Sandstone Cliff (Northern)	CTn11e	
		Dry Open Talus (Northern)	CTn12a	
OPEN LANDSCAPE				
Shoreline – Dunes-Cliff/Talus	**Cliff and Talus**	Mesic Open Talus (Northern)	CTn12b	
		Mesic Malfic Cliff (Northern)	CTn32a	
		Mesic Rove Cliff (Northern)	CTn32b	
		Mesic Thomson Cliff (Northern)	CTn32c	
		Mesic Felsic Cliff (Northern)	CTn32d	
		Mesic Sandstone Cliff (Northern)	CTn32e	
		Wet Malfic Cliff (Northern)	CTn42a	
		Wet Rove Cliff (Northern)	CTn42b	
		Wet Felsic Cliff (Northern)	CTn42c	
		Wet Sandstone Cliff (Northern)	CTn42d	
	Rock Outcrop	Sandstone Outcrop (Northern)	ROn12a	
		Crystalline Bedrock Outcrop (Northern)	ROn12b	
Lowland Shrub	**Open Rich Peatland**	Bog Birch – Alder Shore Fen	OPn81a	No SGCN in NMOP are obligate for this key habitat, but many of the species could use this key habitat
		Leatherleaf – Sweet Gale Shore Fen	OPn81b	
		Shrub Rich Fen (Water Track)	OPn91a	
	Forested Rich Peatland	Alder - (Maple - Loosestrife) Swamp	FPn73a	
Surrogate Grassland	Not defined	Vegetation that dominate this habitat are not native	None	

Wetland-Nonforested	**Marsh**	Cattail - Sedge Marsh (Northern)	MRn83a	No SGCN in NMOP are obligate for this key habitat, but many of the species could use this key habitat
		Cattail Marsh (Northern)	MRn83b	
		Bulrush Marsh (Northern)	MRn93a	
		Spikerush – Bur Reed Marsh (Northern)	MRn93b	
	Wet Meadow/Carr	Sedge Meadow	WMn82b	
	Open Rich Peatland	Graminoid Rich Fen (Water Track)	OPn91b	
		Graminoid Rich Fen (Basin)	OPn92a	
		Graminoid – Sphagnum Rich Fen (Basin)	OPn92b	
		Spring Fen	OPn93a	
	Acid Peatland	Graminoid Bog	APn90b	
		Graminoid Poor Fen (Water Track)	APn91c	
AQUATIC				
Lake – Deep	Not defined	Aquatic systems not classified in the NPC classification	None	Piping Plover
Lake – Shallow	Not defined	Aquatic systems not classified in the NPC classification	None	Least and American Bittern, Virginia Rail, Marsh Wren
River – Headwater to Large	Not defined	Aquatic systems not classified in the NPC classification	None	Tiger beetles
River – Very Large	Not defined	Aquatic systems not classified in the NPC classification	None	Mussels

Table 8.4.3 Past and Ongoing Wildlife Research, Surveys and Monitoring in the NMOP Section as of 2014.

Survey	Organization or Agency	Brief Description
Breeding Bird Survey (1966-present) (North American Bird Survey)	USGS	Long-term monitoring of birds to track status and trends of breeding birds in North America; surveys are conducted in June by citizens; 3-minute points counts are conducted every 0.5 mi along a 24.5 mi route
Minnesota Breeding Bird Atlas (2009-2013) (Minnesota Breeding Bird Atlas)	MN Audubon	Comprehensive, systematic field survey of the occurrence and breeding status of breeding birds in Minnesota
MN Biological Surveys (1987-present) (Minnesota Biological Survey)	MN DNR (Minnesota Biological Survey)	Systematic collection and interpretation of baseline data on the distribution and ecology of rare plants, rare animals, native plant communities, and functional landscapes; these surveys have not yet been undertaken in Koochiching and Lake of the Woods counties
Western Great Lakes Owl Monitoring (2005-present) : HawkRidge_Western Great Lakes Owl Monitoring	Hawk Ridge Bird Observatory	Volunteer-based survey in Minnesota and Wisconsin to understand the distribution, population status and habitat loss for northern forest owls
Lowland Conifer Bird Surveys Ongoing (2012-2015)	U of MN	Study by Natural Resources Research Institute, to survey birds and develop habitat suitability maps for a subset of birds that breed in lowland coniferous forests
Minnesota Frog and Toad Calling Surveys (1996-present): MNDNR_Frog & Toad_Calling_Survey	USGS/MN DNR	A state-wide, citizen-based survey of frogs and toads along surveys routes with 10 stops to look at population changes in abundance and distribution
Northern Goshawk Surveys (2003-present)	MN DNR	Goshawk monitoring to assess habitat requirements and examine temporal and spatial patterns in breeding activity
Ruffed Grouse, Sharp-tailed Grouse Surveys: DNR Ruffed Grouse_Sharp-tailed Grouse surveys	MNDNR	Statewide surveys of drumming ruffed grouse and sharp-tailed grouse leks each spring.
Furbearers: DNR Hunting and Trapping information	MNDNR	Trapping season results and two population survey results. The established statewide surveys include the winter track survey and the late summer scent station survey.
Nightjar Survey: Center for Conservation Biology		A volunteer-based survey across the range of nightjars in North America. There are established 10 stop routes.
Bear Survey: DNR_Bear_Survey	MNDNR	Annual bear harvest reports and estimated bear density results based on bear harvest and population surveys.

Survey	Organization or Agency	Brief Description
Woodcock Survey: Migratory Bird Data Center	USFWS	Results from established routes across the US and Canada that survey spring singing male woodcock.
Deer Survey: MNDNR_Deer_Survey	MNDNR	Annual deer harvest results along with deer density estimates based on the harvest results, aerial surveys, and the winter severity index.

References:

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Minnesota Department of Natural Resources (2003). Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MNDNR St Paul, MN.

Minnesota Department of Natural Resources (2006). Tomorrow's Habitat for the Wild and Rare. An Action Plan for Minnesota Wildlife. Minnesota Comprehensive Wildlife Conservation Strategy. St Paul, MN.

APPENDIX A
Glossary

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

Area forest resource management plan (AFRMP): Successor to timber management planning (TMP), recognizing that TMP discussions and decisions affected or included a lot more than the decision to harvest. This should not be confused with the comprehensive FRMPs developed for a number of areas in the mid to late-1980s.

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 forestlands for timber management, fish and wildlife habitat improvement, fire control, and a variety of recreational activities. Also, see *Forest road*.

Age class: An interval, commonly 10 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).

All-aged: An uneven-aged stand that represents all ages or age classes from seedlings to mature trees.

Animal aggregations: A concentration of animals (of rare or common species or a mixture of rare and common) that occurs during part or all the species life cycle, such that when these animals are in these aggregations, they are highly vulnerable to disturbance. Examples are colonial water bird nesting sites, bat hibernacula, and mussel beds.

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.

Annual work plan: The annual work responsibilities at the area (i.e., Division of Forestry administrative boundary) documented for the fiscal year.

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. The initial round of Subsection Forest Resource Management Plans (SFRMP) will focus primarily on trends and conditions of forest resources. Standard core assessment information sources and products have been defined.

Basal area: 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: Guidelines for MCBS Statewide Biodiversity Significance Rank):* The Minnesota County Biological Survey uses a statewide ranking system to evaluate and communicate the biodiversity significance of surveyed areas (MCBS Sites) to natural resource professional, state and local government officials, and the public. MCBS 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. (*Draft definition 3/24/2004*)

> ***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 the best of the rest, such as sites with 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 MCBS 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.

Board foot: A unit of measuring wood volumes equaling 144 cubic inches. A board foot is commonly used to measure and express the amount of wood in a tree, sawlog, veneer log, or individual piece of lumber. For example, a 16-inch diameter at breast height (DBH) standing tree that is 80 feet tall contains approximately 250 board feet of wood and a tree with a 30-inch DBH and 80 feet tall contains about 1000 board feet or one metric board foot (MBF). A piece of lumber one cubic foot (1 foot x 1 foot x 1 inch) contains one board foot of lumber.

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

Carr: Deciduous woodland or scrub on a permanently wet, organic soil. A carr develops from a bog, fen or swamp.

Clearcut: The removal of all or most trees during harvest to permit the re-establishment of an even-aged forest. A harvest 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.

Coarse filter: Management of lands from a local to landscape scale that addresses the needs of all or most species, communities, environments, and ecological processes. In using a coarse filter approach (Hunter, 1990), it assumes that a broad range of habitats encompassing the needs of most species needs will be met, and their populations will remain viable on the landscape.

Cohort: a group of trees developing after a single disturbance, commonly consisting of trees of similar age.

Collaboration: A group in which members identify with the group and seriously consider the group's overall charge. Group members assume collective responsibility for outcomes, are interdependent, and have a joint ownership of decisions.

Common forest inventory: Also, known as CCSA (Common Cooperative Stand Assessment). Forest inventory stand data compiled by the Minnesota Interagency Information Cooperative from public agencies including the Minnesota DNR, Superior and Chippewa National Forests, and county land departments (2001). The common format contains the common attributes found in the state, federal, and counties forest inventories.

Competition: The struggle between trees to obtain sunlight, nutrients, water and growing space. Every part of the tree, from the roots to the crown, competes for space and food.

Comprehensive DNR subsection plans: Address Minnesota Department of Natural Resources (DNR) programs and activities within the subsection. Involves programs and activities of multiple DNR divisions, not just the Division of Forestry.

Comprehensive Division of Forestry SFRMPs: Address other aspects of forest resource management on DNR Forestry lands (e.g., recreation, land acquisition/sales, fire management, and private forest management).

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: A change through forest management from one tree species to another within a forest stand or site.

Cooperative stand assessment (CSA): The forest stand mapping and information system used by the DNR to inventory the approximately five million acres (7,800 square miles) owned and administered by the state. The spatial information and stand attributes are now maintained in the Forest Inventory Module (FIM).

Cord: A pile of wood 4 feet high, 4 feet wide, and 8 feet long, measuring 128 cubic feet, including bark and air space. Actual volume of solid wood may vary from 60 to 100 cubic feet, depending on 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 feet and contain 133 cubic feet. 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 type 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 species is aspen would be called an aspen cover type.

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

Critical habitat: habitat or habitat elements that must be present and properly functioning to assure the continued existence of the species in question.

Crop tree: any tree selected or retained to be a component of a future commercial harvest.

Cruise: (v) A survey of forestland to locate timber and estimate its quantity by species, products, size, quality, or other characteristics. (n) An estimate derived from such a survey.

Cubic foot: A wood volume measurement containing 1,728 cubic inches, such as a piece of wood measuring one foot on a side. A cubic foot of wood contains approximately six to 10 usable board feet of wood. A cord of wood equals 128 cubic feet.

Cultural resource: An archaeological site, cemetery, historic structure, historic area, or traditional use area that is of cultural or scientific value.

Desired future forest composition (DFFC) goals: Broad vision of landscape vegetation conditions in the long-term future. For the purposes of the initial round of subsection planning, DFFC goals will focus on future desired forest composition looking ahead 50 years. DFFC goals may include aspects like 1) the amount of various forest cover types within the subsection, 2) age-class distribution of forest cover types, 3) the geographic distribution of these across the subsection, and the related level of management for even-aged forest, 4) extended rotation forest, etc.

Disturbance: Any event, either natural or human induced, that alter 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 that are in the upper layer of the forest canopy, larger than the average trees in the stand.

Early successional forest: The forest community that develops immediately following a 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 succession 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. (See Appendix A.)

Ecological evaluation: A concise report containing descriptions of the significant natural features of a site, such as the flora, fauna, rare features, geology, soils, and any other factors that provide interpretation of the site's history, present state, and biodiversity significance. Management and protection recommendations are often included in these reports. Evaluations are produced by the MCBS at the completion of work in a given county or ECS subsection, and are generally reserved for those sites with the highest biodiversity significance in a geographic region, regardless of ownership.

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.

Ecologically important lowland conifers (EILC): includes stands of black spruce, tamarack, and cedar, including stagnant lowland conifer stands, that are examples of high quality native plant communities (NPC) that are representative of lowland conifer NPC's found in the subsections. The designated EILC stands will be reserved from treatment during this 10-year planning period. Future management/designation of these stands is yet to be determined.

Ecosystem based management: The collaborative process of sustaining the integrity of ecosystems through partnerships and interdisciplinary Teamwork. Ecosystem based management seeks to sustain ecological health while meeting social and economic needs.

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 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. (Draft definition 3/24/2004, 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.

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 10 years).

Evenflow: Providing a relatively consistent amount of timber (or other products) in successive management periods.

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

Extended rotation forests (ERF): Forest stands for which the harvest age is extended beyond the normal or economic harvest age. ERF provides larger trees, old forest wildlife habitat, and other nontimber values. Additional details regarding management of ERF on DNR-administered lands is contained in the DNR Extended Rotation Forest Guidelines (1994). **Prescribed ERF** is the cover type acreage designated for management as ERF. Stands designated as ERF will be held beyond the recommended normal rotation (harvest) age out to the established ERF rotation age(s). A stand of any age can be prescribed as ERF. **Effective ERF** is defined as the portion of the prescribed ERF acreage that is actually over the normal rotation age for the cover type at any one time.

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

Fine filter: Management that focuses on the welfare of a single or only a few species rather than the broader habitat or ecosystem. For example, individual nests, colonies, and habitats are emphasized. A *fine filter* approach (Hunter, 1990) considers the specific habitat needs of selected individual species that may not be met by the broader coarse filter approach.

Forest inventory and analysis (FIA): A statewide forest survey of timber lands jointly conducted by the DNR 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 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. Part of the DNR's **FOR**estry **I**nformation **S**ys**T**em (FORIST).

Forest land: Consists of all lands included in the forest inventory from aspen and pine cover types to stagnant conifers, muskeg, lowland brush, and lakes.

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 a variety of recreational activities. The Division of Forestry has three classifications for roads and access routes:

System roads - These roads are the major roads in the forest that provide forest management access, recreational access and may be connected to the state, county, or township public road systems. These roads are used at least on a weekly basis and often used on a daily basis. The roads should be graveled and maintained to allow travel by highway vehicles, and road bonding money can be used to fund

construction and reconstruction of these types of roads. The level and frequency of maintenance will be at the discretion of the Area Forester and as budgets allow.

Minimum maintenance roads - These roads are used for forest management access on an intermittent, as-need basis. Recreational users may use them, but the roads are not promoted or maintained for recreation. The roads will be open to all motorized vehicles but not maintained to the level where low clearance licensed highway vehicles can travel routinely on them. The roads will be graded and graveled as needed for forest management purposes. Major damage such as culvert washouts or other conditions that may pose a safety hazard to the public will be repaired as reported and budgets allow.

Temporary access – If the access route does not fit into one of the first two options, the access route has to be abandoned and the site reclaimed so that evidence of a travel route is minimized. The level of effort to effectively abandon temporary accesses will vary from site to site depending on location of the access (e.g., swamp/winter vs. upland route), remoteness, and existing recreational use pressures.

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 on adjoining areas.

FORIST: The **FOR**estry **I**nformation **S**ys**T**em (FORIST) is a collection of integrated spatial applications and datasets supporting day-to-day operations across the Division of Forestry. The first two parts of the system are in operation: Forest Inventory Module (FIM) and Silviculture and Roads Module (SRM). A Timber Sales Module is scheduled to be operational in 2006.

Fragmentation: Breaking up of large and contiguous ecosystems into patches separated from each other by different ecosystem types. Breaking up a contiguous or homogeneous natural habitat 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 where a contiguous or homogeneous forest area of a similar cover type and age is broken up into smaller dissimilar units. For example, a conifer-dominated forest (or portion of it) is fragmented by clearcutting if it is converted to another type, such as an aspen-dominated forest.

Fully-stocked stand: A forest stand in which all growing space is effectively occupied but having ample space for development of the crop trees.

Globally Imperiled Communities (G1G2): Refers to areas identified by *NatureServe* as highest ranking globally imperiled native plant communities. Through forest certification, the Department is required to identify and appropriately manage these identified communities.

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 type of 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 patches of selected trees to create openings in the forest canopy and to encourage 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 species or longer-lived species.

Habitat: An area in which a specific plant or animal normally lives, grows and reproduces; the area that provides a plant or animal with adequate food, water, shelter and living space.

Herbivory: Plant communities resulting from the browsing and grazing of wildlife. A plant-animal interaction whereby an organism eats some or all of a plant and the plant responds immediately (stress, decline, or death) or over time (evolutionary adaptation). Herbivory occurs both above and below ground. As defined for the issues concerned with herbivory in the plan; the influence by dominant herbivores on forest composition, structure, forest dynamics and spatial patterns. Dominant herbivores include beaver, deer, moose, hares, rabbits, small mammals, and forest tent caterpillars.

High Conservation Value Forests: HCVFs are defined as *areas of outstanding biological or cultural significance.* Through Certification the Department is required to manage for a broad set of objectives and forest resources, including the management and protection of rare species, communities, features, and values across the landscape. This commitment requires certificate holders to identify High Conservation Value Forests (HCVFs) and manage such areas to "maintain or enhance" identified High Conservation Values (HCVs).

High risk low volume (HRLV): HRLV stands are identified based on one or more of the following: 1) stands coded as high risk in FIM forest inventory, 2) significant insect or disease damage to the main species in the stand, 3) stands over normal rotation age at time of survey with total stand volume eight cords per acre (low volume), or 4) very old stand, e.g., aspen over than 80 years old.

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 is 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 clear-cutting 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 of insect or disease problems, and wildlife habitat management (e.g., maintenance of wildlife openings).

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

Issue: A natural resource-related concern or conflict that is directly affected by, or directly affects, decisions about the management of vegetation on lands administered by the DNR divisions of Forestry and Fish and Wildlife. Relevant issues will likely be defined by current, anticipated, or desired resource conditions and trends, threats to resources, and vegetation management opportunities. The key factor in determining the importance of issues for SFRMP is whether vegetation management issues can address the issue in whole or substantial part on DNR-administered lands.

Landform: Any physical, recognizable form or feature of the earth's surface, having a characteristic shape, and produced by natural causes. Examples of major landforms are plains, plateaus, and mountains. Examples of minor landforms are hills, valleys, slopes, eskers, and dunes. Together, landforms make up the surface configuration of the earth. The "landform" concept involves both empirical description of a terrain (land-surface form) class and interpretation of genetic factors ("natural causes"). (An Ecological Land Classification Framework for the United States, 1984, p. 40).

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 ECS, and Minnesota Forest Resources Council (MFRC) regional landscapes. The issue being addressed usually defines the type and size of landscape to be used.

Landscape region: A geographic region that is defined by similar landforms, soils, climatic factors, and potential native vegetation. The landscape region used for this planning effort is the subsection level of the ECS.

Landscape study area (LSA): A large geographic area identified by the MCBS as a core area for the MCBS survey process in northern Minnesota. The LSA is intended to represent some of the landscapes within an ecological subsection (a unit in Minnesota's ECS. A LSA 1) generally captures the range of environmental gradients and ecological conditions found in large landscapes, 2) generally encompasses the range of native plant community complexes that exhibit repeatable patterns at the landform or ecological land-type association (LTA) scale, 3) exhibits the potential for intact landscape level processes to occur, 4) contains representative native plant communities functioning under relatively undisturbed conditions, and 5) often contains habitat for rare species. An LSA area is typically thousands of acres and contains two to several MCBS sites. A LSA may encompass portions of one or more ecological LTAs and lie in more than one county. LSAs are identified prior to MCBS field surveys and boundaries are modified during the survey process. At the completion of the MCBS surveys, a LSA becomes a macro site, two or more sites, or a combination of macro sites and sites. In some cases a LSA is eliminated from further survey consideration during the MCBS survey process.

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.

Macrosite: A large area, generally thousands of acres, containing two or more sites that have some geographical and ecological connection relevant to conservation planning. MCBS sites within a macrosite are generally close to one another but are not necessarily contiguous. Thus, macrosites may contain some disturbed areas. In northern Minnesota, MCBS macrosites correspond to the final (post field-evaluation) boundaries of LSAs. (Areas less than 2,000 acres formerly labeled "preserve designs" are also macrosites).

Managed acres: Timberland acres that are available for timber management purposes.

Management pool: In this plan, the acres available for timber management purposes.

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

Marketable timber: Merchantable timber that is accessible now.

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.

Maximum rotation age: In this plan, the maximum age at which a forest covers type will retain its biological ability to regenerate to the same cover type and remain commercially viable as a marketable timber sale.

Mean annual increment (MAI): Average annual growth of a stand up to a particular age. It is calculated by dividing yield at that age by the age itself (e.g., the mean annual increment for a stand at age 50 with 25 cords per acre total volume: 25) 50 years = 0.5 cords per year).

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.

MCBS Sites: Areas of land identified by Minnesota County Biological Survey (MCBS) 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 site provides a geographic framework for recording and storing data and compiling descriptive summaries.

Minnesota forest resources plan (MFRP): Statewide DNR strategic forest resources plan. Includes statewide vision, mission, preferred future, goals, strategies and objectives. For each of the division's programs, it includes goals, statewide direction, and major strategies and objectives.

Minnesota TAXA: Minnesota Taxonomy Database maintained by the DNR Division of Ecological Services.

Minnesota Wildlife Resource Assessment Project (MNWRAP): A wildlife species database and related information system that provides the overall data management, framework, analysis functions, and long-term support for statewide, landscape, and site level wildlife resource assessment efforts. It will cover the total spectrum of wildlife diversity and habitat associations in Minnesota.

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

Mixed forest conditions: In this plan, refers to vegetative composition and structure that is moving toward the mix and relative proportion (e.g., dominated by, common, occasional, or scattered) of species found in the native plant community for that site. Tree species mix and proportion depends not only on the targeted growth stage (based on the rotation age for the desired cover type) but also species found in older growth stages.

Mortality: Death or destruction of forest trees as a result of competition, disease, insect damage, drought, wind, fire, or other factors.

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

Multiple use: Using and managing a forested area to provide more than one benefit simultaneously. Common uses may include wildlife, timber, recreation, and water.

Native plant community: A group of native plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by 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 physiognomy, hydrology, landforms, soils, and natural disturbance regimes (e.g., wild fires, wind storms, normal flood cycles).

Natural Area: An area of land, with significant native biodiversity, where a primary goal is to protect, enhance or restore ecological processes and Native Plant Community composition and structure. An MCBS *Site* of Outstanding or High biodiversity significance is often recommended for nomination as a natural area. For these Sites, an MCBS *Ecological Evaluation* is written to characterize the ecological significance of the Site as a whole and to serve as a guide for conservation action by the various landowners. Sites (or portions of Sites) that are recommended as natural areas may be identified by the landowner or land management agency for conservation activities such as designation as a (city, county, state, private) park, non-motorized recreation area, scientific and natural area, reserve, special vegetation management (e.g. natural disturbance based forest management for maintenance of mature growth stage), etc. (*Draft definition 3/24/2004*)

Natural Area Registry (NAR) Agreement: a memorandum of understanding between the Ecological Services Division and another governmental unit. The other governmental unit can be Division of Forestry, Wildlife, or Parks, depending on who the land administrator is for the parcel in question. It can also be city, county, tribal, or federal government. The NAR generally identifies the site, explains its significance, sets a proposed management direction, and states that before any management contrary to that direction occurs, the parties will get together and talk about it first. It is not a binding agreement. Examples of NAR's: an old

growth yellow birch stand in Crosby-Manitou State Park; the South Fowl Lake cliff community on Division of Forestry land in Cook County; and a ram's-head orchid site on Hubbard County land.

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

Natural regeneration: The growth of new trees from 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: refers to the size, shape, and arrangement of patches in forested landscapes as determined primarily by natural disturbance and physical factors.

No forest land: Land that has never supported forests, and land formerly forested where use for 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, *non-game species* include amphibians, reptiles, and those mammal and bird species that are not hunted or trapped.

Nontimber forest products: Foods, herbs, medicinals, decoratives and specialty items also known as special forest products. Special forest products might include berries, mushrooms, boughs, bark, Christmas trees, lycopodium, rose hips and blossoms, diamond willow, birch tops, highbush cranberries, burls, conks, Laborador tea, seedlings, cones, nuts, aromatic oils, extractives.

Normal rotation age: For even-aged managed cover types, the rotation age set by the SFRMP Team for non-ERF timberland acres. It is based on the culmination of mean annual increment (CMAI), other available data related to forest productivity that also considers wood quality, and local knowledge.

Old-growth forests: Forests defined by age, structural characteristics, and relative lack of human disturbance. These forests are essentially free from catastrophic disturbances, contain old trees (generally over 120 years old), large snags, and downed trees. Additional details on the management of old-growth forests on DNR-administered lands are contained in Old-Growth Guidelines (1994).

Old forest: A forest stand of any particular forest cover type is considered old forest whenever its age exceeds the normal rotation age established by the landscape Team for that cover type. In this plan, it does not include designated old growth, state park lands, etc.

Old forest conditions: forest that has the 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: Represents an area of land, made up of several too many stands that are managed for old-growth, special management zone (SMZ), and extended rotation forest (ERF) in the vicinity of designated old growth stands.

Operational planning: The specific actions (i.e., projects, programs, etc.) that will be taken to move towards the desired future established by the various sources of strategic direction. Examples include stand examination lists, road projects, recreational trail/facilities projects, staffing, annual work plan targets, etc. Operational planning is also referred to as tactical planning.

Overmature: A tree or even-aged stand that has reached an age where it is declining in vigor and health and reaching the end of its natural life span resulting in a reduced commercial value because of size, age, decay, and other factors.

Overstocked: The situation in which trees are so closely spaced that they are competing for resources, resulting in less than full-growth potential for individual trees.

Overstory: The canopy in a stand of trees.

Partial cut: A cutting or harvest of trees where only some of the trees in a stand are removed.

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 (clear-cut, selective harvest, thin, reforest, reserve, etc.) designed to change current stand structure to one that meets 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 cut or prepared primarily for manufacture into wood pulp or chips, for subsequent manufacture into paper, fiber board, or chip board. Generally, trees 5- to-12 inches diameters at breast height are used.

Pure forest or stand is defined as composed principally of one species, conventionally at least 80 percent based on numbers, basal areas, or volumes.

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 Features Database is maintained by the Natural Heritage and Nongame Research Program and is comprised of locational records of the following features:

- **Rare plants.** Rare plants tracked are 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 animals.** All animal species that are listed as Federally endangered or threatened (except the gray wolf) are tracked, as well as all birds, small mammals, reptiles, amphibians, mussels, and butterflies that are listed as State endangered, threatened or special concern.
- **Natural communities**. Natural communities are functional units of landscape that are characterized and defined by their most prominent habitat features - a combination of vegetation, hydrology, landform, soil, and natural disturbance cycles. Although natural communities have no legal protection in Minnesota, the Natural Heritage and Nongame Research Program and the Minnesota County Biological Survey have evaluated and ranked community types according to their relative rarity and endangerment throughout their range. Locations of high quality examples are tracked in the Rare Features Database.
- **Geologic features**. Noteworthy examples of geologic features throughout Minnesota are tracked if they are unique or rare, extraordinarily well preserved, widely documented, highly representative of a certain period of geologic history, or very useful in regional geologic correlation.
- **Animal aggregations**. Certain types of animal aggregations, such as nesting colonies of waterbirds (herons, egrets, grebes, gulls and terns), bat hibernacula, prairie chicken booming grounds, and winter bald eagle roosts are tracked regardless of the legal status of the species

that comprise them. The tendency to aggregate makes these species vulnerable because a single catastrophic event could result in the loss of many individuals.

Rare species: A plant or animal species designated as **endangered, threatened,** or 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 wind and/or fire event.

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).

Regional landscapes: MFRC established eight regional landscapes covering Minnesota based on ecological, socio-economic, and administrative factors. These landscapes were established to undertake landscape-based planning and coordination across all forest ownerships. The subsections included in this plan are in the Northeast Landscape Region.

Release: Freeing a tree, or group of trees, from competition that is overtopping or closely surrounding them.

Relevé϶s: Vegetation survey plot data.

Research natural areas (RNAs): Areas within national forests that the U.S. Forest Service has designated to be permanently protected and maintained in natural condition (e.g., unique ecosystems or ecological features, rare or sensitive species of plants and animals and their habitat, and high quality examples of widespread ecosystems).

Representative Sample Areas (RSAs): Ecologically viable representative samples designated to serve one or more of three purposes: 1) To establish and/or maintain an ecological reference condition; or 2) To create or maintain an under-represented ecological condition; or 3) To serve as a set of protected areas or refugia for species, communities and community types not captured in other Criteria of this Standard.

Reserved forestland: Forestland withdrawn from timber utilization through statute, administrative regulation, or designation.

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 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 time period is an administrative decision based on economics, site condition, growth rates, and other factors.

Salvage cut: A harvest made 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 value that otherwise would be lost.

Sanitation cut: A cutting made to remove trees killed or injured by fire, insects, disease, or other injurious agents (and sometimes trees susceptible to such injuries) for the purpose of preventing the spread of insects or disease.

Sapling: A tree that is 1 inch to 5 inches in diameter at breast height.

Sawlog: A log large enough to produce lumber or other products that can be sawed. Its size and quality vary with the utilization practices of the region.

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

Scarify: To break up the forest floor and topsoil preparatory to natural regeneration or direct seeding.

Scientific and natural areas (SNAs): Areas established by the DNR, Division of Ecological Services 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, which bears seed; specifically, a tree left standing to provide the seed for natural regeneration.

Selective 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.

Silviculture and Roads Module (SRM): The SRM provides a database and application through which field foresters can record planned and actual forest development prescriptions (e.g., site preparation, tree planting projects, timber harvest, road maintenance, etc.) and follow-up surveys. SRM supports the geographic description of the extent of a development project separate from FIM stand boundaries. A variety of maps and other reports can be generated by the development system. SRM will also produce maps and reports that roll up forestry area data to the regional or statewide level. Part of the DNR's **FOR**estry **I**nformation **S**ys**T**em (FORIST).

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.

Size class: A category of trees based on diameter class. The DNR's forest inventory has size classes such as Size Class *1* = 0 - 0.9 inch diameter; *2* = 1 - 2.9 inches diameter; *3* = 3 – 4.9 inches; *4* = 5 – 8.9 inches; *5* = 9 – 14.9 inches, etc. Also, size class may be referred to as seedling, sapling, pole timber, and saw 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 in the forest as residue after timber harvesting.

Snag: A standing dead tree.

Soil productivity: The capacity of soils, in its normal environment, to support plant growth.

Special concern species: A plant or animal species that is extremely uncommon in Minnesota, or has a 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 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. 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.

Stand: A contiguous group of trees similar in age, species composition, and structure, and growing on a site of similar quality, to be a distinguishable forest 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 10 years of age for aspen and jack pine stands. An ***uneven-aged stand*** is one in which a variety of 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: The average age of the main species within a stand.

Stand density: The quantity of trees per unit area. Density usually is evaluated in terms of basal area, numbers 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, reinventory, 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 will be assigned preliminary prescriptions and most will receive the prescribed treatment. However, based on field appraisal visit, 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 as determined by the subsection Team. Criteria will likely be based on include rotation ages, site index, basal area, cover-type composition, understory composition, location, etc. Factors considered in developing stand-selection criteria will include: 1) desired forest composition goals, 2) timber growth and harvesting, 3) old-growth forests, 4) extended and normal rotation forests, 5) riparian areas, 6) wildlife habitat, 7) age and cover-type distributions, 8) regeneration, 9) thinning and 10) prescribed burning needs.

State forest road: Any permanent road constructed, maintained, or administered by the DNR for the purposes of accessing or traversing state forest lands.

Stocking: An indication of the number of trees in a stand as compared to the desirable 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.

Strategic planning: A process to plan for desired future states. Includes aspects of a plan or planning process that provide statements and guides for future direction. The geographic, programmatic, and policy focus can range from very broad and general to more specific in providing tiers/levels of direction. Strategic planning is usually long term (i.e., at least five years, often longer). It usually includes an assessment of current trends and conditions (e.g., social, natural resource, etc.), opportunities, and threats; identification of key issues; and the resulting development of goals (e.g., desired future conditions), strategies, and objectives. Vision and mission statements may also be included.

Stumpage: The value of a tree as it stands in the forest uncut. Uncut trees standing in the forest.

Stumpage price: The value that a timber appraiser assigns to standing trees or the price a logger or other purchaser is willing to pay for timber as it is in the forest.

Subsection: A subsection is one level within the 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. Subsections areas are generally one to four million acres in Minnesota, with the average being 2.25 million acres. Seventeen subsections are scheduled for the SFRMP process.

Subsection forest resource management plan (SFRMP): A DNR plan for vegetation management on forest lands administered by DNR Divisions of Forestry and Fish and Wildlife that uses ECS subsections as the basic unit of delineation. Initial focus will be to identify forest stands and road access needs for the duration of the 10-year plan. There is potential to be more comprehensive in the future.

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 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.

Tactical planning: See operational planning.

Temporary access: A temporary access route for short-term use that will not be needed for foreseeable future forest management activities. It is usually a short, temporary, dead-end access route.

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 used by animals 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. **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 forest 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 harvest age for that cover-type. It does not include very low productivity sites such as those classified as stagnant spruce, tamarack, and cedar, offsite aspen, or nonforest land.

Timber management plan: The same thing as vegetation management if used with the SFRMP process.

Timber management planning (TMP): Successor to the TMP information system (TMPIS). Recognizes the entire timber management planning process as being more than just the computerized system. Incorporates GIS technology and an interactive process with other resource managers.

Timber management planning information system (TMPIS): Circa mid-1980s. Original computerized system for developing 10-year stand treatment prescriptions by area.

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.

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

Two-aged stand: a stand with trees of two distinct age class separated in age by more than 20 percent of the rotation age.

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

Understocked: A stand of trees so widely spaced that even with full growth potential realized, crown closure will not occur.

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 stand: A stand of trees of a variety of ages and sizes growing together on a uniform site. A stand of trees with three or more distinct age classes.

Uneven-aged management: Forest management that results in forest stands comprised of intermingling trees or small groups that have three or more distinct age classes. Best suited for shade tolerant species.

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 harvest 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.

Vegetation growth stage: The vegetative condition of an ecosystem resulting from natural succession and natural disturbance, expressed as vegetative composition, structure and years since disturbance. The vegetation growth stage describes both the successional changes (i.e., the change in the presence of different tree species over time) and developmental changes (i.e., the change in stand structure overtime due to the regeneration, growth, and mortality of trees). Vegetation growth stages express themselves along the successional pathways for a particular ecosystem depending on the type and level of natural

disturbance that has occurred. Forest tree and other vegetation composition, habitat features, and wildlife species use change with the various growth stages.

Vegetation management plan: In the process of developing the 10-year stand examination list, many decisions and considerations go beyond identifying what timber will be cut (i.e., broader than timber management). This includes designation of old growth, extended rotation forests, riparian areas, desired future forest composition, visually sensitive travel corridors, etc., all of which are intended to address wildlife habitat, biodiversity, and aesthetic and other concerns. Prescriptions assigned to stands reflect decisions based on these multiple considerations and are broader than decisions relative to final harvest (e.g., ERF designation, uneven-aged management, thinning, regeneration, underplanting, prescribed burning, etc.).

Viable populations: The number of individuals of a species sufficient to ensure the long-term existence of the species in natural, self-sustaining populations that are adequately distributed throughout their range.

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 closely enough to utilize the entire site.

Wildlife management area (WMA): Areas established by the DNR, Division of Fish and Wildlife, 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.

Appendix B Acronyms

AFRMP	Area Forest Resource Management Plan
BT	Bearing Tree
CMAI	Culmination of Mean Annual Increment
CMT	Commissioner's Management Team
CSA	Cooperative Stand Assessment
CWCS	Comprehensive Wildlife Conservation Strategy
DBH	Diameter at Breast Height
DFC	Desired Future Condition
DFFC	Desired Future Forest Composition
DMT	Division Management Team
DNR	Department of Natural Resources
DOQ	Digital Orthophoto Quadrangle
DRG	Digital Raster Graphics
ECS	Ecological Classification System
EILC	Ecologically Important Lowland Conifers
ELCP	Ecological Land Classification Program
ERF	Extended Rotation Forestry
ETS	Endangered, Threatened, or Special Concern
FIA	Forest Inventory and Analysis
FIM	Forest Inventory Module
FORIST	Forest Information System
FRIT	Forest Resource Issues Team
FTC	Forest Tent Caterpillar
FY	Fiscal Year
G1G2	Globally Critically Imperiled (G1) and Globally Imperiled (G2) Native Plant Communities
GAP	Gap Analysis Program
GEIS	Generic Environmental Impact Statement
GIS	Geographic Information System
GM	Gypsy Moth
HCVF	High Conservation Value Forest
HRLV	High Risk/Low Volume
HWDs	Hardwoods
LSA	Landscape Study Area
LSL	Laminated Strand Lumber
LTA	Land Type Association
LFV	Littlefork Vermilion Uplands
MACLC	Minnesota Association of County Land Commissioners
MAI	Mean Annual Increment
MBF	Thousand Board Feet
MCBS	Minnesota County Biological Survey
MFRC	Minnesota Forest Resources Council
MFRP	Minnesota Forest Resources Plan
MnTAXA	Minnesota Taxonomy Database
MnWRAP	Minnesota Wildlife Resource Assessment Project
NAPP	National Aerial Photography Program
NAR	Natural Area Registry Agreement
NCFES	North Central Forest Experiment Station
NHIS	Natural Heritage Information System
NHNRP	Natural Heritage & Nongame Research Program
NPC	Native Plant Community
NMOP	Northern Minnesota & Ontario Peatlands

NRCS	Natural Resource Conservation Service
OFMC	Old Forest Management Complex
OHV	Off-Highway Vehicles
OSB	Oriented Strand Board
PM	Pine Moraines and Outwash Plains
RMT	Regional Management Team
RMZ	Riparian Management Zone
RNAs	Research Natural Areas
RNV	Range of Natural Variability
RSA	Representative Sample Area
SFRMP	Subsection Forest Resource Management Plan
SGCN	Species in Greatest Conservation Need
SI	Site Index
SMA	Special Management Area
SMZ	Special Management Zone
SNA	Scientific and Natural Area
SNN	Shipstead-Newton-Nolan Act
SONAR	Statement of Need and Reasonableness
SPP	Species
SRM	Silviculture and Roads Module
TMP	Timber Management Plan
TMPIS	Timber Management Plan Information System
TNC	The Nature Conservancy
WMA	Wildlife Management Area

APPENDIX C: METADATA - GENERAL INFORMATION OF DATA

Data	*Date(s)*	*Source*	*Size of Data Area*	*Spatial Resolution*	*Summary*	*Pros (+) / Cons (-)*
Forest Inventory Module FIM	January 2013	Aerial photos and ground surveys	Minnesota Stand Level,Public Forest Lands	1 to 3 acres	Updated version of CSA.	+ Detailed forest stand information - Only land managed by public agencies
Cooperative Stand Assessment CSA	1998	Aerial photos and ground surveys	Minnesota, Stand Level, Public Forest Lands	1 to 3 acres	Public agencies responsible for forest management use this data as their main inventory source.	+ Detailed forest stand information - Only land managed by public agenciesfor forest magement
Forest Inventory and Analysis FIA	1977 1990	Aerial photos and ground surveys	Minnesota, Plot Level	1225 acres represented per plot	A federally funded inventory of the state's forest resources: their type, extent, growth, mortality, and removals.	+ Detailed forest stand information + Represents public and private lands - Poor spatial resolution
GAP Stewardship	2008	PLS Sections and ownership data	Minnesota	40 acres	Database containing land ownership information. Attribute fields describe ownership, administrator, and conservation management code	+ Best data available to get quickly get an idea of land ownership. -Inaccurate below 40 acre level.
National Land Cover Dataset (NLCD)	2006	Aerial photos and satellite images	Conterminous United States	30 meters	Shows land use broken down by 16 different land cover classifications.	+Recognize and evaluate types of land use changes
Minnesota Wildlife Resource Assessment Project MNWRAP	2000	MNDNR Section of Wildlife	Minnesota State Level		Lists wildlife species present in Minnesota and state status (e.g., endangered, threatened, or special concern)	+ Statewide - Needs to be field checked -Further development
National Wetlands Inventory NWI	1994	Aerial photos	Minnesota		Linear wetland features (including selected streams, ditches, and narrow wetland bodies)	+High spatial resolution
Natural Heritage Information System	2000	MNDNR Section of Ecological Services, Nongame Program	Varies according to completion of CBS in state.		Displays inventory of native plant communities, rare species, and biodiversity.	+ Extensive habitat classification - Not complete statewide - Different standards statewide
Silvicultural Practices	2013 prepared		Minnesota	none	harvesting practices in the Blufflands/Rochester Plateau subsections.	+ Shows volume and value trends for 2007 - 2012 - No spatial breakdown - Does not account for practices on non-industrial private forest (NIPF)