DEPARTMENT OF NATURAL RESOURCES:

DIVISION OF FORESTRY

Mille Lacs Uplands, Glacial Lake Superior Plain,
St. Croix Moraines

Subsection Forest Resource Management Planning

ASSESSMENT

Summer 2000

Division of Forestry Planning Document

Printed July 2000

This document is on the Internet at www.dnr.state.mn.us/forestry/subsection/_____.
Information about the Division of Forestry and the Subsection Forest Resource Management Planning (SFRMP) process can be found at www.dnr.state.mn.us/forestry/subsection/index.html
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This information is available in an alternative format upon request.

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Figure 1. Location of The Mille Lacs Uplands, Glacial Lake Superior Plain, and St. Croix Moraines subsections.

DNR Subsection Forest Resource Management Planning

INTRODUCTION:

For many years the DNR defined its timber harvesting activities in five- or 10-year forest resource management plans developed for each of its 40 administrative forestry areas. Public involvement in the development or review of these timber management plans was limited.

Now, the DNR will be developing its forest resource management plans using the subsection level of its ecological classification system (ECS) rather than its administrative areas. It is also developing a more standardized, formal process that will give the public more opportunities to become involved in the planning process.

What Is a DNR Subsection Forest Resource Management Plan?
A Subsection Forest Resource Management Plan (SFRMP) is a DNR plan for vegetation management on forest lands administered by the Division of Forestry and Section of Wildlife. ECS subsections, not administrative boundaries, are the basic units of delineation. The focus of the first round of subsection plans will be:

- Identifying a desired future forest composition. The longer term strategic component of SFRMPs will focus on desired future forest composition (DFFC) 50 years into the future. This could include the amount of various forest types within the subsection, age-class distribution of forest types, and the geographic distribution of forest types and age-classes across the subsection. DFFC will be guided by assessment information and strategies developed to address identified issues.

- Identifying forest stands to be treated over a seven-year period. SFRMPs will identify forest stands on DNR forestry- and wildlife-administered lands that are proposed for treatment (e.g., harvest, thinning, regeneration, prescribed burning, reinventory) over the seven-year planning period. Forest stands will be selected using criteria developed to move DNR forest land towards the desired future forest composition. Examples of possible criteria include stand age; site productivity; size; number and species of trees; soils; and stand location. There are many decisions and considerations that go into developing these criteria and the list of stands proposed for treatment. Examples include identification of areas to be managed as old growth and older forests, areas to be managed at normal harvest age, management of riparian areas and visually sensitive travel corridors; age and cover type distributions; and regeneration, thinning, and prescribed burning needs. Decisions will be made based upon the management activities (including no action) that will best move a forest landscape toward DFFC goals.

PROCESS OBJECTIVES:

The objectives of the SFRMP process are to:

- inform and involve the public and stakeholders;
- complete the process in each ECS subsection in a reasonable amount of time (there is a target of 12 to 15 months);
- conduct a process that is reasonable and feasible within current staffing levels and workloads;
- develop plans that are credible to most and that enable good forest management.

Experience, new information, new issues, changing conditions, and the desire to broaden the focus of SFRMPs in the future will demand that the process be flexible and adaptable over time. The plans will also need to be flexible to reflect changing conditions. The SFRMP process will provide for annual reviews by DNR planning teams to determine whether plans need to be updated to respond to unforseen changes in forest conditions.

TIME FRAMES:

The early stages of the SFRMP process are presently underway for the first group of subsections (i.e., Agassiz Lowlands, Border Lakes, Mille Lacs Uplands, Anoka Sand Plains, and Blufflands/Rochester Plateau). The Department will initiate planning in three or four subsections each year with the intent of completing all subsection plans within five years. Statewide there are 17 subsections with substantial DNR-administered forest land. Some smaller subsections may be combined.

INTERDISCIPLINARY/INTERAGENCY INVOLVEMENT:

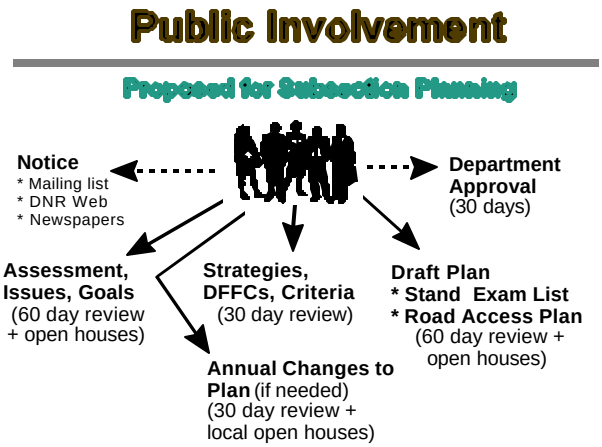
Teams comprised of DNR forestry, wildlife, and other agency staff will have primary responsibility for the work and decision making involved with the subsection plans. Managers of adjacent county, federal, tribal, and industrial forest lands will be invited to provide information about the condition of their forest lands and their future management direction. This information will help the DNR make better decisions on the forest lands it administers.

PUBLIC INVOLVEMENT:

Public involvement will, at a minimum, occur through:

- distribution of a summary of the initial assessment information;
- public meetings and comment period to help identify key forest management issues and solicit public opinion of preferred management direction;
- opportunities to review and comment on forest management strategies proposed by the DNR to address identified issues and the criteria that will be used to select stands to be treated;
- opportunities to review and comment on the DNR's 7-year list of stands proposed for treatment and associated road access needs;
- public review and comment on proposed plan revisions.

SFRMP planning documents will be available at DNR Area Forestry offices, selected public locations, the DNR web site, and summary information will be available upon request.



LOOKING TOWARD THE FUTURE:

While the initial focus of SFRMPs is on forest composition and vegetation management, the intent is to broaden their scope in the future. Changes in this direction will probably be incremental as the process becomes more familiar to DNR staff and the public. The likely progression in future years will be to include other aspects of forest land management on DNR lands (e.g., recreation facilities/systems, land acquisition/sales) and other DNR Forestry programs including private forest management and fire management. A subsequent step may be to include all DNR lands, making this a DNR subsection plan not limited to DNR forest land.

For further information visit the SFRMP web site at http://www.dnr.state.mn.us/forestry/subsection/ or contact Lynn Mizner, Forest Resources Planner, at (218) 927-7511.

SFRMP PROCESS:

The Mille Lacs Uplands/Glacial L. Superior Plain/St. Croix Moraines DNR subsection team is in the second step (see Table 1) of the SFRMP process. The team has developed a preliminary set of issues to be considered in the plan, a core set of assessment information, and is now requesting public input (one of three opportunities in the SFRMP process).

Table 1. SFRMP Steps, Public Notification/Participation, Comment Period, and Length of Step.

Subsection Forest Resource Management Planning Steps	Public Notification/Participation	Comment Period	Length of Step
Step. 1. Initiating the Planning Process C DNR develops mailing list of public/ stakeholders. C Establishes web site for subsections.	C Inform the public of planning efforts, schedule, and how and when they can be involved.	None	30 days
Step 2. Assessment and Issue Identification	C Mail Preliminary Issues to mailing list. C Provide complete maps and make assessment information available in key locations and on Web/CD. C Hold open houses in the subsection and Twin Cities Metro area.	60 days July- August 2000	120 days
Step 3. Strategies To Address Issues, Desired Future Forest Composition, and Stand Selection Criteria	C Mail summary to mailing list. C Provide complete maps and documents in key locations and on Web/CD.	30 days October or November 2000	90 days
Step 4. Draft Plan: Stand Examination List and Road Access Needs	C Mail summary to mailing list. C Provide complete maps and documents in key locations and on Web/CD. C Hold open houses in subsection and in Twin Cities Metro area.	60 days Late Winter or Spring 2001	90 - 150 days
Step 5. Final Plan C Planners summarize public comments and DNR responses. C Present revised plan to Department for Commissioner's approval. C Commissioner approves final plan.	C Inform public of final plan. C Provide summary of public comments and how DNR responded. C Provide final plans in key locations and on Web/CD. C Mail plan summaries to mailing list.	None	30 days
Total* * Total time frame of process steps includes public involvement/comment periods			360 - 420 days

Subsection Forest Resource Management Planning Steps	Public Notification/Participation	Comment Period
SFRMP Revisions C Annual subsection team review to determine need for plan revision. C Need for plan revision based on substantial departures from the plan, changes in resource conditions/policies/issues.	C Notice to mailing list and on DNR web-site regarding plan revisions C Hold local open house.	30-60 days, depending on scope of revisions.

The objective of the issue identification/assessment (step 2) is to review the preliminary set of issues developed by the DNR subsection team, review the assessment information provided, then identify additional issues that can be addressed through vegetation management decisions. Vegetation management decisions include proposed treatments to DNR forest stands based on criteria and other considerations that are intended to move DNR forest lands toward a desired future forest composition. Proposed forest stand treatments include a broad range of prescriptions including final harvest, older forest designation, uneven-age management, thinning, regeneration, underplanting, prescribed burning, etc. Only those issues that can be addressed through vegetation management will be considered.

The ultimate product from this SFRMP process is a list of DNR forest stands to be treated over the next seven years in the Mille Lacs Uplands, Glacial Lake Superior Plain, and St. Croix Moraines subsections. The Mille Lacs Uplands SFRMP process is projected to conclude in the late winter or spring of 2001.

In the following pages is the assessment information that was developed for the Mille Lacs Uplands SFRMP process. The assessment information is provided to give the context of the Mille Lacs Uplands forest resource and enable the identification of additional relevant issues not included in the preliminary set of issues.

An SFRMP Information Standards Work Group was formed to develop standard information and formats for the core products in the SFRMP Assessments. Standards were viewed as being important to help guide DNR staff on SFRMP content, provide consistent information in a clear and concise format for public communication, and permit summaries at various levels through consistent reporting. The Information Standards Work Group met through the fall of 1999 and identified the core assessment products for the SFRMP Assessment.

The following core assessment products are not yet available or do not apply in the Mille Lacs Uplands, Glacial Lake Superior Plain, and St. Croix Moraines subsections:

- a map displaying old-growth, riparian, historical and cultural, and other administratively unique areas from federal and county agencies in the subsection
- a map of forest types on public ownerships (there is minimal federal or county forest land ownership in the subsections);
- a map of age-classes on public ownerships
- tables of area by forest type and age-class for public ownerships
- Volume of Timber Sold in the Subsections from FY95-99
- Value of Timber Sold in the Subsections from FY95-99

- Volume of Timber Scaled in the Subsections from FY95-99
- Acres Reforested from FY95-99
- Acres of Site Preparation from FY95-99
- Acres Treated for Forest Protection from FY97-99
- Acres of Forest Receiving TSI or Release from F Y 95-99
- Natural Community Classes, Types, and Subtypes Present in the Blufflands/Rochester Plateau Subsections (acres).
- trends in special product (e.g., balsam bough) and Christmas tree permits issued DNR lands in the subsection
- range of natural variability (RNV) information including disturbance regimes (frequency, patch size, severity, intensity) and age-class distributions of native plant communities in the subsection

This information is part of the entire assessment that is available at http://www.dnr.state.mn.us/forestry/subsection/ , the Great River Regional Library (Stearns Co), Milaca Community Library (Mille Lacs Co), Aitkin Public Library (Aitkin Co), Pine City Public Library, Brainerd Public Library (Crow Wing Co), the Aitkin, Hinckley, Moose Lake, Sauk Rapids, and Cloquet area offices of Minnesota DNR, and the Brainerd Regional DNR Forestry Office.

Land Use/Land Cover

Core Assessment Products
1. A map showing land use and cover in the subsection
2. A table summarizing the area in each land use and land cover class
3. A map of intermittent streams, perennial streams, trout streams, lakes, trout lakes, and open water wetlands in the subsection
4. A table summarizing the area of area-based features and length of linear features

Figure 1.1 Land Use and Land Cover

These remotely-sensed data were developed from satellite imagery collected between 1988 and 1996. This map will be available at the public libraries, Area Forestry offices, DNR Regional office in Brainerd, the DNR Central Office in St. Paul, and on the DNR web site at www.dnr.state.mn.us/forestry/subsection/index.html. Due to the size of data layers for this map, the most useful size for viewing this map may be a wall size map.

Table 1.1 Land Use Land Cover Acres

Land Use Land Cover	*Mille Lacs Uplands*	*Glacial L. Superior Plain*	*St. Croix Moraines*
Urban-Rural Dev.	52868	883	136
Cultivated Land	489331	5285	261
Hay/Pasture/Grassland	771530	17165	294
Brushland	84012	2172	25
Forested	1315897	71988	1820
Water	214080	1413	344
Bog/Marsh/Fen	457034	10552	5
Mining	4202	217	0

Table 1.2 Land Use Land Cover Percentages

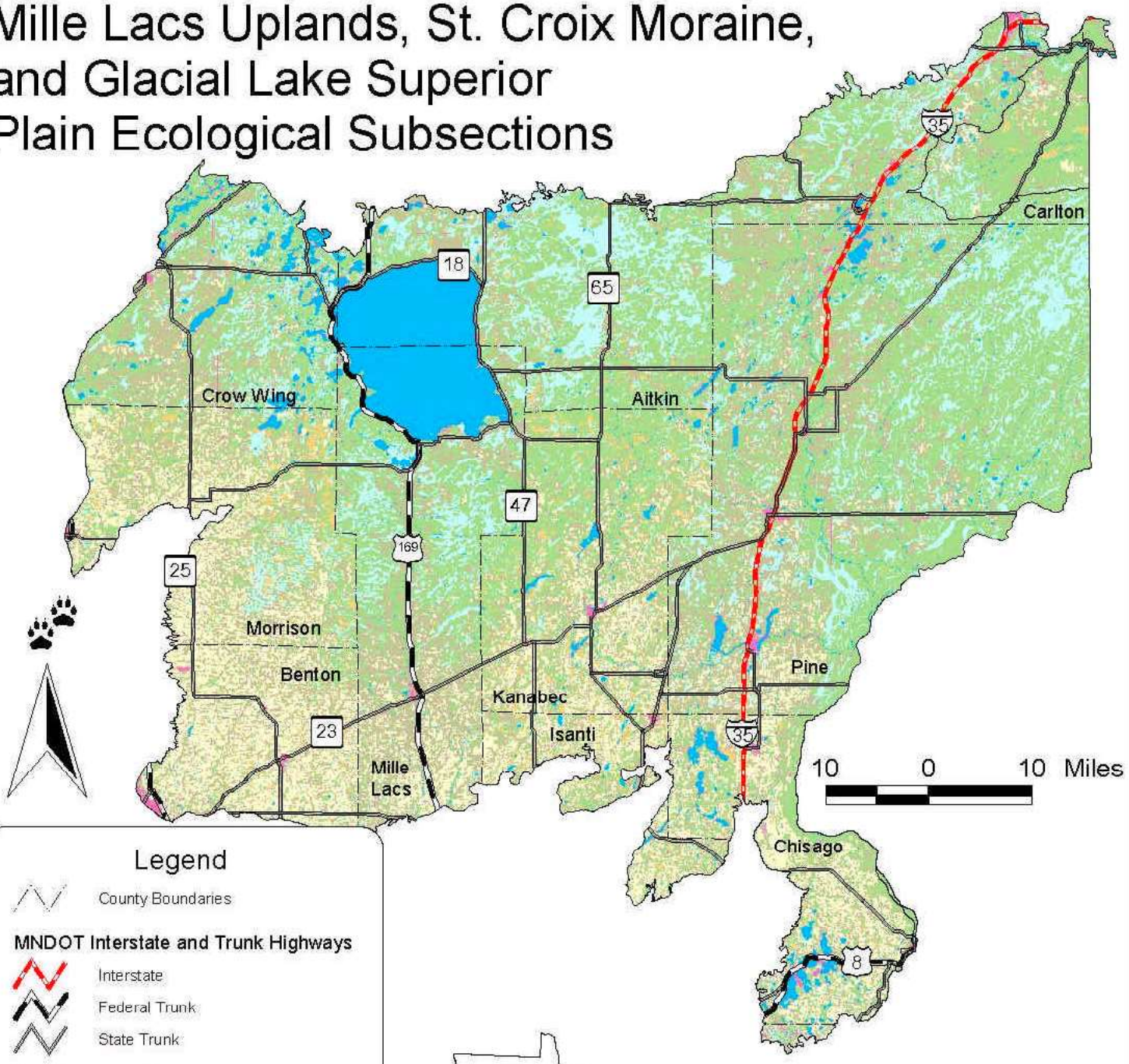
Land Use Land Cover	*Mille Lacs Uplands*	*Glacial L. Superior Plain*	*St. Croix Moraines*
Urban-Rural Dev.	0.015	0.008	0.046
Cultivated Land	0.144	0.048	0.089
Hay/Pasture/Grassland	0.228	0.157	0.100
Brushland	0.025	0.020	0.009
Forested	0.388	0.656	0.619
Water	0.063	0.013	0.117
Bog/Marsh/Fen	0.135	0.096	0.020
Mining	0.001	0.002	0

Figure 1.2 National Wetlands Inventory and Waterways

This map will be available at the public libraries, Area Forestry offices, DNR Regional office in Brainerd, the DNR Central Office in St. Paul, and on the DNR web site at www.dnr.state.mn.us/forestry/subsection/index.html. Due to the size of data layers for this map, the most useful size for viewing this map may be a wall size map.

Land Use and Cover

Mille Lacs Uplands, St. Croix Moraine, and Glacial Lake Superior Plain Ecological Subsections



Legend

- County Boundaries

MNDOT Interstate and Trunk Highways

- Interstate
- Federal Trunk
- State Trunk

Land Use and Cover

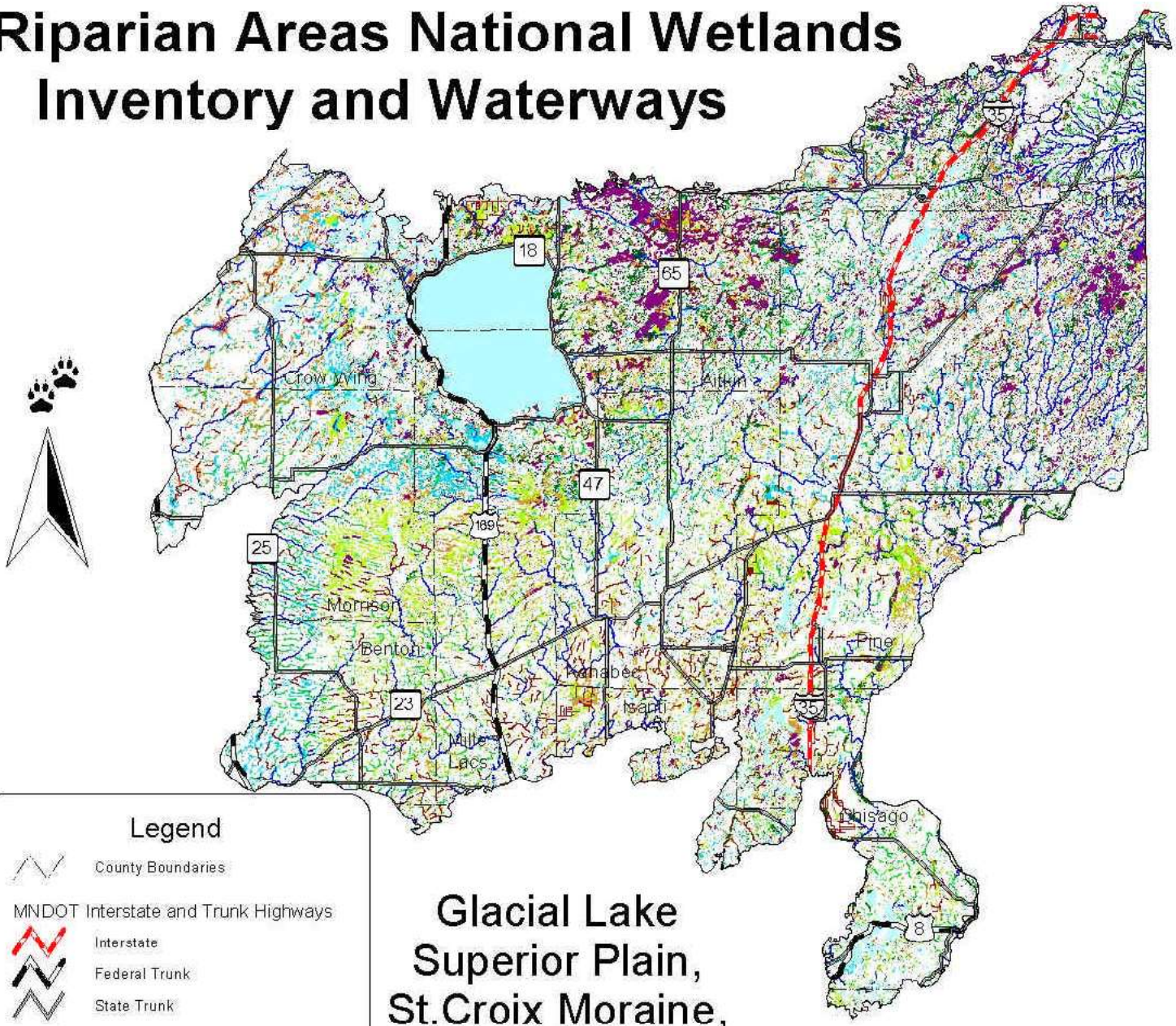
- Unknown
- Urban and Rural Development
- Cultivated Land
- Hay/Pasture/Grassland
- Brushland
- Forested
- Water
- Bog/Marsh/Fen
- Mining

Source Data: Remotely Sensed (1988-1996)

Date: March 2000
Created by DNR Central Office
Information about the data can be found on the Internet at deli.dnr.state.mn.us

Minnesota Forest Resources Council

Riparian Areas National Wetlands Inventory and Waterways



Legend

- County Boundaries

MNDOT Interstate and Trunk Highways

- Interstate
- Federal Trunk
- State Trunk

Waterways

- Perennial Streams
- Intermittent Streams
- Ditches

National Wetlands Inventory

- Seasonally flooded basin or flat
- Wet Meadow
- Shallow Marsh
- Deep Marsh
- Shallow open water
- Shrub Swamp
- Wooded Swamp
- Bogs
- Municipal and industrial activities
- Riverine Systems

Glacial Lake Superior Plain, St.Croix Moraine, and Mille Lacs Uplands Ecological Subsections

10 0 10 20 Miles

Sources of Data: Aerial photography (1979-1988), and USGS quadrangle maps.

Date: March 2000
Created by DNR Central Office
Information about the data can be found on the Internet at deli.dnr.state.mn.us

Minnesota Forest Resources Council

Table 1.3 National Wetlands Inventory Acreage

* Circular 39 Class	Mille Lacs Uplands	Glacial L. Superior Plain	St. Croix Moraines
1	11637.19	623.59	30.25
2	200277.00	371.62	30.47
3	137567.34	789.94	8.23
4	2938.04	32.91	17.12
5	198370.87	550.42	146.11
6	258842.58	4707.18	25.58
7	116836.70	4752.33	54.26
8	152047.61	4998.74	0
80	998.10	0	0
90	19338.46	2261.74	314.24
98	2290043.16	90586.47	2298.44
99	29.80	0	0.44

Table 1.4 National Wetland Inventory Percentages

Circular 39 Class	Mille Lacs Uplands	Glacial L. Superior Plain	St. Croix Moraines
1	0.003	0.006	0.010
2	0.059	0.003	0.010
3	0.041	0.007	0.003
4	0.001	0.000	0.006
5	0.059	0.005	0.050
6	0.076	0.043	0.009
7	0.034	0.043	0.019
8	0.045	0.046	0
80	0.000	0	0
90	0.006	0.021	0.107
98	0.676	0.826	0.786
99	0	0	0.000

* National Wetlands Inventory Lookup Table

Circular 39 Code	*Circular 39 Name*
1	Seasonally flooded basin or flat
2	Wet meadow
3	Shallow marsh
4	Deep marsh
5	Shallow open water
6	Shrub swamp
7	Wooded swamps
8	Bogs
80	Municipal and industrial
90	Riverine systems, system
98	Uplands, system
99	Area outside Minnesota

Table 1.5 Stream Miles

Stream Type	*Mille Lacs Uplands*	*Glacial L. Superior Plain*	*St. Croix Moraines*
Perennial (28)	1609.04	2137.51	0.87
Intermittent (29)	1960.40	608.27	3.43
Ditch (30)	1178.01	13.38	0

Table 1.6 Stream Density

Stream Type	*Mille Lacs Uplands*	*Glacial L. Superior Plain*	*St. Croix Moraines*
Perennial (28)	0.30	1.20	0.19
Intermittent (29)	0.37	1.31	0.75
Ditch (30)	0.22	0.01	0

ADMINISTRATION AND OWNERSHIP

Core Assessment Products
1. A map displaying ownership (federal, county, state, forest industry, and private) patterns in the subsection, and accompanying table.
2. A map displaying ownership the boundaries of various administrative areas (national forests, state forests, SNAs, RNAs, wilderness, WMAs, Shipstead-Nolan, wild and scenic areas, national parks, and state parks), and accompanying table.
3. A table of Old Growth Candidate stands by cover type.

Figure 2.1. Ownership of land in the Mille Lacs Uplands/Glacial L. Superior Plain, and St. Croix Moraines Subsections.

This map will be available on the DNR web site and at DNR Forestry Area offices and public libraries in the subsections.

As the table below shows, by far the largest landowner in the Mille Lacs Uplands is the State of Minnesota. State (including tax forfeit land administered by counties) and county-owned lands comprise 85% of the land included in the subsection. In the Glacial Lake Superior Plain, and the St. Croix Moraines, the ownership pattern is similar, with State and county lands comprising 86% and 83% of the land, respectively.

Table 2.1. Gap Classification Acres

Gap Ownership Name	*Mille Lacs Uplands*	*Glacial Lake Superior Plain*	*St. Croix Moraines*
County	41.24		
Federal	2738.94	40.18	57.28
Other private property	55966.67	43.04	
Other Public			
Private Conservancy			
Private Industrial, more than 1000	33074.70	4991.51	
Private Non-Industrial Business or Trust	4462.48	176.31	
State, including tax-forfeited lands under county stewardship	590547.11	31785.11	487.06
Tribal	4104.84		
Total	690,935.98	36,993.11	587.38

Figure 2.2. Mille Lacs Uplands/Glacial L. Superior Plain/St. Croix Moraines Administrative Boundaries

This map will be available at the public libraries, Area Forestry offices, DNR Regional office in Brainerd, the DNR Central Office in St. Paul, and on the DNR web site at www.dnr.state.mn.us/forestry/subsection/index.html. Due to the size of data layers for this map, the most useful size for viewing this map may be a wall size map.

The land administration patterns in the Mille Lacs Uplands/Glacial L. Superior Plain/St. Croix Moraines are characterized by a few large blocks of state agency land ownerships, one federally administered wildlife refuge, one large Indian Reservation and several smaller blocks of Native American trust land, many areas of intermingled state, county, and private land ownerships. DNR Forestry and Wildlife-administered Lands are being considered in this SFRMP. Table 2.2, below, lists the acreage totals for state- and federally-administered lands within the subsections. Note that some areas may be included in more than one category, for example, WMAs that are within a state forest, or state parks that are within a state forest.

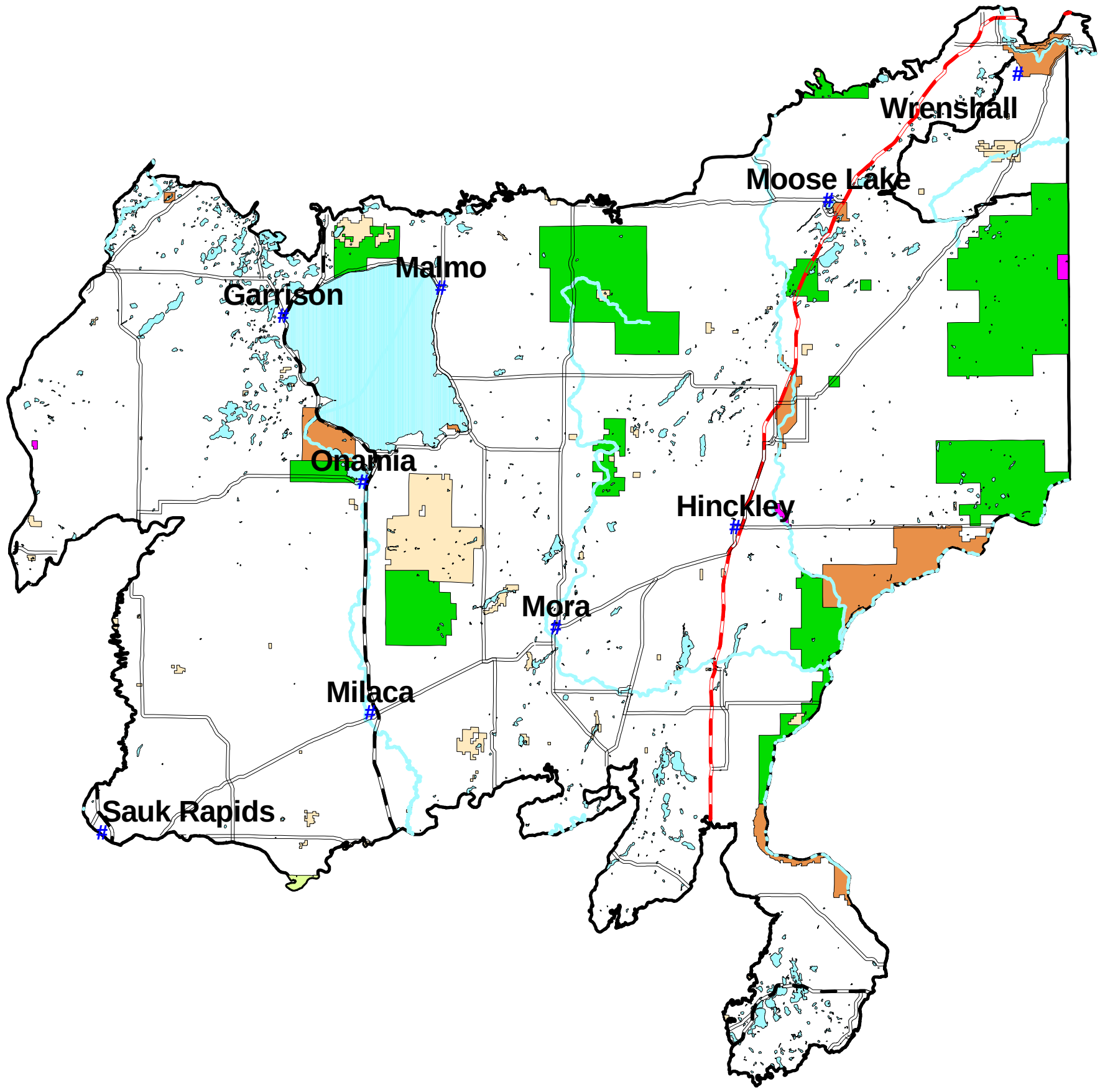
Table 2.2. Acres of Land by Administrator

Administrator	*Acres*
Scientific and Natural Areas (State)	2,505
State Forests	307,739
State Parks	70,153
National Wildlife Refuges (Federal)	1,243
Wildlife Management Areas (State)	65,335

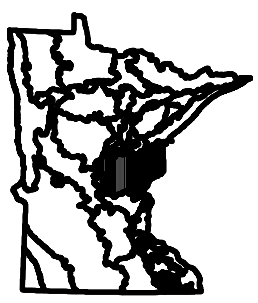
Old Growth Forests

Old Growth candidate evaluations are in progress for the Mille Lacs Uplands subsection. These evaluations will be completed by the end of July, 2000. Final scoring, data entry, and GIS mapping will be conducted in August, and the Minnesota DNR Old Growth Team will meet in September to determine which stands will be designated “Old Growth Forest” and which will be released from candidacy. The table and chart below illustrate the variety of forest types that are being evaluated; northern hardwoods, lowland hardwoods, ash and oak are the candidate forest types with the largest acreage.

Mille Lacs Uplands
Glacial Lake Superior Plain
Special Administration Areas



Cities
MNDOT Interstate and Trunk Highways
Interstate
Federal Trunk
State Trunk
Rivers
Lakes
Scientific and Natural Areas
WMA's
State Parks
State Forests
National Wildlife Refuge
Subsection Boundaries



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Subsection Forest Resources Mgmt Planning
Created by DNR Division of Forestry
July 18, 2000
More information can be found at:
http://www.dnr.state.mn.us/forestry/subsection/index.html

Table 2.3. Old Growth candidate acres by Forest Type (DNR Old Growth Forest Guidelines 1994)

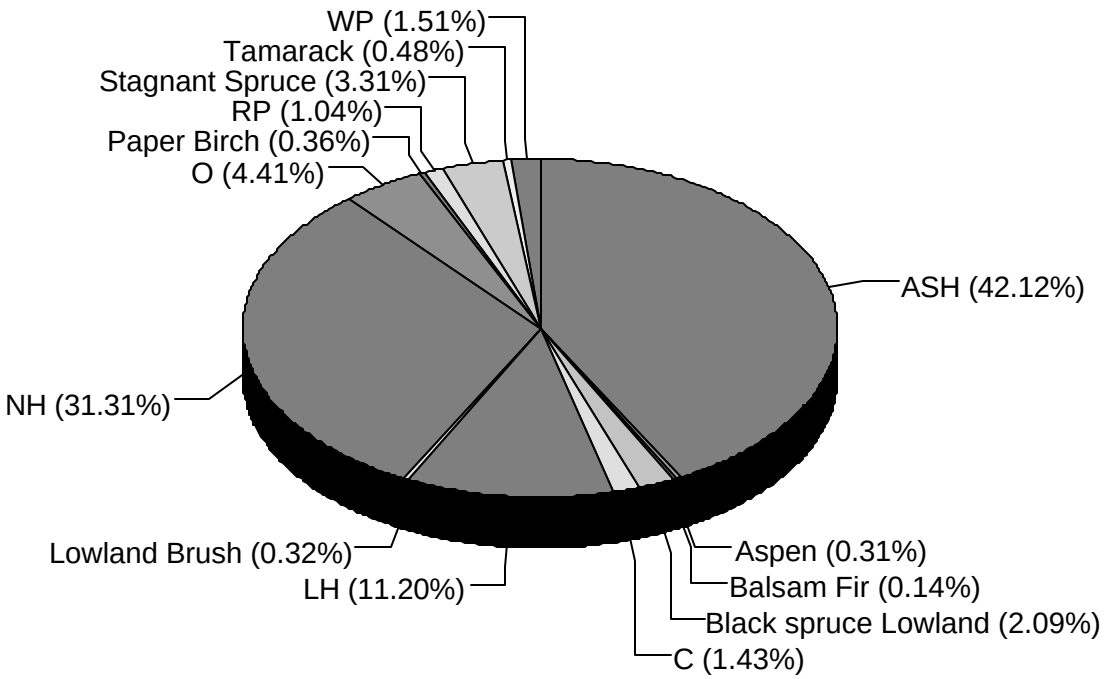
Mille Lacs Uplands

Administrator	***Cover type***	***Acres***
Unknown	lowland hardwoods (LH)	17
Unknown	northern hardwoods (NH)	40
DNR Div. of Forestry	ASH	123
DNR Div. of Forestry	LH	552
DNR Div. of Forestry	NH	1295
DNR Div. of Forestry	oak (O)	112
DNR Div. of Forestry	red pine (RP)	27
DNR Div. of Forestry	white pine (WP)	59
DNR Div. of Forestry	aspen	18
DNR Div. of Forestry	paper birch	21
DNR Div. of Forestry	balsam Fir	8
DNR Div. of Forestry	black spruce (lowland)	36
DNR Div. of Forestry	stagnant spruce	37
DNR Div. of Forestry	lowland brush	19
DNR Div. of Fisheries and Wildlife	LH	42
DNR Div. of Fisheries and Wildlife	NH	30
DNR Div. of Fisheries and Wildlife	WP	11
DNR Div. of Parks and Recreation	ASH	2359
DNR Div. of Parks and Recreation	LH	49
DNR Div. of Parks and Recreation	NH	480
DNR Div. of Parks and Recreation	RP	34
DNR Div. of Parks and Recreation.	WP	19
DNR Div. of Parks and Recreation	O	148
DNR Div. of Parks and Recreation	cedar (C)	84
DNR Div. of Parks and Recreation	black spruce (lowland)	87
DNR Div. of Parks and Recreation	tamarack	28
DNR Div. of Parks and Recreation	stagnant spruce	158

Glacial Lake Superior Plain

Administrator	Cover type	Acres
Unknown	WP	502

Figure 2.3. Old Growth Candidate Stands by Forest Type.



FOREST COMPOSITION AND STRUCTURE

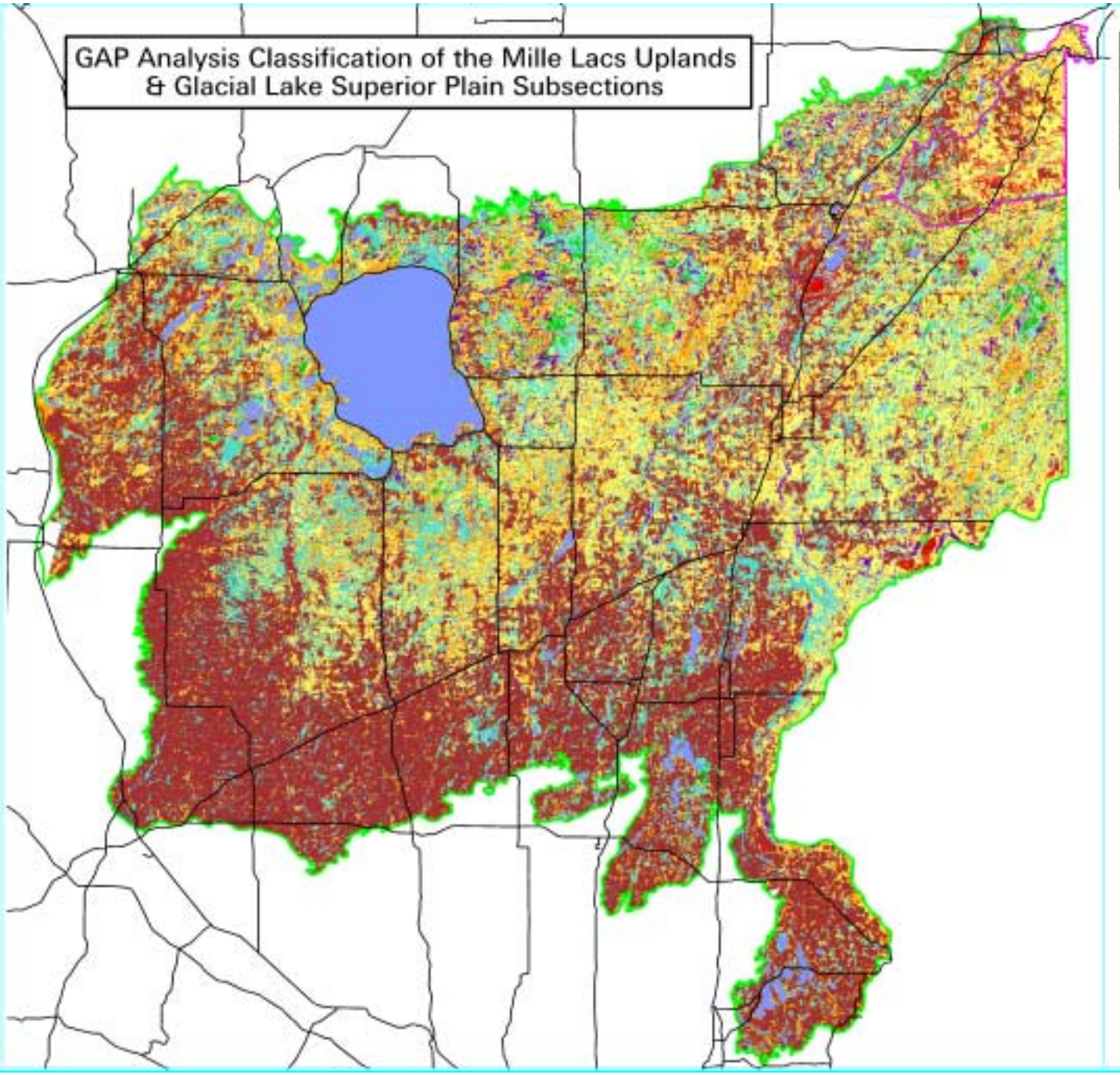
Core Assessment Products	
1.	A map of the GAP classification cover types on all ownerships in the subsection(s)
2.	A table summarizing the area in each of the GAP classifications.
3.	A map of forest types on DNR lands being considered in SFRMP.
4.	A map of age-classes on DNR lands being considered in SFRMP. Prepare maps of age-classes for individual forest types as needed.
5.	Table of area by forest type and age-class for DNR lands being considered in SFRMP.
6.	Trends in the extent of forest land, forest type, and age-classes for DNR lands.

Figure 3.1 GAP Classification Cover Types

This map will be available at the public libraries, Area Forestry offices, DNR Regional office in Brainerd, the DNR Central Office in St. Paul, and on the DNR web site at www.dnr.state.mn.us/forestry/subsection/index.html. Due to the size of data layers for this map, the most useful size for viewing this map may be a wall size map.

GAP data are developed from satellite imagery, supplemented with other techniques.

GAP Analysis Classification of the Mille Lacs Uplands & Glacial Lake Superior Plain Subsections



The GAP classification for the Mille Lacs Uplands & Glacial Lake Superior Plain ECS Subsections was completed in Oct. 1996 - as one unit. Two dates of TM Landsat 5 imagery was used, 9/20/91 and 6/8/94 in path 27 row 28. Two image dates are used to capture the phenological differences between vegetation types. The classification area is divided into two strata (lowland and upland), these two strata are classified separately to individual species, then stitched back together, smoothed to 1 acre minimum mapping units, and finally collapsed to the current species list.

GAP Collapsed Classes

Class Names	Acres
Non-vegetated	40880
Ag/Grassland	1274280
Upland shrubland	11314
Lowland shrub	331889
Aquatic	210345
Wetland	234215
Red/White Pine	37942
Jack Pine	10846
Other Upland Coniferous Forest	22576
Lowland Coniferous Forest	72922
Stagnant Coniferous Forest	23294
Aspen/Birch/BAM	810220
Other Upland Deciduous forest	304765
Lowland deciduous forest	111365

Mille Lacs Uplands Boundary

Glacial Lake Superior Plain Boundary

DOT Roads

N

Scale

10 0 10 20 30 Miles

Table 3.1 GAP Cover Types

Mille Lacs Uplands

Row	*Class Names*	*Acres*	*Class%*	*Vegetated%*	*Forested%*
1	Non-vegetated	43220	1.24%	0.00%	0.00%
2	Ag/Grassland	1288157	36.83%	37.30%	0.00%
3	Upland shrub	11806	0.34%	0.34%	0.00%
4	Lowland shrub	332326	9.50%	9.62%	0.00%
5	Aquatic	216740	6.20%	6.28%	0.00%
6	Wetland	240268	6.87%	6.96%	0.00%
7	Red/White Pine	34534	0.99%	1.00%	2.53%
8	Jack Pine	10500	0.30%	0.30%	0.77%
9	Other Upland Coniferous Forest	18305	0.52%	0.53%	1.34%
10	Lowland Coniferous Forest	74280	2.12%	2.15%	5.44%
11	Stagnant Coniferous Forest	24195	0.69%	0.70%	1.77%
12	Aspen/Birch/BAM	776677	22.21%	22.49%	56.92%
13	Other Upland Decidous Forest	312505	8.94%	9.05%	22.90%
14	Lowland Decidous Forest	113625	3.25%	3.29%	8.33%
	Totals	3497140	100.00%	100.00%	100.00%

Glacial Lake Superior Plain

Row	*Class Name*	*Acres*	*Class%*	*Vegetated%*	*Forested%*
1	Non-vegetated	970	0.88%	0.00%	0.00%
2	Ag/Grassland	23898	21.70%	21.90%	0.00%
3	Upland shrub	989	0.90%	0.91%	0.00%
4	Lowland shrub	8509	7.73%	7.80%	0.00%
5	Aquatic	1304	1.18%	1.20%	0.00%
6	Wetland	876	0.80%	0.80%	0.00%
7	Red/White Pine	6683	6.07%	6.12%	9.09%
8	Jack Pine	1237	1.12%	1.13%	1.68%
9	Other Upland Coniferous Forest	6289	5.71%	5.76%	8.55%
10	Lowland Coniferous Forest	2213	2.01%	2.03%	3.01%
11	Stagnant Coniferous Forest	324	0.29%	0.30%	0.44%
12	Aspen/Birch/BAM	50088	45.49%	45.89%	68.09%
13	Other Upland Deciduous Forest	4782	4.34%	4.38%	6.50%
14	Lowland Deciduous Forest	1948	1.77%	1.79%	2.65%

Totals	110111	100.00%	100.00%	100.00%

Figure 3.2 (map). Timber stands administered by DNR Divisions of Forestry and Wildlife that are being considered in the Subsection Forest Resource Management Plan (SFRMP)

This map is available to be downloaded on the DNR web site at www.dnr.state.mn.us/forestry/subsection/index.html It can also be viewed as a wall-size map at the public libraries in the subsection(s) and at the DNR Forestry Area offices, the DNR Brainerd Regional office, and the DNR St. Paul Central Office Library.

*Table 3.2. *CSA Timber Stands under consideration*

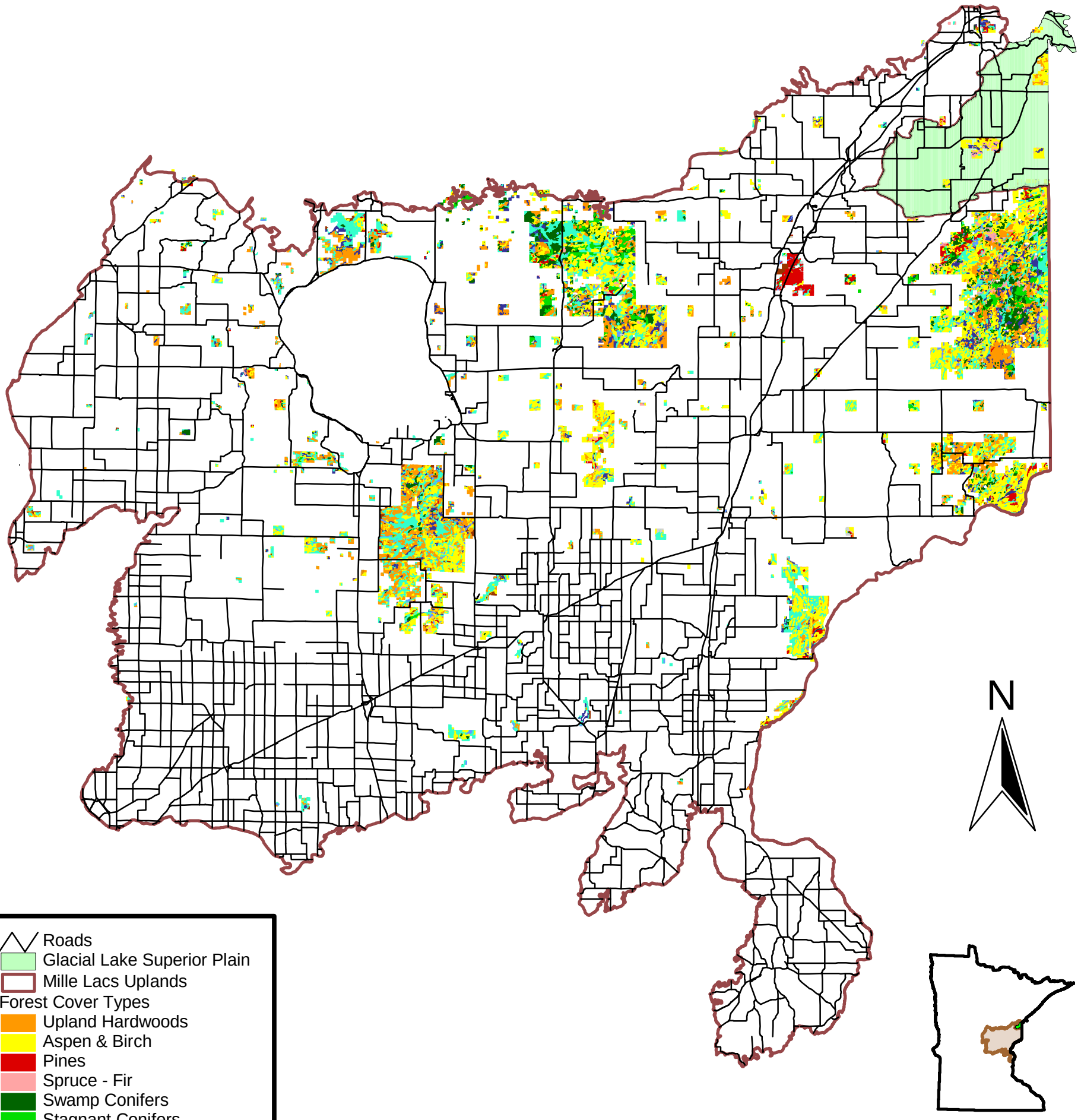
Forest Cover Type	Mille Lacs Uplands (Acres)	Glacial L. Superior Plain (Acres)
Upland Hardwoods	63382	475
Aspen & Birch	112495	4032
Pines	9561	10
Spruce - Fir	5501	553
Lowland (swamp) Conifers	22257	53
Stagnant Conifers	10252	0
Unknown	1446	84
Lowland Non-Forest	77196	38
Upland Non-Forest	2965	132
Developed	763	87
Water	5672	28
Lowland Hardwoods	19148	456
Total Acres	330638	5948

* The Cooperative Stand Assessment (CSA) is the forest stand mapping and information system used by the Minnesota Department of Natural Resources to inventory the approximately 5 million acres (7800 sq. mi.) owned and administered by the state.

Figure 3.3. Age Class of forest cover types being considered in the SFRMP.

This map is available to be downloaded on the DNR web site. It can also be viewed as a wall-size map at the public libraries in the subsection(s) and at the DNR Forestry Area offices, the DNR Brainerd Regional office, and the DNR St. Paul Central Office Library.

Mille Lacs Uplands
Glacial Lake Superior Plain
Forest Cover Types Under Consideration



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Mille Lacs Uplands
Glacial Lake Superior Plain
Forest Cover Types by Age Class

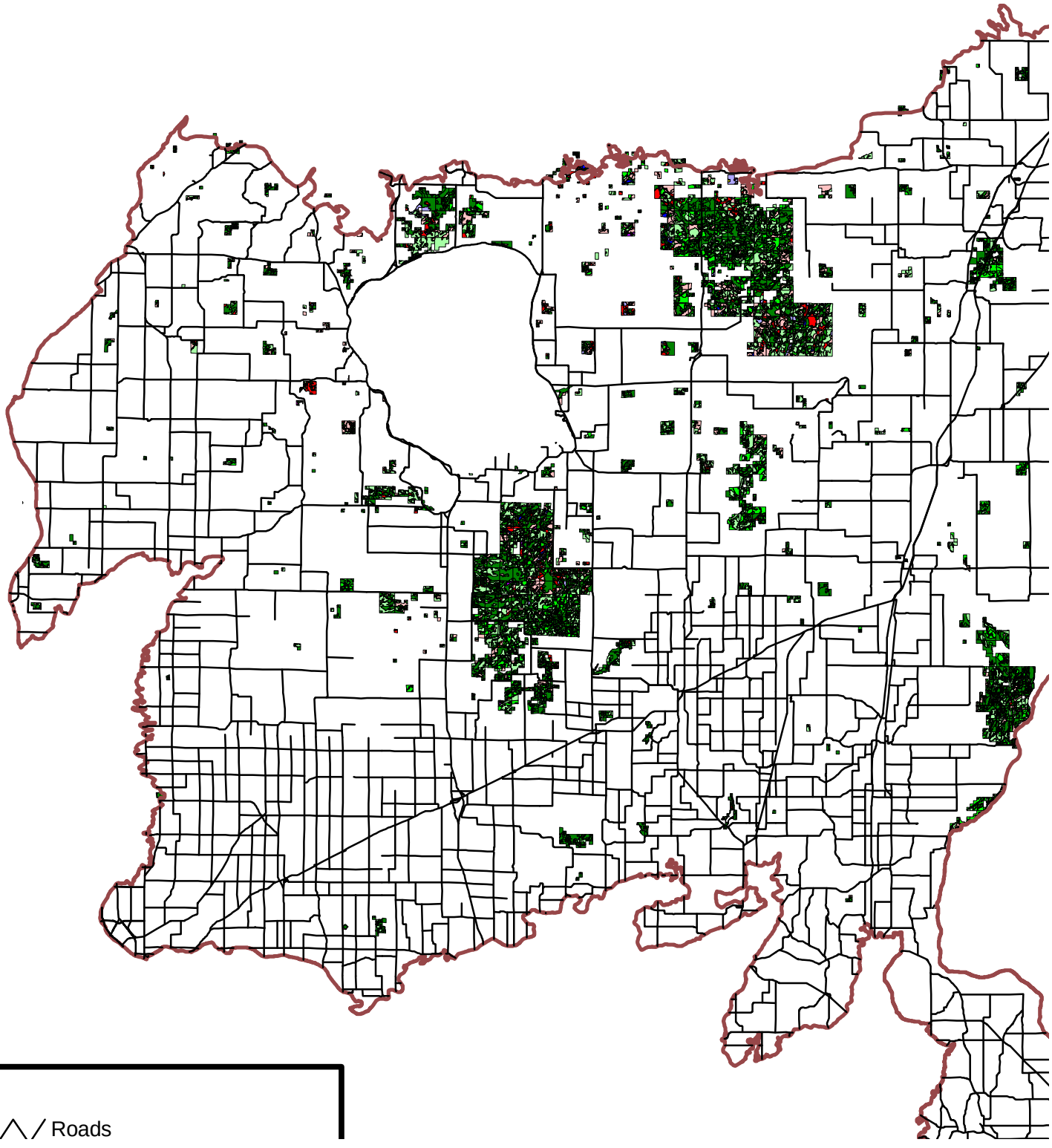


Table 3.3. The largest age class across all cover types is the 0-20 age class that includes recently harvested and regenerating forest. The second largest age class is the 41-60 year class; this is consistent with the fact that the aspen/birch type is the dominant forest type in the Mille Lacs Uplands subsection. The aspen type is typically harvested before 60 years of age, being a short-lived species that begins to show a decline in vigor after that age in most areas. There is currently a large amount of aspen/birch cover type in the older age classes in this subsection.

Forest Age Class	Mille Lacs Uplands (Acres)	Glacial L. Superior Plain (Acres)
0 - 20	139711	981
21 - 40	34375	786
41 - 60	90813	2540
61 - 80	42085	1058
81 - 100	13188	461
101 - 120	6694	80
121 - 140	2723	42
141 - 160	764	
161 - 180	222	
181 - 200	36	
201 - 220	27	
Total Acres	330638	5948

Trends in Timber Resources

The CSA inventory for the Mille Lacs Uplands subsection, updated to current (2000) age, is given in Table 3.4. For comparative purposes, CSA acreage in 1989 age classes is shown in Table 3.5. Further, comparisons of the most important cover types (by acreage or management importance) in the Mille Lacs Uplands subsection follow. Note that there is an increase of 4,000 total acres in 2000 compared to the 1989 acreage. Timber status codes 3, 5, 6, 7, 8 and 9 were not added to the CSA until after 1989; stands with those codes are now subject to restricted timber harvesting (see note on table 3.4).

Table 3.4. Acres of Commercial Cover Type by age class on DNR Forestry and Wildlife Administered Lands (updated to age in year 2000)

Administrator = 1,2,3 and 4; Timber status = All

Cover Type	00-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-120	121+	TOTAL
ASH	0	350	205	174	43	198	426	1463	2795	3207	5554	4701	19116
ASPEN	12665	15391	8251	3001	7578	25649	22048	8394	1225	92	0	0	104294
BALM OF GILEAD	0	18	0	0	0	0	55	0	0	0	0	0	73
BALSAM FIR	190	55	7	45	84	338	1051	814	227	99	36	0	2946
BIRCH	0	35	40	13	322	2507	3832	3508	739	91	5	0	11092
BLACK SPRU. UPLAND	0	4	17	13	0	21	32	38	7	14	4	0	150
BLACK SPRU. LOWLAND	0	153	840	952	475	1238	1728	1453	1263	997	1575	1017	11691
CENTRAL HARDWOODS	0	0	0	49	0	0	0	295	18	11	17	0	390
JACK PINE	11	117	77	519	777	397	107	73	0	0	0	0	2078
LOWLAND HARDWOODS	0	53	40	30	18	130	214	389	144	312	324	171	1825
N. WHITE CEDAR	0	0	6	0	0	0	18	16	83	0	121	67	311
NORTHERN HARDWOODS	351	762	833	359	1084	5315	15453	11235	6486	3829	2991	923	49621
NORWAY PINE	626	1411	423	2951	1098	439	96	40	72	74	14	0	7244
OAK	117	202	80	10	270	1866	7040	8460	2463	964	246	25	21743
RED CEDAR	0	0	9	0	0	0	0	0	0	0	0	0	9
SCOTCH PINE	0	0	0	0	25	0	0	0	0	0	0	0	25
TAMARACK	15	219	1005	658	305	963	1117	1574	2093	686	1525	658	10818
UNKNOWN/MISC	5	0	0	0	0	0	0	0	0	0	0	0	5
WHITE PINE	0	8	0	45	5	0	15	19	116	57	144	13	422
WHITE SPRUCE	140	968	352	530	300	41	31	9	20	0	0	0	2391
TOTAL ACRES	14120	19746	12185	9349	12384	39102	53263	37780	17751	10433	12556	7575	246244

*Administration codes listed above in the sub title refer to DNR Forestry (1) and Wildlife (2) lands respectively. The timber status codes have the following meanings:
1 - normal timber harvest allowed
2 - restricted timber harvest allowed
4 - extended rotation forest
6 - old growth management zone: restricted timber harvest allowed
8 - stands adjacent to future old growth or old growth candidates: restricted timber harvest allowed during evaluation period

9 - under development

Table 3.5. Acres of Commercial Cover Type on DNR - Administered Lands (1989) in the Mille Lacs Uplands.

Administration = All, Timber Status = All

COVER TYPE	00-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-120	121+	Total 1989
ASH	9	186	181	49	169	301	1,072	2,272	2,655	3,074	3,302	2,666	15,936
ASPEN	5,623	9,449	2,733	8,059	32,325	35,651	11,916	1,393	186	0	0	0	107,335
BALM OF GILEAD	0	0	0	109	0	0	28	0	0	0	0		137
BALSAM FIR	0	0	49	41	562	1,466	924	296	28	20	8	0	3,394
BIRCH	18	12	31	506	2,557	5,547	3,041	195	28	5	0	0	11,940
BLACK SPRU. UPLAND	5	0	0	0	0	0	26	0	0	0	0	0	31
BLACK SPRUCE LOWLAND	31	600	833	550	905	1,223	728	1,160	1,466	569	1,179	594	9,838
CENTRAL HARDWOODS	0	0	49	0	0	0	299	16	11	16	0	0	391
JACK PINE	121	83	731	570	467	570	53	27	24	0	0	0	2,646
LOWLAND HARDWOODS	60	39	32	18	261	469	565	385	461	342	265	661	3,558
N. WHITE CEDAR	0	6	0	0	0	0	0	49	50	42	103	38	288
NORTHERN HARDWOODS	391	635	224	578	5,356	16,263	15,751	7,649	4,426	1,570	1,079	1,353	55,275
NORWAY PINE	1,041	569	2,204	823	389	61	36	89	90	31	7	0	5,340
OAK	6	39	11	124	966	5,479	6,837	1,979	517	244	33	0	16,235
RED CEDAR	0	0	0	7	0	0	0	0	0	0	0	0	7
SCOTCH PINE	0	0	0	23	0	0	0	0	0	0	0	0	23
TAMARACK	41	812	812	278	626	1,140	866	731	590	740	776	402	7,814
WHITE PINE	0	19	27	0	0	5	22	42	75	26	24	0	240
WHITE SPRUCE	541	465	567	277	0	13	0	0	8	0	0	0	1,871
TOTAL ACRES	7,887	12,914	8,484	12,012	44,583	68,188	42,164	16,283	10,615	6,679	6,776	5,714	242,299

Trends in Major Forest Cover Types

Figure 3.4. Aspen spp. The largest number of acres in the Mille Lacs Uplands are in the aspen covertype. This includes a number of different aspen species, and often also includes Balm of Gilead. The reduction in acreage may be partly due to conversion to other types, especially northern hardwood or oak; as aspen becomes over mature and begins to die out, other species in the stand may start to become dominant, causing a type change. In addition, starting in around 1990, the State began to use color infrared aerial photography, which led to the ability to differentiate among aspen, oak, and northern hardwood stands more accurately.

Although there is a slight decline in aspen acreage from 1989 to 2000, there is a slight increase in acreage of both very young and very old aspen. This trend toward a more balanced age distribution in this type is desirable and encouraging. You will recall aspen are short lived pioneer species, so 70 -80 year old aspen is considered "old".

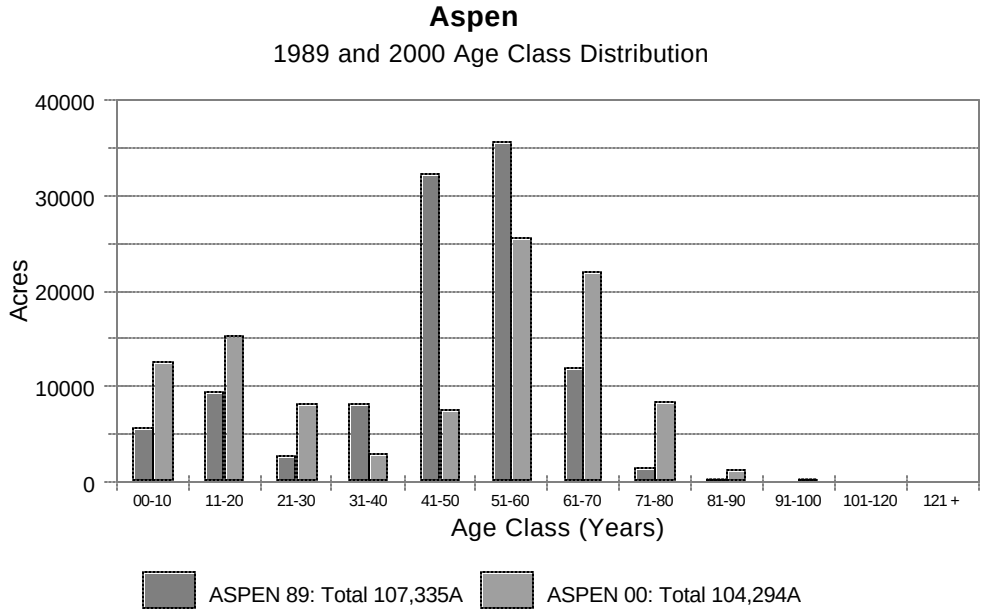


Figure 3.5. Northern hardwoods

The northern hardwoods type is often used as a catchall type to describe stands with a variety of hardwoods, possible with quite a bit of aspen. Furthermore, northern hardwoods are typically managed as "all age" stands, which is difficult to display on a conventional age chart. As we reach the goal of normal age structure in these stands, every stand will have an age from 0 to 120+. There have been efforts recently to improve management of northern hardwood sites that were high graded much earlier and had been growing back without much management to improve their quality. That situation is changing, and there is now a concerted

effort on the parts of DNR Forestry Areas that have such stands, to actively manage them for higher quality hardwoods. We anticipate continued improvement of this type, with a higher number of stands including representation of older age classes that provide prime timber, wildlife habitat, and optimal ecological services to the landscape.

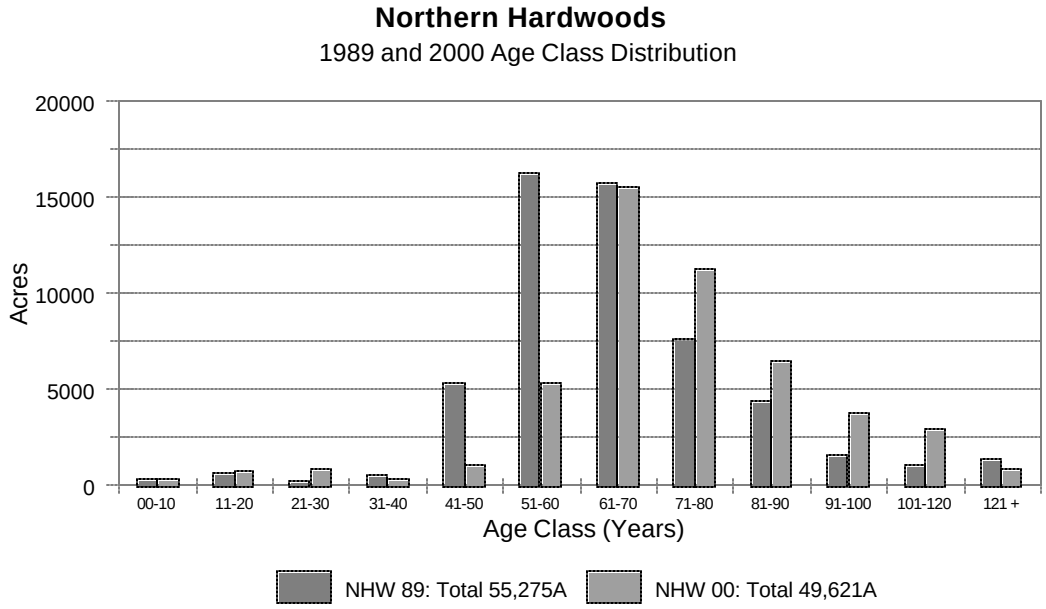


Figure 3.6. Oak

The distribution of age classes in the oak type in this subsection reflects historical events such as clearing and burning of forests in the late 1890s. There was a substantial increase in the amount of oak from 1989 to 2000. Oaks of an age where regeneration harvests would be expected to occur are not yet common (i.e., 120+ years old); the lack of older oak stands is of course also reflected in the absence of the younger age classes that would result from those regeneration harvests. In this subsection, in some of the mixed species stands, the shorter lived species (aspen, birch) are being logged out or are dying out leaving the longer lived species, including oak. We are gaining oak cover type, not because of oak regeneration, but because of a slow conversion from mixed types. A real concern is the lack of oak in younger age classes. It is going to take a major effort in time and budget to undertake management activities such as prescribed fire and scarification needed to convert aspen, northern hardwoods, and upland brush to oak, in order for us to have a meaningful increase in younger oak. Management that is occurring in existing oak stands includes selective thinning and stand improvement of the middle-aged oak stands, to encourage development of healthier older oak forests for the future.

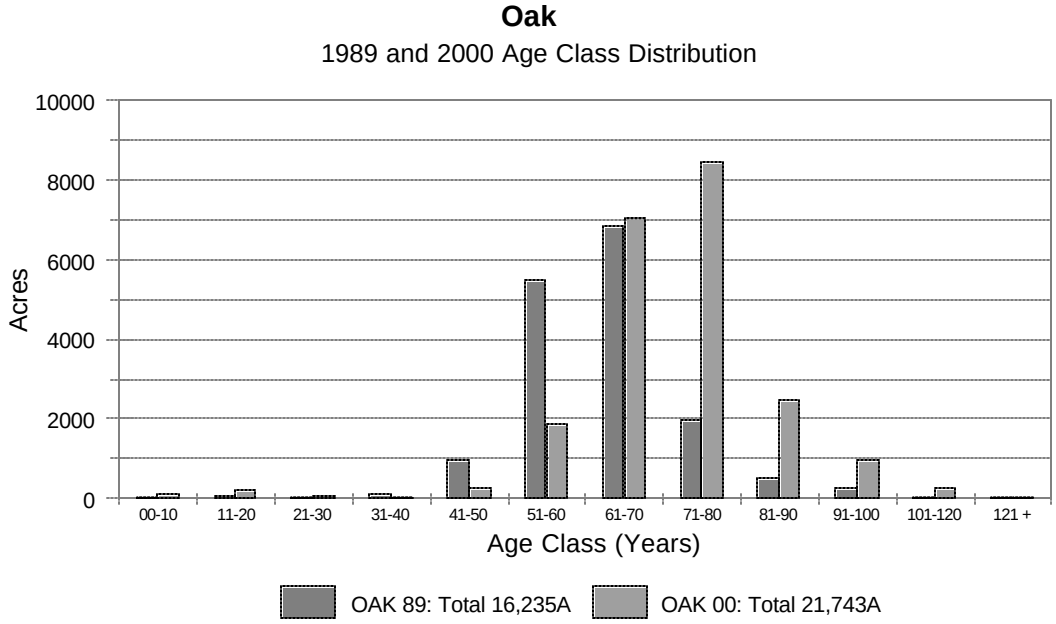


Figure 3.7. Ash

Although there is an increase in the number of acres in the ash covertype, there is only a small increase between 1989 and 2000 in younger age classes of ash. Stands in the ash cover type are being held to very old ages in the subsection for a variety of reasons. Ash stands receive very little attention, due to the fact that there is only an intermittent demand for ash, and that demand is typically for veneer-quality logs. State policy doesn't permit selectively logging a stand for removal of veneer-quality trees, therefore, ash stands aren't usually offered on

timber sales. Ash that is sold typically makes up a small portion of sales that are predominantly some other type, it is commonly left behind on such sales. However, with care, selective harvest of larger ash can be done, opening the canopy for regeneration. It requires careful selection of trees for removal, but all age management of ash stands, particularly on organic soils, is a management option.

Some of the increase in older ash is likely due to conversion of stands from the lowland hardwood type, which typically has a high percentage of ash. As the shorter lived species such as silver maple, Balm of Gilead, etc., drop out, the stands become more dominated by ash, hence the type change.

Another reason for holding ash stands is that they often exert a moderating influence on water levels in low-lying areas, and their removal can be accompanied by undesirable rises in water levels. The quality of timber in such areas is typically very low. About half the ash stands in the Aitkin Forestry area fall into this category.

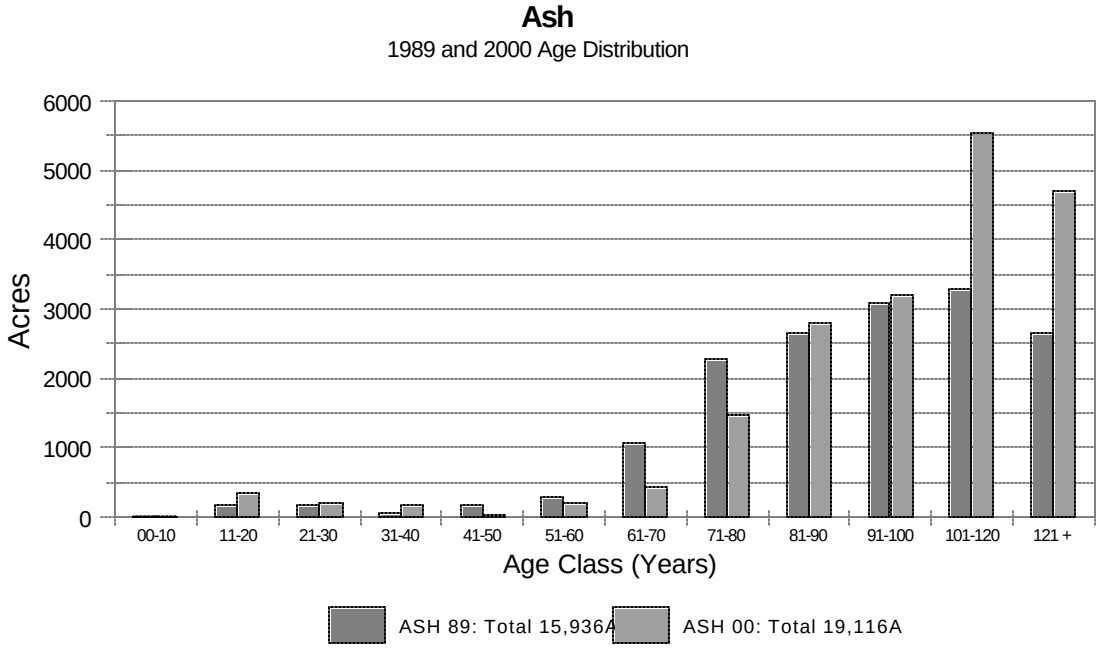
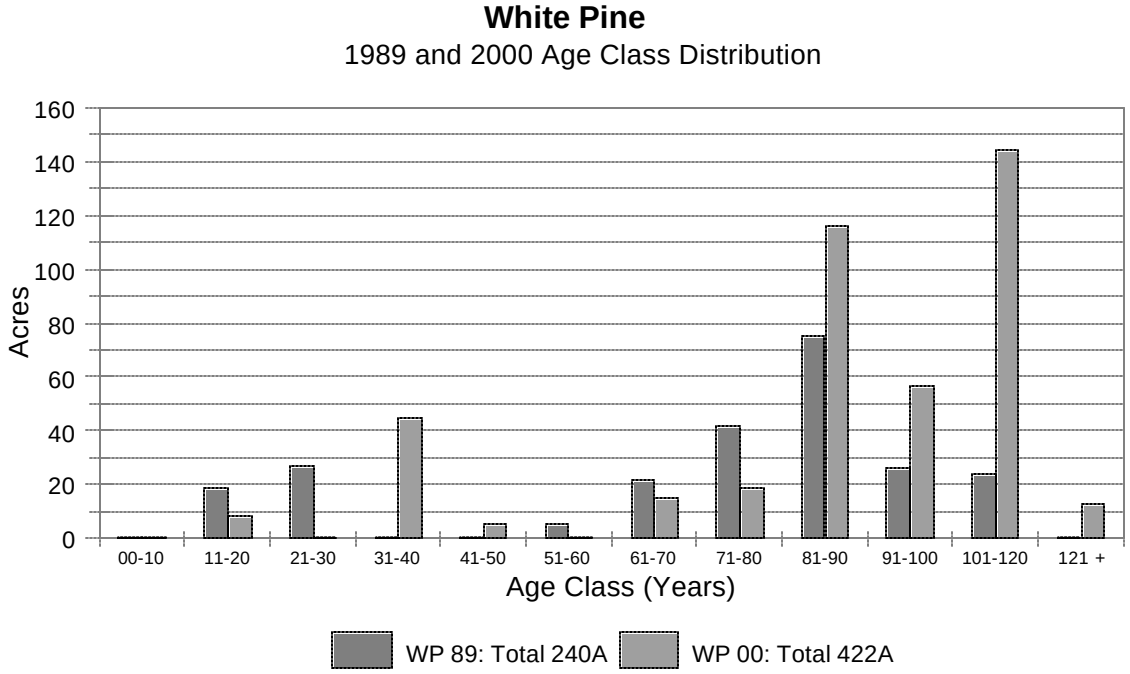


Figure 3.8. White pine

Although not a dominant cover type in terms of acres, white pine was historically important as a timber species, and is now the focus of a statewide effort to increase its presence to historical levels. White pine more typically occurs as a component in other types, thus the small number of acres of the pure white pine type. There have been widespread efforts to increase the amount of white pine on state lands, typically by underplanting in an existing forest, after thinning the canopy to about 50% cover and scarifying the underlying seedbed, or by planting clumps of larger transplants in areas that can be monitored and tended. There is also an effort to protect white pine regeneration by bud capping. These efforts are not reflected in the chart because many of them occur in stands where white pine is not the dominant species. The increase in older age classes is largely due to more detailed cover type mapping that is delineating small stands that previously were mixed with the adjoining larger types.



Silvicultural Practices

Core Assessment Products	
1.	Report harvest levels on DNR lands in the Region(s). Report previous year's harvest level on DNR lands in the subsection, by forest type and silvicultural system.
2.	Report forest development statistics e.g., artificial regeneration by species, natural regeneration, site preparation etc., on DNR lands in the Region(s).
3.	Information on growth and yield (Mean Annual Increment curves) of forest types. Provide separate curves for all species combined and main species in the subsection(s).
4.	Trends in special product e.g., balsam bough and ornamental tree permits issued for DNR lands in the subsection(s).
5.	Trends in volume sold and average prices received for stumpage by public agencies with lands in the subsection.

4.1 Data on harvest levels are still being compiled at the time of writing.

4.2 Forest Development statistics are still being compiled at time of writing.

Growth and yield of forest types in the subsection

Growth and yield of commercial forest types are presented as cords per acre per year. Forest managers determine the rotation age of forest stands by analyzing these data and determining the culmination of mean annual increment, or MAI. That point is the age at which growth becomes less efficient; harvest at that point therefore maximizes the productive capacity of that timber stand. Local environmental factors are taken into consideration in determining the actual rotation age, because factors such as climate and site index can affect the efficiency of tree growth and the length of time trees can be held without losing quality.

The figures that follow are an example of MAI curves for four major forest types in the subsection, plus white pine.

Figure 4.3 Ash

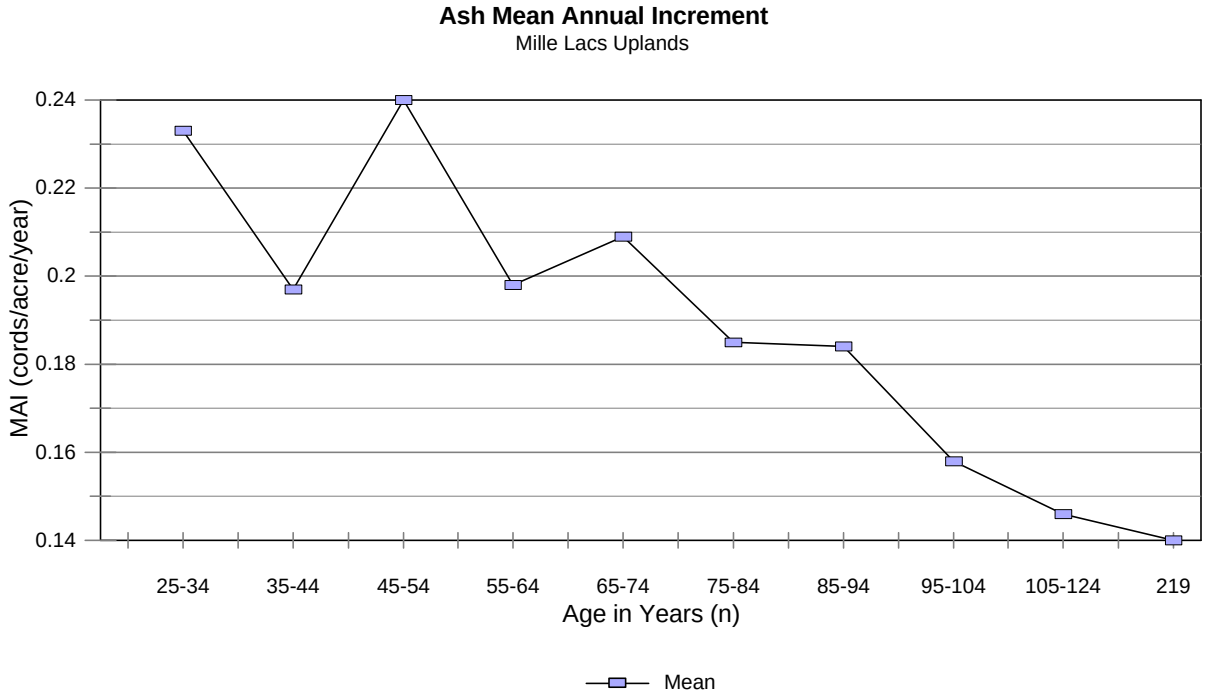


Table 4.3 Ash summary statistics

Age Class	Mean	Minimum	Maximum	CV	N Obs
25-34	0.233	0	0.471	373.519	8
35-44	0.197	0.071	0.414	271.915	5
45-54	0.24	0.038	0.44	152.468	22
55-64	0.198	0.031	0.487	195.065	66
65-74	0.209	0.043	0.594	243.424	112
75-84	0.185	0.024	0.453	208.853	115
85-94	0.184	0.034	0.418	174.888	133
95-104	0.158	0.031	0.392	188.834	94
105-124	0.146	0.017	0.361	225.1	118
219	0.14	0.031	0.261	195.965	94

Figure 4.4 Aspen

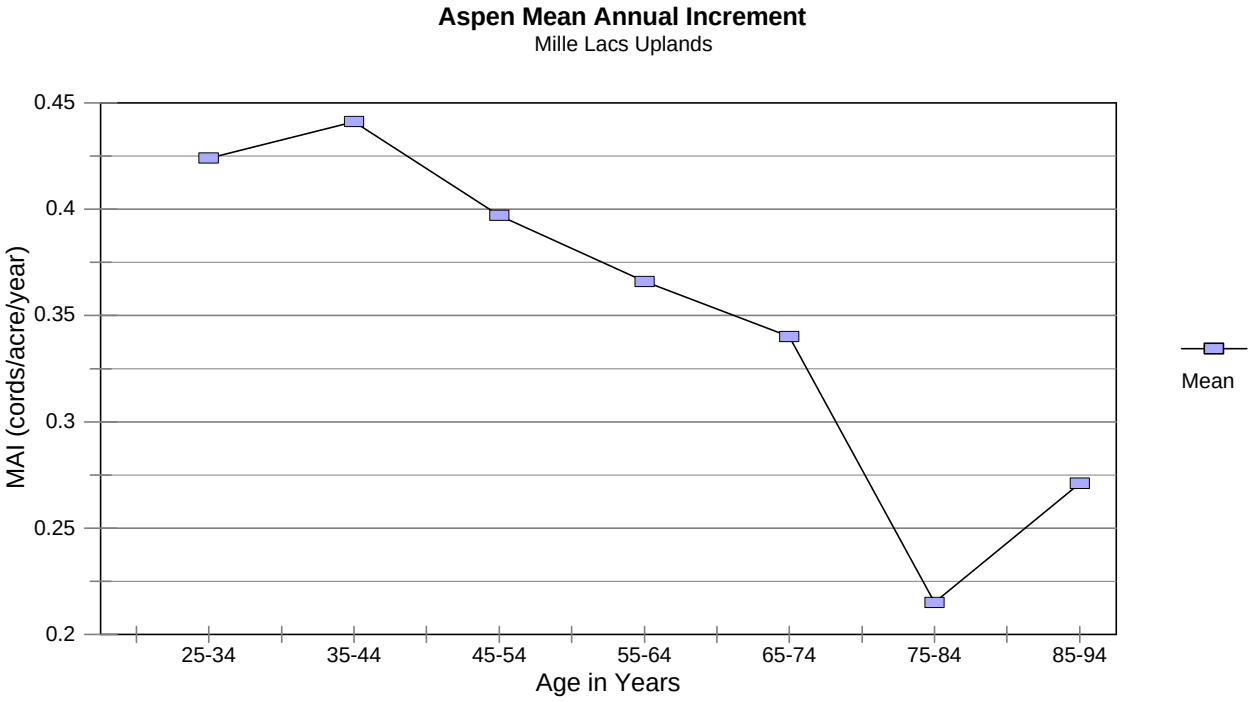


Table 4.4 Aspen summary statistics

Age Class	Mean	Minimum	Maximum	CV	N Obs
25-34	0.424	0	1.103	224.25	285
35-44	0.441	0	1.4	203.672	670
45-54	0.397	0.064	0.88	163.677	694
55-64	0.366	0.061	0.839	148.274	347
65-74	0.34	0.082	0.662	191.595	127
75-84	0.215	0.138	0.382	111.765	18
85-94	0.271	0.074	0.432	214.755	4

Figure 4.5 Northern hardwoods

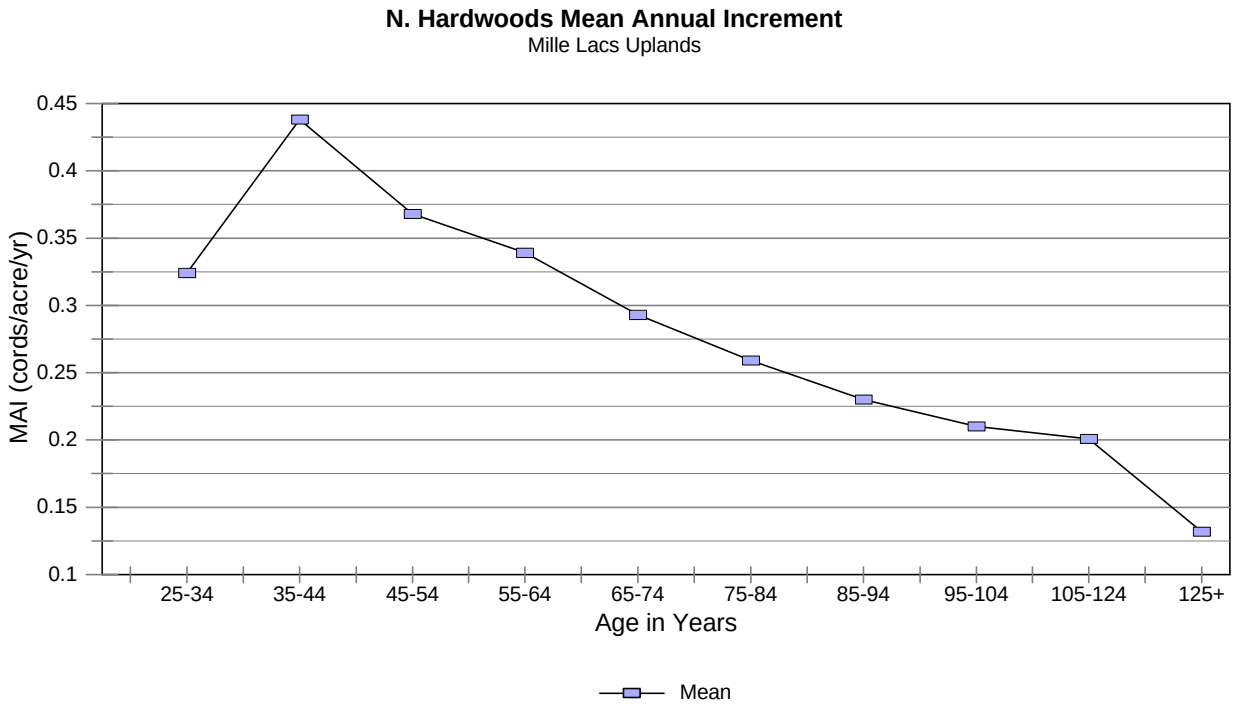


Table 4.5 Northern Hardwoods summary statistics

Age Class	Mean	Minimum	Maximum	CV	N Obs
25-34	0.324	0	1.313	363.852	18
35-44	0.438	0.086	0.816	170.48	141
45-54	0.368	0.06	0.728	182.464	387
55-64	0.339	0.066	0.903	198.466	421
65-74	0.293	0.057	0.477	133.518	218
75-84	0.259	0.086	0.427	193.341	107
85-94	0.23	0.034	0.339	180.836	27
95-104	0.21	0.12	0.376	160.813	27
105-124	0.201	0.077	0.319	198.65	28
125+	0.132	0.039	0.222	111.179	6

Figure 4.6 Oak

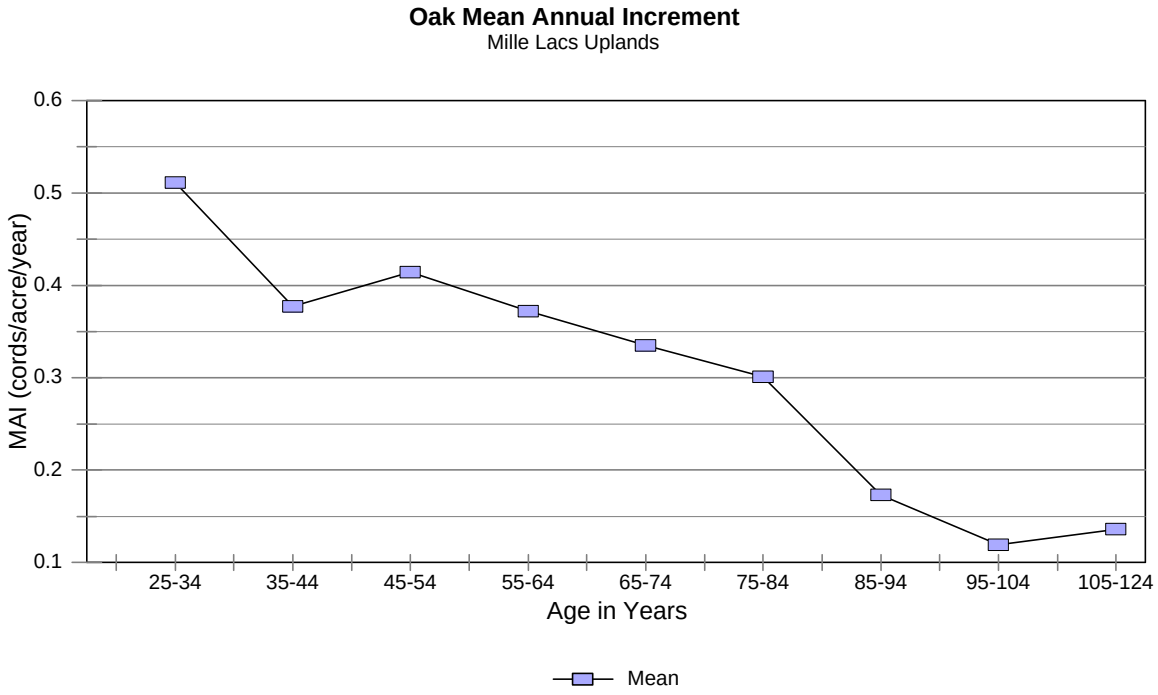


Table 4.6 Oak summary statistics

Age Class	Mean	Minimum	Maximum	CV	N Obs
25-34	0.511	0.167	0.533	113.394	4
35-44	0.377	0.125	0.707	167.477	56
45-54	0.414	0.085	0.792	180.62	176
55-64	0.372	0.078	0.782	170.144	222
65-74	0.335	0.12	0.638	134.317	105
75-84	0.301	0.091	0.526	178.052	32
85-94	0.173	0.08	0.326	197.071	7
95-104	0.119	0.113	0.17	90.052	2
105-124	0.136	0.136	0.136	.	1

Figure 4.7

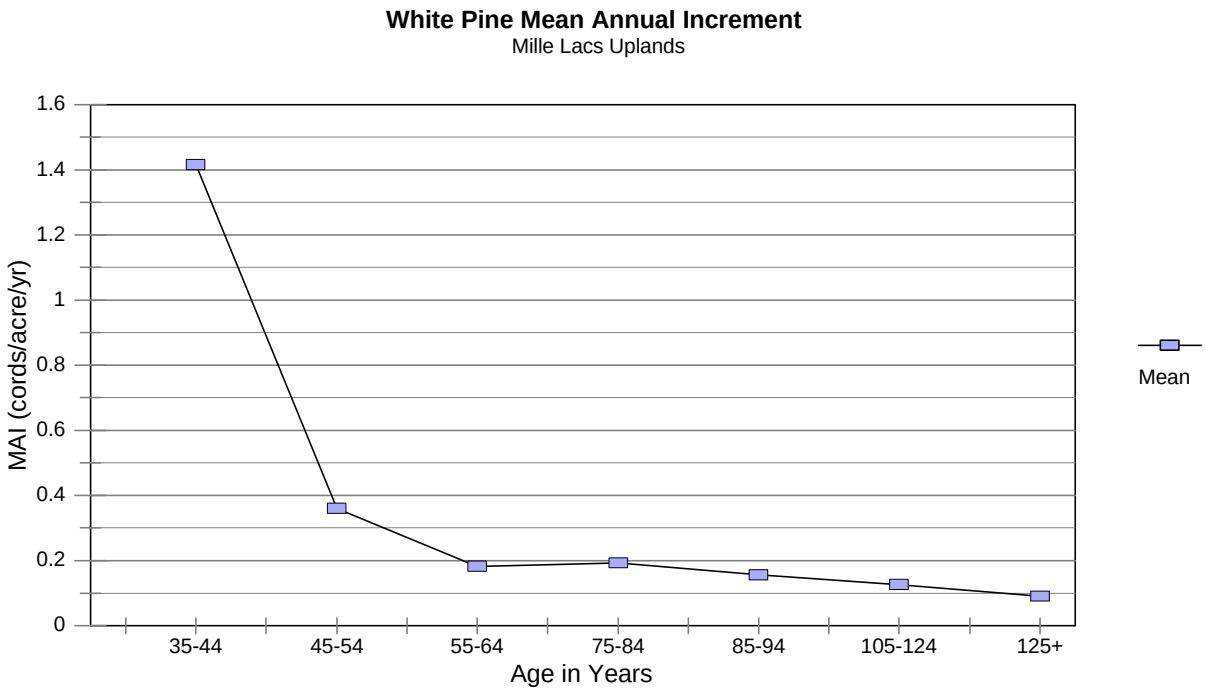


Table 4.7 White pine summary statistics

Age Class	Mean	Minimum	Maximum	CV	N Obs
35-44	1.415	1.415	1.415	.	1
45-54	0.36	0.36	0.36	.	1
55-64	0.182	0.182	0.182	.	1
75-84	0.193	0.09	0.471	232.441	7
85-94	0.156	0.125	0.193	71.823	2
105-124	0.126	0.06	0.295	505.698	4
125+	0.09	0.055	0.208	258.087	2

Status of the Wood Products Industry in the Mille Lacs Uplands

State Obligation to Timber Management and Industrial Demand

The pulp and paper as well as the oriented strand board (OSB) industry in Minnesota has either been rebuilt or established since 1982. This industry, though unofficial, probably rates the highest of comparable industries in other states and Canada in terms of plant efficiency, pollution abatement, and best product manufacturing technologies. The capital investments of these major industries that use wood harvested in the Mille Lacs Upland has exceeded **$2.5 billion** since 1982. These industries have made commitments to be lifelong residents of the State of Minnesota.

The **major** industries that purchase wood or stumpage in the Mille Lacs Upland Subsection include:

Blandin Paper Company, Grand Rapids ---------- paper
Boise Cascade Corporation, International Falls ---------- paper
Certainteed, Shakopee ---------- roofing
Champion International Corporation, Sartell ---------- paper Lake Superior Paper Industries (Consolidated Paper), Duluth ------ paper
Louisiana-Pacific Corporation, Hayward, WI ---------- OSB
Potlatch Corporation, Grand Rapids---------- OSB
Potlatch Corporation, Cloquet ---------- paper
Potlatch Corporation, Bemidji ---------- OSB
Truss Joist MacMillan, Deerwood---------- timberstrand

Industries purchasing **minor** amounts of wood or stumpage from the Mille Lacs Upland Subsection include:

Bass Lake Millworks, Sandstone---------- lumber
Diamond Brands Incorporated, Cloquet ---------- veneer bolts
Georgia-Pacific Corporation, Duluth & Superior ---------- hardboard
Savanna Pallets, McGregor---------- lumber
Woodline Sawmill, Onamia---------- lumber

The major modernizations and new establishments were all required to participate in an extensive review process before permits were granted for their expansions. When the permits were granted, the State of Minnesota and its citizens obligated the forest land within the Mille Lacs Upland subsection as a source of sustainable timber resources for these uses.

Current and Future Timber Supply and Demand

The current species demand for timber stumpage from the Mille Lacs Uplands subsection is as follows:

High Demand
Aspen---------- sawbolts and pulpwood
Red and Jack Pine ---------- sawbolts and pulpwood
White Pine ---------- sawtimber

Medium Demand
Paper Birch ---------- sawbolts and pulpwood
Soft Maple---------- sawbolts and pulpwood
Red and Jack Pine ---------- sawtimber and sawbolts
Red Oak---------- sawtimber and sawbolts
Basswood---------- sawtimber and sawbolts

Limited Demand
Black Ash ---------- sawtimber and sawbolts
Balsam Fir ---------- sawbolts and pulpwood

Table 4.8 Estimate of Increases by Year 2002

The following is an industry estimate of **statewide annual <u>additional</u>** wood use projected by 2002 (in cords):

Company	Aspen & Balm	Pine	Spruce	Balsam	Birch	Maple & Basswood
Potlatch - Cloquet	72,000	55,000			110,000	120,000
Blandin - Grand Rapids			25,000	25,000		
Sawmills		42,000	15,000	18,000	10,000	5,000

Other Impacts That May Affect Timber Supply and Demand

1. **Pulpwood Exports**

In 1998, loggers in Minnesota exported 243,000 cords of roundwood pulpwood, mainly to mills in Wisconsin. This was about 9% of the total pulpwood harvest in Minnesota. Exports to Wisconsin are expected to increase in future years. The Mille Lacs Upland Subsection will be affected by increased demand for spruce and balsam from Wisconsin mills.

2. **Pulpwood Imports**

Roundwood pulpwood imports from Wisconsin, Ontario and Manitoba to paper and OSB mills in northern Minnesota totaled 140,000 cords in 1998. A gradual increase in imports of Canadian pulpwood is expected during the next 3 years. The recent relaxation of import restrictions of aspen and birch pulpwood from Provincial lands in Ontario may give additional options to Minnesota mills. The imports must be approved by forest industry in Canada before the provincial government will approve it. There is some question on roundwood imports yet, but it is expected that wood chip imports will be available.

3. **Certified Wood Products**

Approximately 600,000 acres of public forest land in the Mille Lacs Upland Subsection has been certified as "well-managed" by the Forest Stewardship Council, and efforts are underway that area expected to double that number of acres during the life of this plan. In addition, certification of private forest land through the formation of private forest land cooperatives is expected to increase the amount of certified wood that will be available from this area. While, to this point, certification has had a minimal impact on the total wood market; it provides a unique niche for the timberlands that can meet the certification criteria. It may also ensure a market share for products from qualifying timber lands when and if wood markets take a downturn.

Businesses that handle certified forest products from the forest to the consumer, are also eligible to become certified under FSC, as "chain-of-custody" certified operations. The main criterion for this type of certification is the ability to track certified product and keep it separate from non-certified product and materials in the same business. In 2000, the following businesses are c-o-c certified in the Mille Lacs Uplands subsection:

Aitkin Hardwoods (Aitkin, Minnesota)
Hawkins Sawmill (Onamia, Minnesota)
Woodline Sawmills (Onamia, Minnesota)

ECOLOGICAL INFORMATION

Core Assessment Products
1. A description of the subsection. Include information on landform, bedrock geology, soils, climate, hydrology, topography.
2. A map of the surficial geology of the subsection.
3. A map of Land Type Associations (LTAs) in the subsection.
4. LTA descriptions.
5. A list of the natural communities known to occur in the subsection. Include community descriptions, state ranking, subsection ranking, and abundance information when available.
6. MCBS maps of natural communities and rare species for the subsection or counties within the subsection.
7. Range of natural variability (RNV) information, including disturbance regimes (frequency, patch size, severity, intensity) and age class distributions of native plant communities in the subsection.

Description of the Subsection

This subsection covers the large area of Superior Lobe ground moraines and end moraine in east central Minnesota. Gently rolling till plains and drumlin fields are the dominant landforms in this ecoregion. The jewel of this region is Mille Lacs Lake, well known for walleye fishing. This Subsection is unique because of its soils, brown and red till deposited by the Superior lobe originating from an ice accumulation center located east of James Bay, Canada. As it flowed southwest into eastern and central Minnesota, it carved out the Lake Superior basin. In the southern portion, upland hardwoods consisting of red oak, sugar maple, basswood and aspen-birch were common before settlement. Presently, forestry, recreation, and some agriculture are the most common land uses.

LANDFORM This subsection consists primarily of Superior Lobe ground moraine, and includes the Brainerd-Pierz and Automba Drumlin Fields (Dept. of Soil Science, Univ. of Minnesota 1977, 1980b, Hobbs and Goebel 1982). The depressions between drumlin ridges contain peatlands with shallow organic material. There are also small areas of Des Moines Lobe ground moraine in the southeastern portion of the subsection in Minnesota (Hobbs and Goebel 1982). There is a large end moraine that was the dam for the formation of Mille Lacs Lake. In the northeast, there is another series of end moraines, which marked later advances and retreats of the Superior Lobe.

BEDROCK GEOLOGY Glacial drift ranges from 100 to 300 feet in depth over bedrock. Bedrock is locally exposed throughout the northern portion of the subsection, where depths are typically 100 feet or less (0lsen and Mossler 1982, Trotta and Cotter 1973). Bedrock consists of Middle to Late Archean and Early Proterozoic gneiss, amphibolite, undifferentiated granite, and metamorphosed mafic. At the southeastern edge of the subsection are Cretaceous marine shale, sandstone, and variegated shale (Morey 1976, Morey et al. 1982, Ostrom l98l).

SOILS At the eastern end of the subsection, the end moraines and ground moraines have loamy soils. Typically, there is dense glacial till underlying most soils in this subsection. This dense till impedes water movement throughout the soil profile. The soils are described as acid, stony, reddish sandy loams, silt loams, and loamy sands (Hole 1976, Hobbs and Goebel 1982). The parent material in the Grantsburg (Des Moines Lobe) portion of the subsection is more calcareous and finer textured than Superior Lobe sediments. It is underlain by Superior lobe drift which is locally exposed. The soils are classified as Boralfs (well drained soils developed under forest vegetation and Ochrepts (poorly developed soils formed under forest vegetation) on the moraines (Anderson and Grigal 1984).

CLIMATE This subsection has little moderation from Lake Superior. Total annual precipitation ranges from 27 inches in the west to 30 inches in the east, with growing season precipitation ranging from 12 to 13 inches. Snowfall is relatively light - the location, primarily southwest of Lake Superior, is not characterized by lake-effect snows (Albert 1993). Growing season length is quite variable, ranging from 97 to 135 days, with the longest growing season in the south and the shortest on the outwash plains at the northern edge of the subsection. (Dept. of Soil Science, Univ. of Minnesota 1977, 1980b).

HYDROLOGY Major rivers running through this subsection include the St. Croix, which forms part of the eastern boundary, Kettle, Snake, Rum, and Ripple Rivers. The drainage network is

young and undeveloped, with extensive areas of wetlands present. There are 100 lakes that are greater than 160 acres in size. Most are found on end moraines.

PRESETTLEMENT VEGETATION The original vegetation consisted of a mosaic of forest types. Along the southern boundary, maple-basswood forests were prevalent. The rest of the subsection was a vast mix of conifer, hardwood and mixed conifer-hardwood forests. Peatland areas were inhabited by sedge-fen, black spruce-sphagnum, or white cedar-black ash communities.

PRESENT VEGETATION AND LAND USE Agriculture is concentrated in the western and southern portions of this subsection. Forestry and recreation are the most important land uses in the central and eastern part. There are large areas in eastern Pine County that are still heavily forested and relatively undisturbed, although there are no significant examples of large white pine stands still present.

NATURAL DISTURBANCE Both fire and windthrow were important in determining the vegetation of the subsection. Windthrow was and is common because of the subsection nature. Dense basal till occurs at depths of 20 to 40 inches throughout most of the subsection. Because of this, rooting depths for trees are shallow and they are subject to windthrow.

CONSERVATION CONCERNS Conservation concerns include timber harvesting, old growth, and water quality.

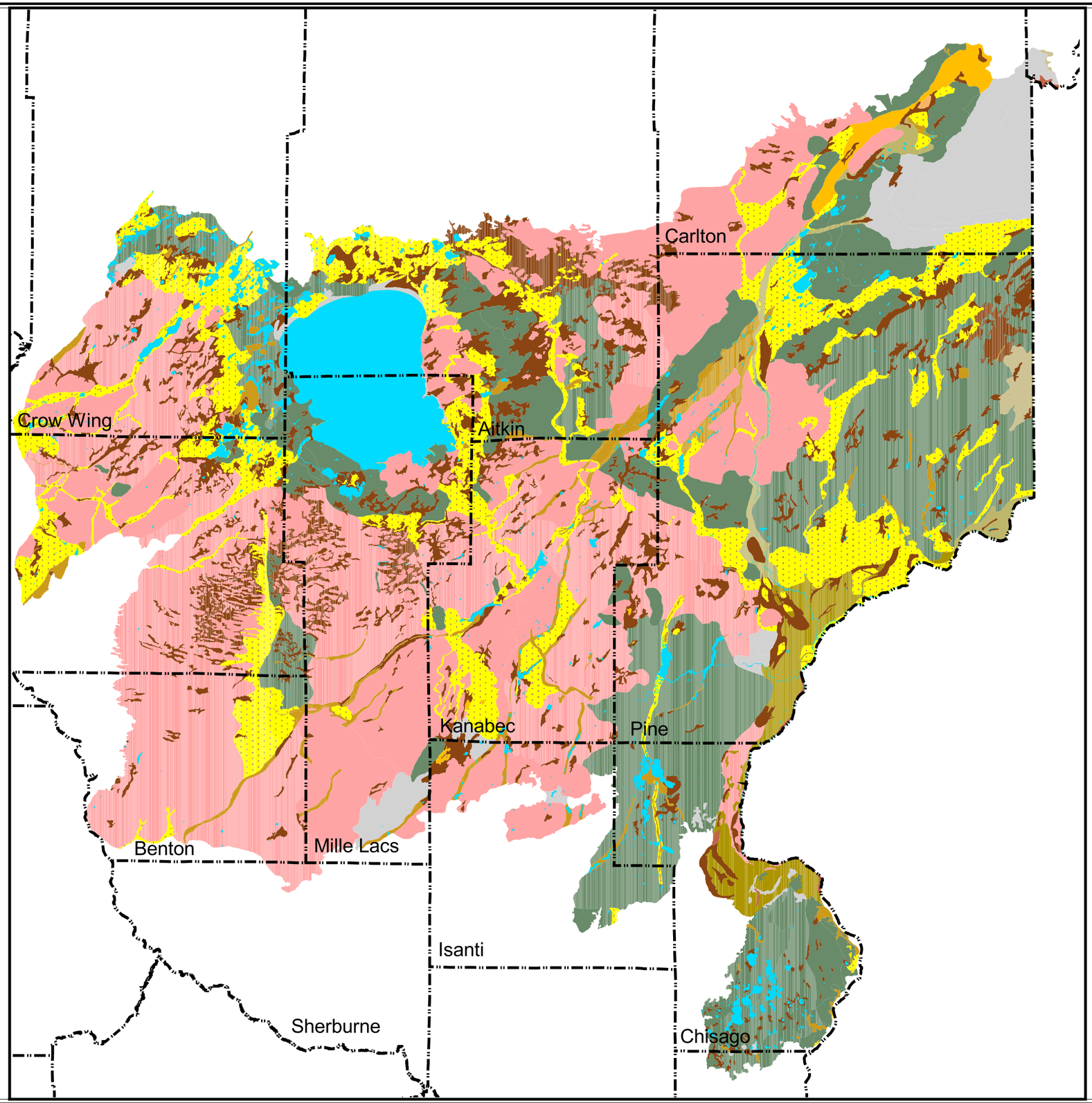
Figure 5.1 Surficial geology of the Mille Lacs Uplands Subsection

This map will be available at the public libraries, Area Forestry offices, DNR Regional office in Brainerd, the DNR Central Office in St. Paul, and on the DNR web site at www.dnr.state.mn.us/forestry/subsection/index.html

Figure 5.2. Land Type Associations in the Mille Lacs Uplands Subsection

This map is available to be downloaded on the DNR web site. It can also be viewed as a wall-size map at the public libraries in the subsection(s) and at the DNR Forestry Area offices, the DNR Brainerd Regional office, and the DNR St. Paul Central Office Library. There are 34 LTAs in the Mille Lacs Uplands and Glacial L. Superior Plain subsections. They are:

Glacial Geology of the Mille Lacs Uplands and Glacial Lake Superior Plain Ecological Subsections

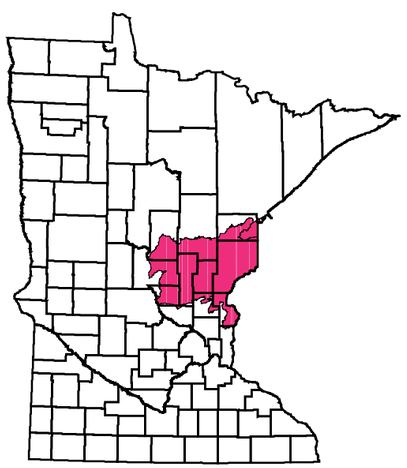


Lakes

Geomorphology

- Alluvium
- Bedrock Dominated
- Outlets
- Sedimentary
- Igneous
- Ice Contact
- Lacustrine
- Outwash
- Peat
- Terrace
- Supraglacial Drift Complex
- Till Plain
- Undifferentiated

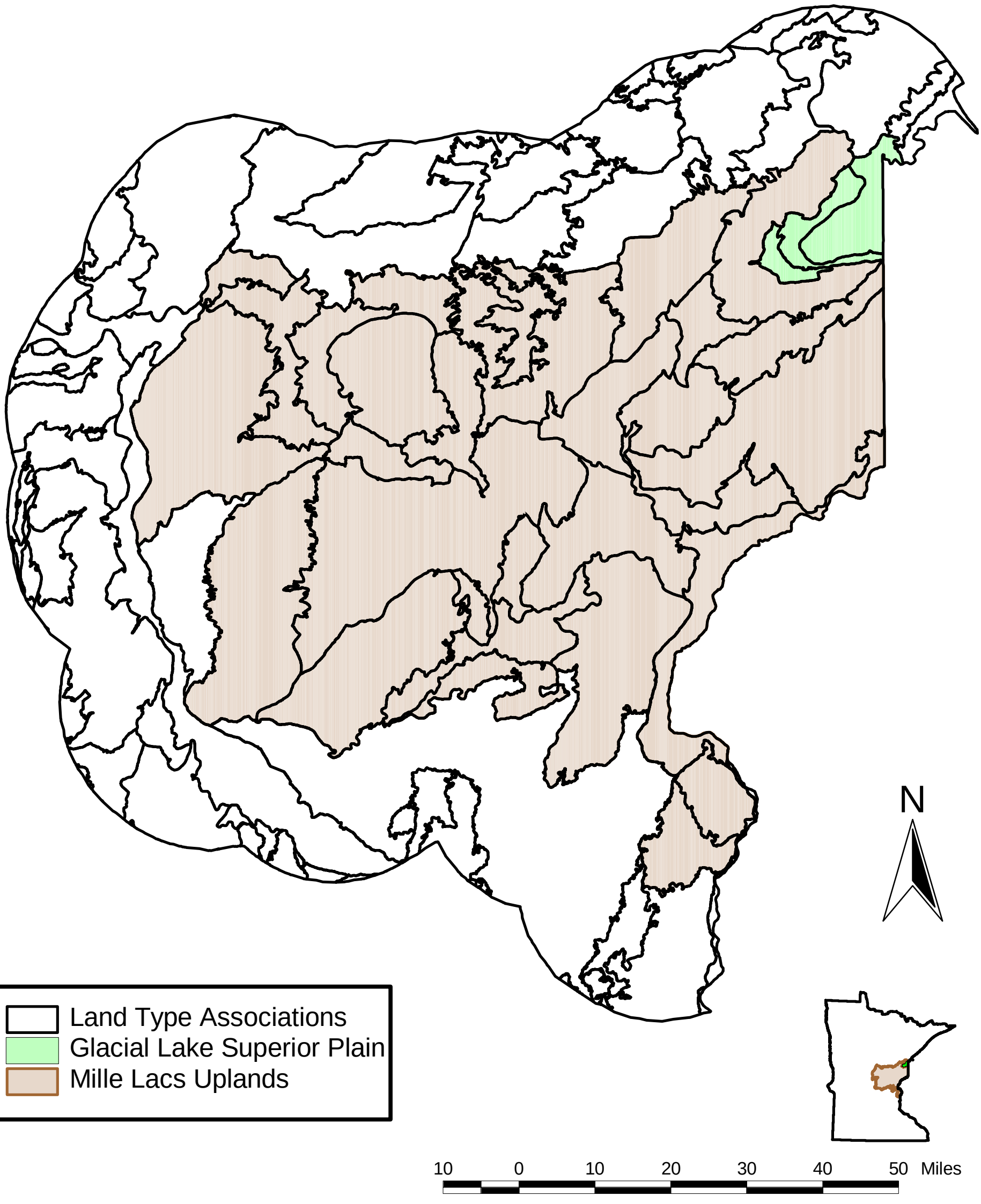
10 0 10 Miles



Minnesota Department of Natural Resources

N W E S

Mille Lacs Uplands
Glacial Lake Superior Plain
Land Type Associations



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LTA NUMBER	SUBSECTION	LTA NAME	ACRES
212Kb14	Mille Lacs Uplands	Nickerson Moraine	154603.731
212Kb16	Mille Lacs Uplands	Mille Lacs Lake	126623.682
212Kb05	Mille Lacs Uplands	Eastside Till Plain	68577.847
212Kb12	Mille Lacs Uplands	Kettle River Drumlin Plain	122823.600
212Kb15	Mille Lacs Uplands	Finlayson Till Plain	76160.200
212Kb27	Mille Lacs Uplands	Riverton Moraine	30562.135
212Kb06	Mille Lacs Uplands	Three Rivers Peatlands	46719.988
212Kb07	Mille Lacs Uplands	Solana Till Plain	177359.634
212Kb01	Mille Lacs Uplands	Bruno Moraine	76792.365
212Kb03	Mille Lacs Uplands	Malmo Peatlands	46717.447
212Kb10	Mille Lacs Uplands	Nokay Sand Plain	85706.238
212Kb13	Mille Lacs Uplands	Willow River Sand Plain	41449.152
212Kb02	Mille Lacs Uplands	Duxbury Moraine	276227.191
212Kb28	Mille Lacs Uplands	Mille Lacs Moraine	61223.058
212Kb11	Mille Lacs Uplands	Brainerd Drumlin Plain	267617.847
212Kb08	Mille Lacs Uplands	Pine Lake Till Plain	93546.885
212Kb22	Mille Lacs Uplands	Pierz Drumlin Plain	234807.686
212Kb31	Mille Lacs Uplands	Chisago Moraine	58699.608
212Kb32	Mille Lacs Uplands	Almelund Moraine	49955.432
212Kb04	Mille Lacs Uplands	Kathio Moraine	40050.419
212Kb09	Mille Lacs Uplands	Ann Lake Drumlin Plain	376361.470
212Kb19	Mille Lacs Uplands	Cloverdale Sand Plain	63400.071
212Kb18	Mille Lacs Uplands	St. Croix Terraces	123923.140
212Kb25	Mille Lacs Uplands	Brooke Park Till Plain	132590.790
212Kb20	Mille Lacs Uplands	Stanchfield Lake Plain	79626.775
212Kb23	Mille Lacs Uplands	Mora Sand Plain	31911.858
212Kb26	Mille Lacs Uplands	Rush City Moraine	196431.218
212Kb23	Mille Lacs Uplands	Mora Sand Plain	16687.407
212Kb24	Mille Lacs Uplands	Milaca Till Plain	179480.904
212Kb21	Mille Lacs Uplands	Elm Park Till Plain	52248.043
212Ja10	Glacial Lake Superior Plain	Nemadji Lake Plain	16124.170
212Ja09	Glacial Lake Superior Plain	Duesler Lake Plain	33398.894
212Ja01	Glacial Lake Superior Plain	Douglas Lake-Modified Till	60150.372

Natural community types, sections, and subtypes that occur in the Mille Lacs Uplands and Glacial Lake Superior Plain Subsections.*

Vegetation from northern Minnesota has been analyzed many times, using different numerical techniques. These analyses have identified groups of species that consistently occur together. These groups are called species guilds. As expected, these guilds have similar ecology because they occur together. The five guilds that consistently occur in this region are:

- **Fire-dependent Pine/Oak System** – characterized by plants that are adapted to fire
- **Mesic Hardwood System** – characterized by plants adapted to shade and rapid nutrient cycling
- **Floodplain Forest** – characterized by plants adapted to annual flood cycles
- **Nutrient-rich Wetland System** – characterized by plants adapted to permanently waterlogged soils and water buffered largely by carbonates
- **Acid Peatland System** – characterized by plants adapted to permanently waterlogged soils and water buffered by organic acids

Within Ecological Systems, several Native Plant Communities have been identified. These communities share species of the guilds used to describe the Systems. The communities can, in fact, share nearly three quarters of their flora, yet consistent compositional differences in the remainder allow them to be differentiated. Differences in the type, frequency, and severity of fire were used to help differentiate the communities of the Fire-dependent Pine/Oak System. Differences in the competitive ability of sugar maple as a result of occasional fire, anaerobic soil conditions, and nutrients were used to help differentiate among the communities of the Mesic Hardwood System. Perceptions of the hydrologic regime and relative dominance of conifers versus hardwoods influenced the classification of samples within the Nutrient-rich Wetland System. Water chemistry and the water level or water flow (hydrologic regime) influenced classification of communities within the Acid Peatland System.

System classifications for non-forest community types are currently being developed.

DECIDUOUS FOREST

Aspen - Birch Forest
Aspen - Birch Forest *Northern Hardwoods Subtype*

Mixed Oak Forest *(Central Section)*
Mixed Oak Forest *(Central Section) Mesic Subtype*
Mixed Oak Forest *(Central Section) Dry Subtype*

Northern Hardwood Forest *(Northern Section)*
Maple - Basswood Forest *(East Central Section)*
Maple - Basswood Forest *(Northern Section)*

Lowland Hardwood Forest

CONIFEROUS FOREST

White Pine Forest *(Central Section)*

Jack Pine Forest *(Central Outwash Plain Section)*
Jack Pine Forest *(Central Outwash Plain Section) Hazel Subtype*
Jack Pine Forest *(Central Outwash Plain Section) Blueberry Subtype*
Black Spruce - Feathermoss Forest

Red Pine Forest
Upland White Cedar Forest
Spruce - Fir Forest
Spruce - Fir Forest *Fir - Birch Subtype*
Spruce - Fir Forest *White Spruce - Balsam Fir Subtype*

MIXED CONIFEROUS-DECIDUOUS FOREST

Mixed Pine - Hardwood Forest

White Pine - Hardwood Forest *(North Central Section)*

Boreal Hardwood - Conifer Forest

Northern Hardwood - Conifer Forest *(Northern Section)*

DECIDUOUS SAVANNA

Mesic Oak Savanna *(Central Section)*

Dry Oak Savanna *(Central Section) Barrens Subtype*
Dry Oak Savanna *(Central Section) Sand - Gravel Subtype*

DECIDUOUS WOODLAND

Aspen Woodland

Oak Woodland - Brushland *(Central Section)*

CONIFEROUS SAVANNA

Jack Pine Barrens

CONIFEROUS WOODLAND

Jack Pine Woodland

UPLAND PRAIRIE

Dry Prairie *(Central Section) Barrens Subtype*

BOG

Black Spruce Bog

Open Sphagnum Bog

FLOODPLAIN FOREST

Floodplain Forest
Floodplain Forest *Silver Maple Subtype*

HARDWOOD SWAMP FOREST

Black Ash Swamp
Black Ash Swamp *Seepage Subtype*

Mixed Hardwood Swamp
Mixed Hardwood Swamp *Seepage Subtype*

CONIFER SWAMP FOREST

White Cedar Swamp

Tamarack Swamp
Tamarack Swamp *Sphagnum Subtype**
Tamarack Swamp *Minerotrophic Subtype**

Black Spruce Swamp

SHRUB SWAMP

Alder Swamp

Willow Swamp

EMERGENT MARSH

Cattail Marsh

Mixed Emergent Marsh *(Forest Section)*

WET MEADOW/FEN

Poor Fen
Poor Fen *Sedge Subtype*
Poor Fen *Shrub Subtype*
Poor Fen *Scrub Tamarack Subtype*

Rich Fen *(Transition Section)*
Rich Fen *(Transition Section) Sedge Subtype*
Rich Fen *(Transition Section) Shrub Subtype*
Rich Fen *(Transition Section) Floating-Mat Subtype*

Wet Meadow
Wet Meadow *Shrub Subtype*

Seepage Meadow

PRIMARY COMMUNITY

Moist Cliff *(Northeast Section)*
Dry Cliff *(Northeast Section)*

Rock Outcrop *(Northeast Section)*

Talus Slope
River Beach

Lake Beach *(Inland Section)*
Lake Beach *(Inland Section) Mud Subtype*
Lake Beach *(Inland Section) Sand Subtype*
Lake Bed

***Note: the classification of forest plant communities is currently under revision. A revised Native Plant Community Classification will be available in early 2001.**

The Range of Natural Variation

Historical range of natural variation is being investigated throughout the Minnesota landscape, by an interdisciplinary, and inter-agency team. Some subsections are further along in this process than others. Information that group gathers about the frequency and intensity of natural disturbances will give forest managers and planners insight into the ways nature created openings, woody debris, exposed mineral soil, fire, and other features of change in the forested landscape. We anticipate this information will be available prior to the next round of Subsection Forest Resource Management Planning (2006).

FOREST INSECTS AND DISEASE

Core Assessment Products	
1.	List of forest insects and diseases known to cause tree mortality or grade reductions in the subsection(s)
2.	Description and trend information for forest insects and diseases

Forest Insects and Diseases Assessment

This assessment deals with insects and diseases known to cause tree mortality, growth reduction or timber grade reductions in the Western Superior Upland and the Southern Superior Upland Sections and, where possible, specifically in the Mille Lacs Upland and Glacial Lake Superior Plain Subsections. The gypsy moth, an exotic insect not yet known to occur in the sections, is also included because of the potential for high impact in the future. The presence of forest insect and disease problems in Minnesota have been documented in reports by the Minnesota Department of Natural Resources, Forest Health Unit: the USDA Forest Service, State and Private Forestry; and the North Central Forest Experiment Station.

Table 6.1. Incidence of forest insects and diseases

based on CSA data (state ownership, forest lands only)

Insect or disease agent	Favored covertypes	Covertype acreage	Current incidence	Percent incidence
Defoliators	All	254,100 acres	237 acres	< 1 %
Bark beetles	Pines	9700	22	"
Wood borers	All	254,100	192	"
Spittlebug	Pines	9700	71	"
White pine weevil	Pines, spruces	12300	32	"
Spruce budworm	Balsam fir, spruces	5400	148	"
Jack pine budworm	Jack pine	2050	29	1
Root collar insects	Conifers	12300	74	< 1
Other insects	All	254,100	585	< 1
White pine blister rust	White pine	500	168	34
Sweet fern rust	Jack pines	2050	24	< 1
Sirococcus canker	Pines	9700	76	< 1
Butternut canker	Butternut	350	93	31
Oak mortality	Oak	21400	1354	6
Dwarf mistletoe	Black spruce	11700	2651	23
Diplodia tip blight	Pines	9700	29	< 1
Hypoxylon canker	Aspen	103400	19703	19

White trunk rot of aspen	Aspen	103400	5322	5
Hypox and WTR of aspen	Aspen	103400	26825	26
Heart rot	All	254,100	20503	8
Dutch elm disease	Elm	1700	59	
Birch decline	Birch	10900	4924	45
Hardwood cankers	Hardwoods	49400	4200	9
Other diseases and unknown	All	254,100	12537	5
Animal damage	All	254,100	2698	< 1
Environmental causes	All	254,100	14498	< 1
Human-caused	All	254,100	710	< 1
Unknown	All	254,100	2246	< 1

For each of the following insects and diseases the common name, scientific name, brief description, damage caused and potential for damage in the future or trend is given. Decisions on which pests and information to include in this assessment were based on literature, surveys and reports of state and federal agencies and university forest pathologists and entomologists as well as on personal experience. ***See map Figure 6.1***.

Insects

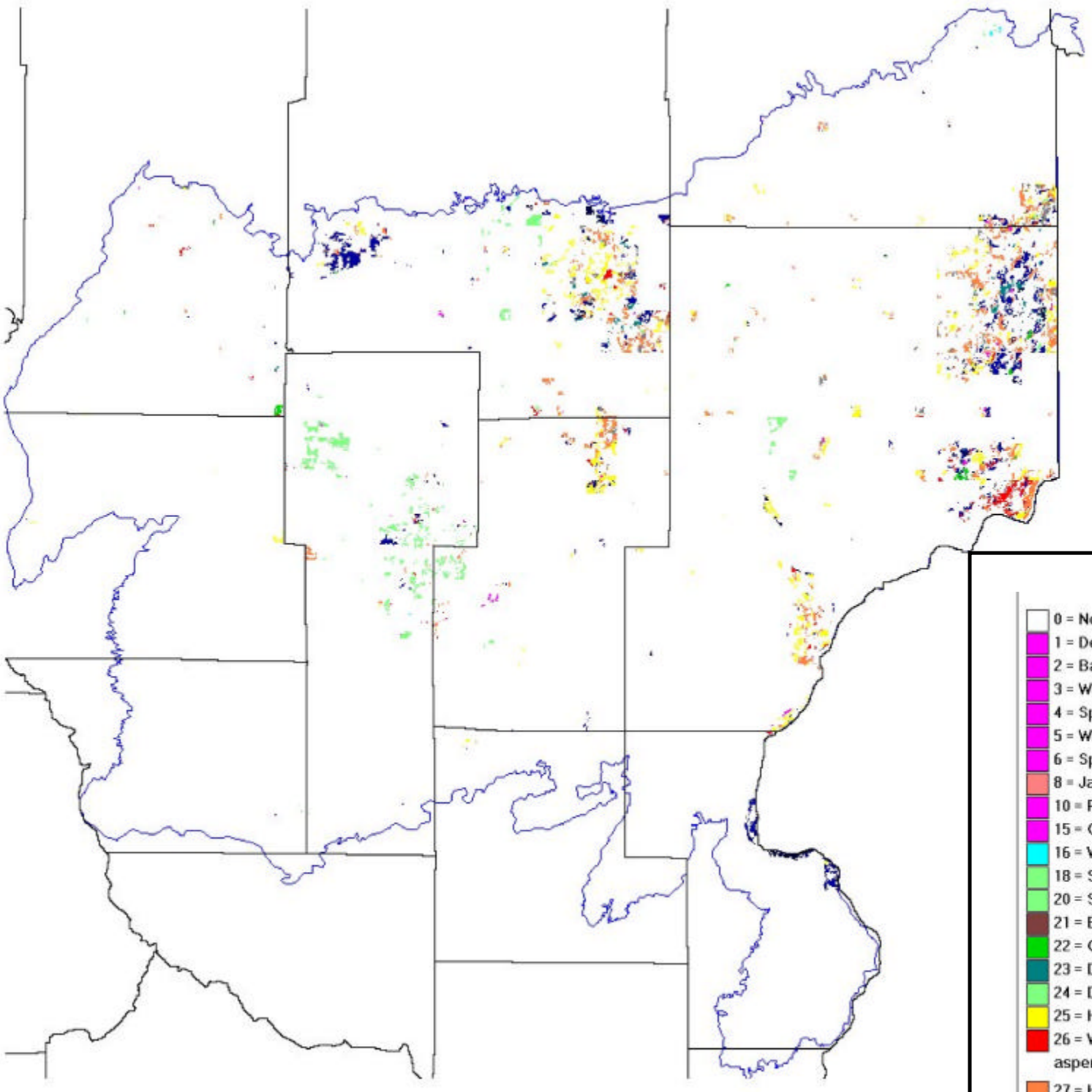
Forest tent caterpillar - *Malacosoma disstria*

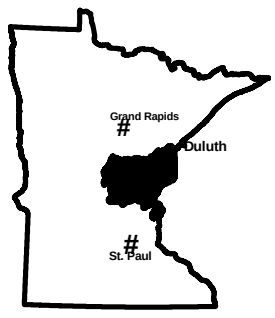
Outbreaks occur about once a decade and usually last about 3 - 4 years, although some have lasted for 5-8 years . They result in defoliation of most hardwood tree species especially aspen, birch, basswood and oaks, within the outbreak area. The last outbreak peaked here in 1989 when defoliation occurred across approximately 2,290,000 acres. Fortunately, tree mortality is usually not very common unless the outbreak is unusually long or is concurrent with a severe drought. Significant growth loss is widespread during the outbreak. According to research work in Minnesota, repeated FTC outbreaks during the life of an aspen stand may result in a 20 to 25% growth loss (Duncan and Hodson, 1958). ***See map Figure 6.2.***

8[1] It appears that another outbreak of FTC is just starting. Populations and acres of defoliation will likely be very high during the next 3 to 4 years and then decrease back to endemic levels for

[1]. 8 - up sharply, 9 - down sharply, _ - up moderately, ` - down moderately, 6 - stable or not predicted, ? -unknown or not predicted.

Mille Lacs Uplands
Glacial Lake Superior Plain Subsections
CSA Insect & Disease Damage



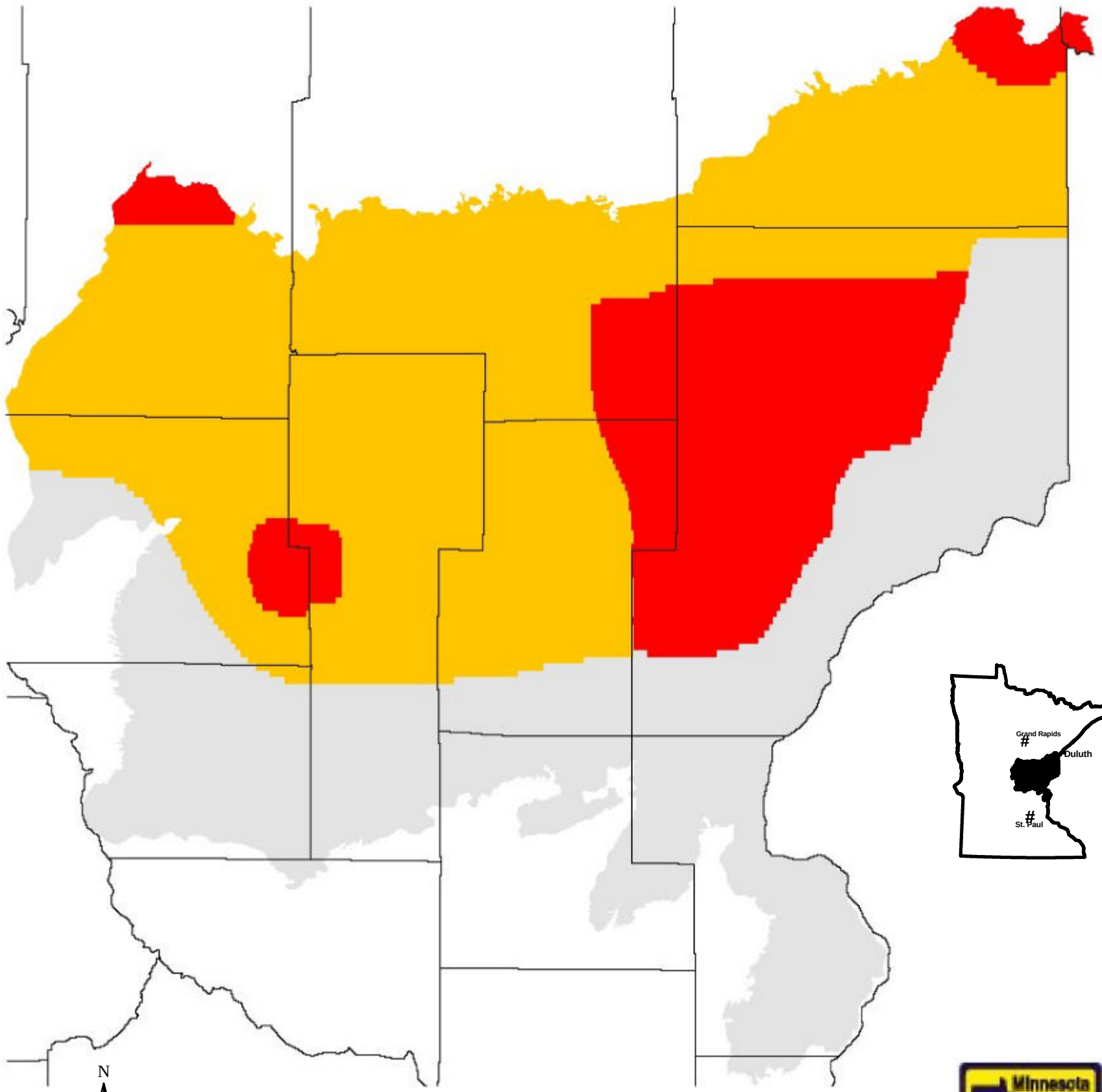


0 = None
1 = Defoliators
2 = Bark beetles
3 = Wood borers
4 = Spittlebug
5 = White pine weevil
6 = Spruce budworm
8 = Jack pine budworm
10 = Root collar insects
15 = Other insects
16 = White pine blister rust
18 = Sweet fern rust
20 = Sirococcus canker
21 = Butternut canker
22 = Oak mortality
23 = Dwarf mistletoe
24 = Diplodia tip blight
25 = Hypoxylon canker
26 = White trunk rot of aspen
27 = Hypox and WTR of aspen
28 = Heart rot
29 = Dutch elm disease
30 = Birch decline
31 = Hardwood cankers
40 = Other diseases
41
42
43
44
45
50
51 = Windthrow
52 = Drought
53
54 = Fire
55 = Flooding
56
57 = Frost crack
60
61 = Machinery
62 = Chemical
99 = Unknown

Subsection Forest Resources Mgmt Planning
Created by DNR Division of Forestry
July 11, 2000
More information can be found at:
http://www.dnr.state.mn.us/forestry/subsection/index.html

Minnesota
DEPARTMENT OF NATURAL RESOURCES

Mille Lacs Uplands
Glacial Lake Superior Plain Subsections
Forest Tent Caterpillar, 1989



LIGHT TO MOD. DEFOL.
<50%

HEAVY DEFOLIATION
>50%

3

Minnesota
DEPARTMENT OF NATURAL RESOURCES

Subsection Forest Resources Mgmt Planning
Created by DNR Division of Forestry
July 11, 2000
More information can be found at:
http://www.dnr.state.mn.us/forestry/subsection/index.html

the next 8-12 years.

Two-lined chestnut borer - *Agrilus bilineatus*

This insect is an opportunistic insect that attacks weakened oak trees. It is a native beetle known to attack all oak species found in Minnesota, red oak being its preferred host. When trees and stands are healthy, TLCB confines its attack to low-vigor trees or broken branches. When drought stress and/or defoliation have reduced tree and stand vigor, they are predisposed to TLCB attack. Under severe stress and/or defoliation conditions, widespread outbreaks of TLCB can occur. A goal in oak management should be to promote stand vigor by manipulating stocking in order to prevent and minimize TLCB-caused oak mortality. Once the damage from a population of TLCB's becomes evident, management options are postponement of any activity in the stand, salvage and sanitation. Thinning during an outbreak should be strictly avoided because it wounds trees and creates droughty conditions for the crop trees.

6 Currently at endemic levels, but these insects are always a component of oak forests so they can quickly respond to windstorms, severe defoliation, wounding and drought. A widespread outbreak would be brought on by a severe drought. A localized outbreak could be induced by excessive wounding during partial harvest or by wounding due to wind damage.

Gypsy moth - *Lymantria dispar*

Gypsy moth is an exotic insect pest spreading across the US and Canada. While gypsy moth is currently not established in the state, it was included in this assessment because of its occurrance in Wisconsin and because it will spread into and become established here. Minnesota is being invaded by gypsy moth from the east. The invasion pressure will increase as the populations in Wisconsin get closer to Minnesota. Pressure may also increase from Ontario. Natural spread of the gypsy moth is slow but the unintentional spread by humans can be very rapid. Egg masses are transported on cars, recreational vehicles, logs, firewood, nursery stock, etc. Permanent populations are likely to become established in some locations in Minnesota during the life of this plan. Gypsy moth caterpillars feed on most hardwood trees and shrubs and in heavy infestations will also feed on conifers. Repeated defoliations lead to tree decline and death. Trees under stress suffer higher levels of mortality. Oaks, aspen, birch, basswood, tamarack, willows, hazelnut and ironwood are among the gypsy moth's preferred trees. The extent and severity of impact in this area is unknown at this time, however, gypsy moth will cause changes in the forest composition once it is established. A Risk Potential map was developed and applied to these subsections:

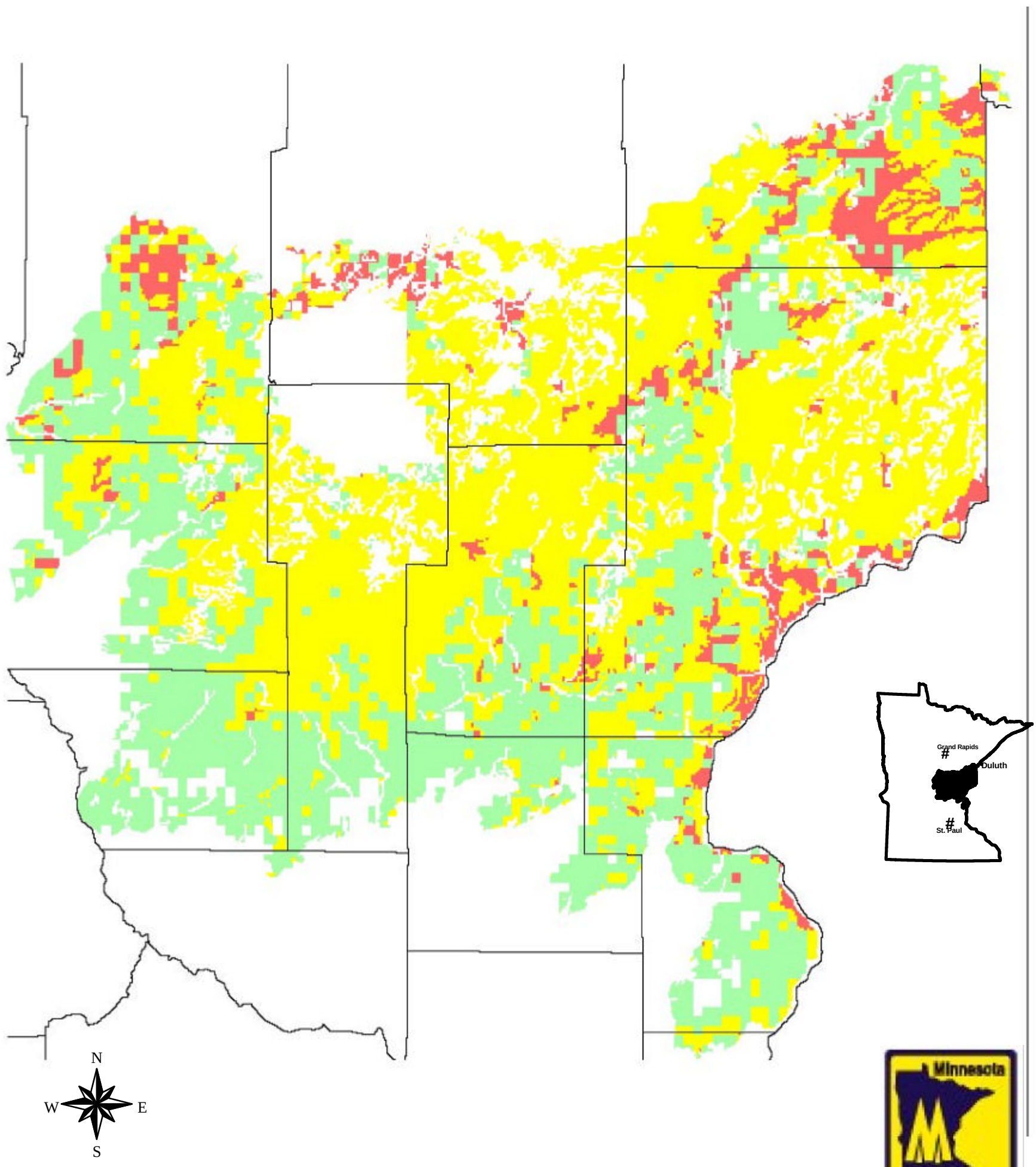
Low risk	1,049,000 acres
Moderate risk	1,512,000 ac.
High risk	230,000 ac.

See map Figure 6.3.

Gypsy moth defoliation and mortality will make management planning more difficult as well as have an adverse impact on tourism and real estate values. Phermone traps are the primary method used to detect and monitor gypsy moth populations. The DNR is a member of the Gypsy Moth Program Advisory Council and cooperates with the Dept. of Agriculture in pheromone trapping.

_ The number of male moths caught in phermone traps will increase over the life of this plan. But it will probably not have a significant impact such as noticeable defoliation, during this period. Population centers may develop requiring eradication during this period also.

Mille Lacs Uplands
Glacial Lake Superior Plain Subsections
Gypsy Moth Damage Potential
(MFRC Version)



Low Damage Potential
Moderate Damage Potential
High Damage Potential
No Damage Potential

Minnesota
DEPARTMENT OF NATURAL RESOURCES

Subsection Forest Resources Mgmt Planning
Created by DNR Division of Forestry
July 11, 2000
More information can be found at:
http://www.dnr.state.mn.us/forestry/subsection/index.html

Large aspen tortrix - *Choristoneura conflictana*

Large aspen tortrix is a native defoliating insect of aspen. It is also found on birch and some other hardwoods associated with aspen. Defoliation reduces the growth rate of trees but outbreaks generally last only 2-3 years. This is seldom long enough to cause mortality. Populations of this defoliator have experienced explosive outbreaks in the past covering millions of acres in Minnesota, especially in these two subsections. The latest and most severe outbreak occurred in 1994. ***See map Figure 6.4.***

` An outbreak has been occurring the last several years but is likely to decline as it gets over run by the developing outbreak of forest tent caterpillar. Then it will be at endemic levels for the next few years.

Jack pine budworm - *Christoneura pinus pinus*

Jack pine budworm larvae eat the needles of jack pine causing defoliation , top kill and mortality. In the Lake States, JPBW outbreaks tend to occur at roughly 6 to 12 year intervals but on a local level this can vary greatly. They generally persist for 2-4 years, then decline. Poorly stocked stands, over stocked stands, over-mature stands or stands with low-vigor trees are most susceptible to build-up of JPBW populations. In these Subsections, jack pine barrens are the most susceptible jack pine covertype. These stands also sustain the highest level of damage and mortality. Multi-storied stands allow the buildup of large populations of budworm and understory trees in such stands may sustain heavy defoliation and high mortality. Defoliation of jack pine occurred in the Mille Lacs Upland Subsection from 1993-1996 and peaked in 1994 at 14,700 acres. Defoliation was generally in the moderate category and did not cause much top kill or mortality. ***See map Figure 6.5.***

? Jack pine budworm has not caused noticeable defoliation in the subsection since 1996. However, JPBW can cause considerable defoliation, top-kill and mortality in Minnesota and it's future impact in the subsection can't be predicted accurately based on past history.

Bark beetles (pine engraver beetle) - *Ips pini*

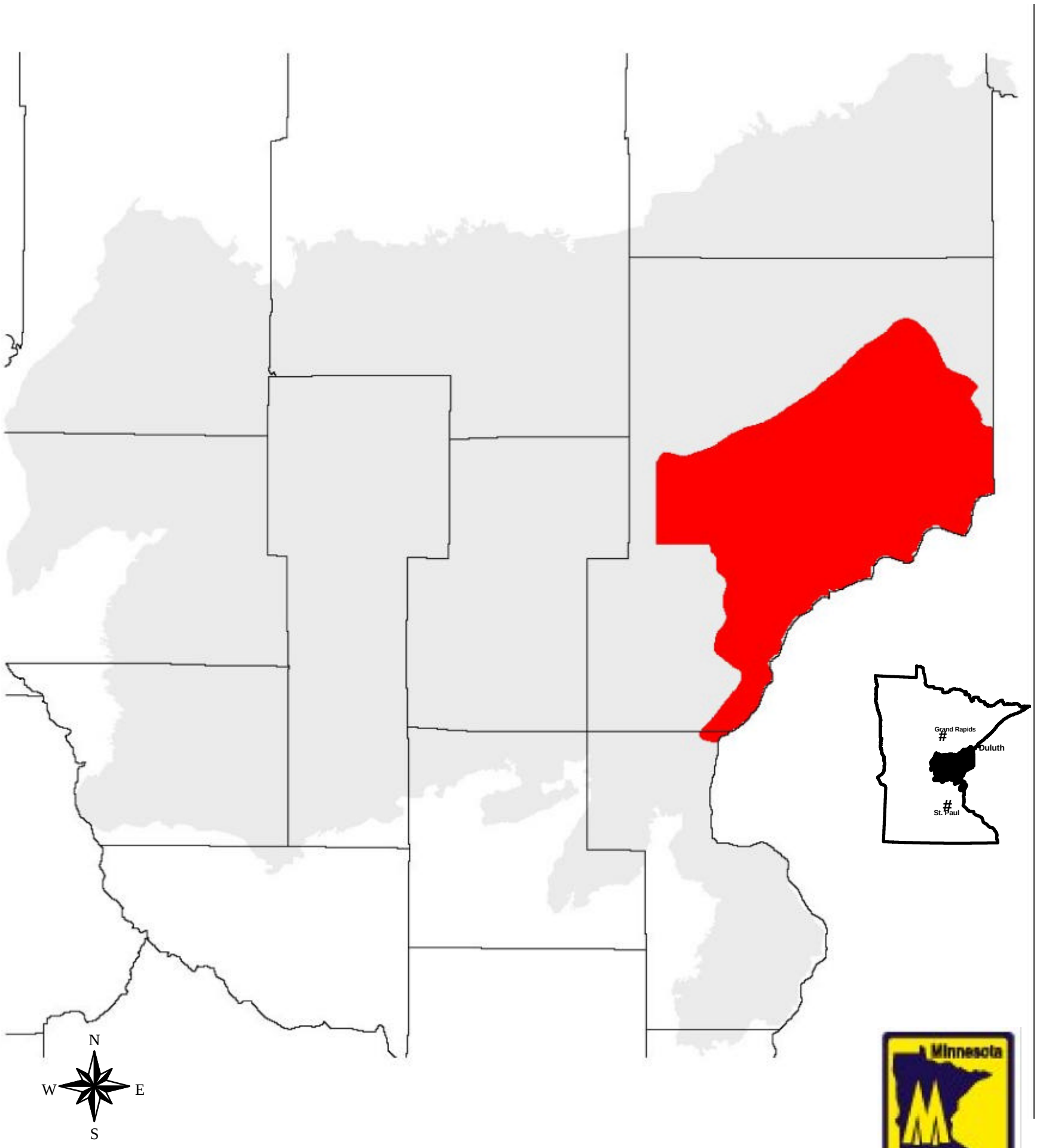
Many species of bark beetles exist in Minnesota. The pine engraver beetle is very common and sometimes very abundant. Bark beetles feed and reproduce in the moist cambium of freshly cut, recently killed or blown down red, jack pine and occasionally white pine. Up to three generations of *Ips pini* develop in a growing season. After developing in the dead material the new adults may attack standing live trees nearby and massive attacks are able to kill standing, damaged as well as healthy trees. Dead trees often occur in patches or pockets because emerging beetles usually attack trees adjacent to brood material. Attack often begins in tree tops and progresses downward. Stress such as drought, overcrowding, wounding, lightning strikes, fire scaring etc., reduce tree vigor and predispose them to bark beetle attack, making it easier for the beetles to kill the trees. Thinning of pines during the spring and summer is the number one preventable cause of bark beetle outbreaks.

6 Currently at endemic levels. Thinning pines during the spring and summer will allow them to attack crop trees, especially during a droughty year. In the long term, bark beetle problems could increase on harvested sites if care is not taken in selecting trees to be left as coarse woody debris and leave trees.

White pine weevil - *Pissodes strobi*

White pine weevil larvae kill the terminal leaders of white pines resulting in crooked or forked stems

Mille Lacs Uplands
Glacial Lake Superior Plain Subsections
Aspen Defoliator Complex, 1994



Unaffected Area

Heavy & Continuous Damage

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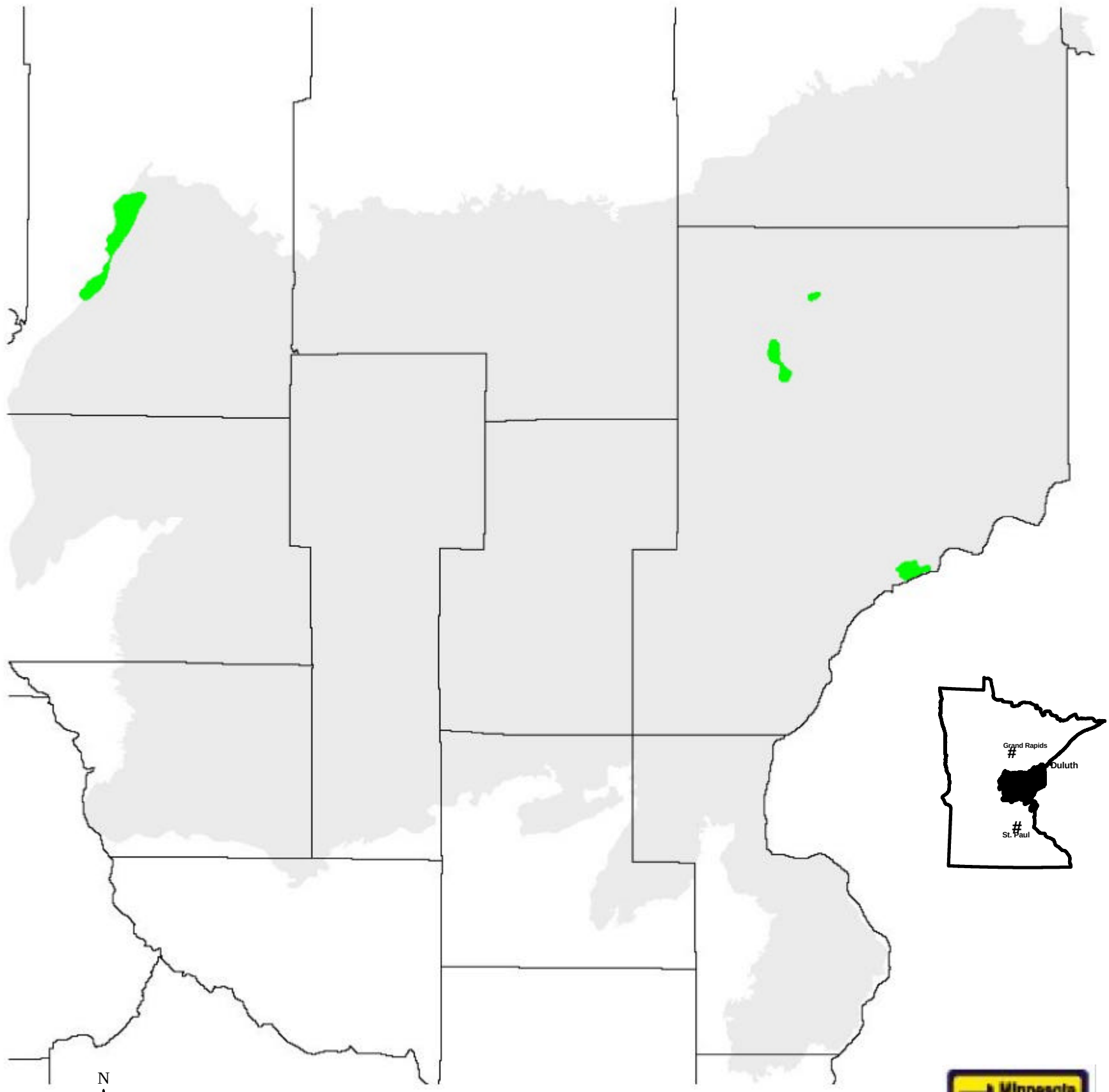
Mille Lacs Uplands
Glacial Lake Superior Plain Subsections
Jack Pine Budworm, 1994



Unaffected Area

Light Damage (Below Threshold)

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resulting in reduced volume and lumber degrade. A report in Ontario claims that 80% of the stem decay in white pines trees was associated damage caused white pine weevils. Trees growing in the open sunlight are preferred by the weevils. The most severe damage occurs in northern Minnesota, but is common in these subsections. The weevil will attack other trees including jack pine and the spruces but usually do not cause significant damage to these species.

_ Damage from white pine weevil is most significant on trees less than 20 feet in height. If white pine planting increases the amount of damage will increase.

Spruce budworm - *Christomeura fumiferana*

Spruce budworm is a native insect and outbreaks have periodically defoliated forests for hundreds of years. Spruce budworm has defoliated an average of 250,000 acres per year in northeastern Minnesota for the past 46 years. The larvae eat the needles of primarily balsam fir and white spruce causing defoliation, top kill and mortality.

Balsam fir is the preferred host but budworm has been causing defoliation, top kill and mortality in plantation white spruce for the past decade. Top-kill in white spruce begins after about 3-4 years of heavy defoliation and tree mortality may begin after 5-7 years. Most damage appears to be occurring in spruce plantations that are 25-30 years and older. Low levels of mortality have been observed thus far. ***See map Figure 6.6.***

` The spruce budworm population is declining statewide and that is reflected here as well. However, the potential still exists for localized flare-ups in the maturing white spruce plantations.

Pine tussock moth - *Dasychira pinicola*

Periodic outbreaks of pine tussock moth cause spring and summer defoliation of jack pines. One heavy defoliation can kill a fourth of the trees and kill the tops of another half the strees in a stand. Caterpillars can completely defoliate and kill pockets of trees within a stand. Two successive yearas of heavy defoliation can often destroy an entire stand. In adjacent counties in Wisconsin, major outbreaks have gegun in pockets of less than 1,000 acres and spread to 40-60,000 acres within 2 years. In Minnesota, the last outbreak occurred in 1979 and 1980 near General Andrews Nursery in Pine County. To control this pest, an insecticide was aerially applied. Extensive areas have been replanted to red pines, disrupting the large, contiguous acreage of jack pine. Also, since that time, pheromone traps have monitored PTM populations in mature stands of jack pine. Trap catches are very low, no larvae have been found and no defoliation observed.

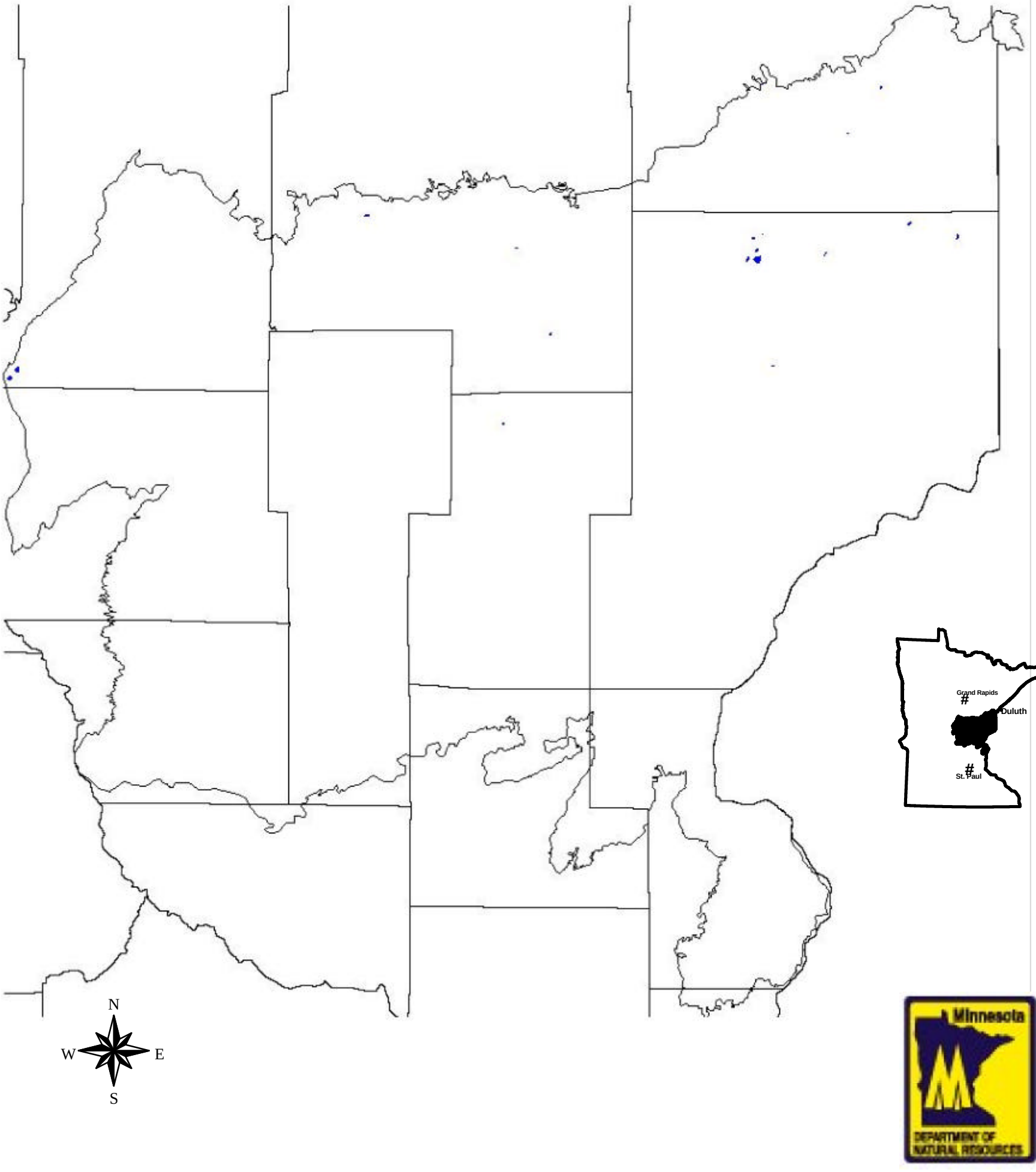
6 At endemic levels and expected to remain low.

Larch casebearer - *Coleophora laricella*

An unfortunate introduction from Europe, the larch casebearer was first found in Massachusetts in 1886 and by the 1950's was found in the western states. It is a serious defoliator of larch (tamarack), capable of causing mortality. When the insect is abundant, needles are mined during the spring causing the tree to look scorched. Heavy defoliation retards both height and diameter growth. If severe defoliation occurs for two or more consecutive seasons, then the larches may be killed. A number of parasitic insects have been imported to control the severity of casebearer outbreaks, and have been successfully established.

_ During the summer of 2000, light to moderate defoliation was observed in tamarack stands

Mille Lacs Uplands
Glacial Lake Superior Plain Subsections
Spruce Budworm Damage,
Aerial Survey, 1996



No Defoliation

Continuous, light defol.

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throughout Aitkin County. Populations are expected to increase and will be monitored for the next few years.

Larch sawfly - *Pristiphora erichsonii*

Larch sawfly is the most destructive defoliator of larch in North America and was, at least in the recent past, considered the major pest of tamarack in Minnesota. The larvae eat the needles of tamarack. Tamaracks do not readily die from defoliation, but repeated defoliations eventually kill trees. Larch sawfly has been a historically spectacular insect defoliator, although we have not seen large outbreaks since the 40's and 50's. Between 1910 and 1926, it is estimated that this defoliator killed a billion board feet of timber in Minnesota. Parasites where introduced into Minnesota in the 1970's to try to keep this insect under control. In the past 20-25 years, pockets of defoliation have frequently occurred, but have collapsed after a couple of years. Whether this pattern of outbreaks being local in nature and collapsing quickly will continue or not is unknown.

6 Stable, with only small local short lived outbreaks causing no significant damage. Larch sawfly has not caused significant damage in the past 20-25 years, but historic levels of damage show that it should not be ignored.

Diseases

Oak wilt - *Ceratocystis fagacearum*

Thousands of oaks in woodland and urban settings die from oak wilt every year. Widespread in Minnesota and Wisconsin, the disease is caused by a fungus that invades the tree's water conducting system, resulting in wilting and tree death. The Anoka Sandplain Subsection has, by far, the most oak wilt in the state. The Mille Lacs Upland Subsection abuts the northern border of the Anoka Sandplain and has had oak wilt disease spreading into it, especially in Chisago County. The amount of oak wilt (on all land ownerships) is:

Chisago Co.	133 acres
Isanti Co.	7 acres
Sherburne Co.	15 acres

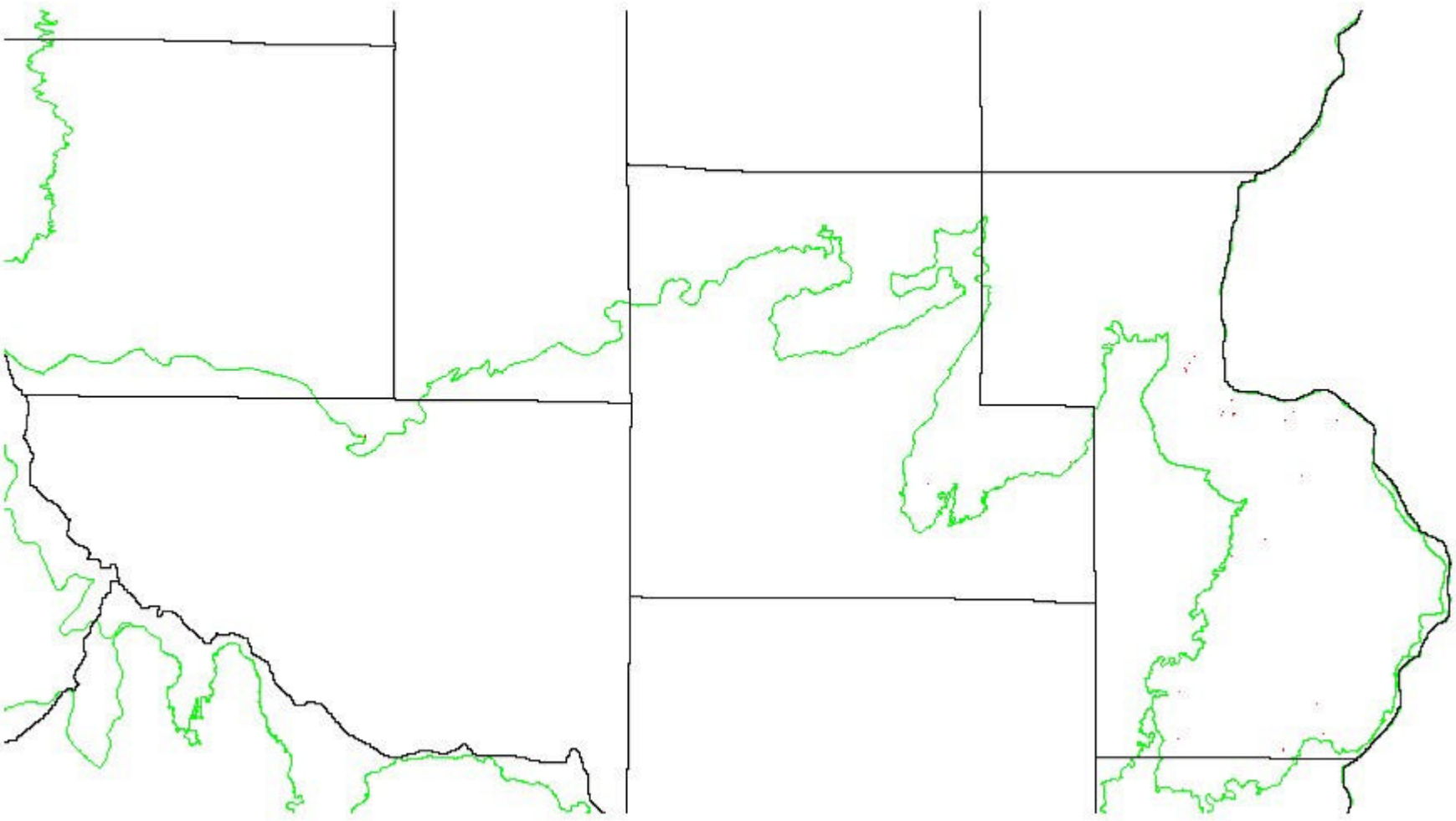
See map Figure 6.7.

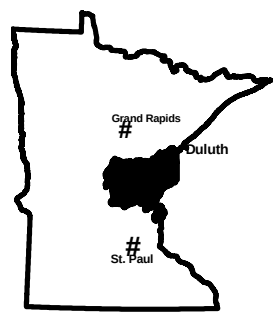
Oaks vary in their susceptibility to the disease; red oaks are very susceptible and white oaks are moderately resistant. Oak trees become infected by (1) beetles carrying the oak wilt fungus to fresh wounds, or (2) the spread of spores in grafted roots of a diseased tree. In the first case, a beetle carrying spores to a fresh wound only travels 1500 feet from the infected tree or wood pile. In the second case, tree root systems must be grafted together, usually less than 75 feet between the healthy and infected tree.

Two precautions can decrease the chance of oak wilt from invading a woodlot or a wooded homesite. Do not harvest, prune or otherwise wound oak trees from budbreak to 3 weeks past full leaf development (generally from April 1 to July 15). Secondly, do not move infected trees with the bark still attached (logs or firewood) into the woodlot or homesite.

Root graft spread of oak wilt can be controlled by using a vibratory plow to sever roots around the perimeter of an oak wilt infection center. And, overland spread can be controlled by cutting and treating all the wilting and recently dead red oaks inside the plowline perimeter so spores are not produced to spread the disease further.

Mille Lacs Uplands
Glacial Lake Superior Plain Subsections
1999 Active Oak Wilt
for northern oak wilt counties





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0 Rest of State
2 Active oak wilt site

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July 11, 2000
More information can be found at:
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__ The number and size of oak wilt infection centers are increasing in spite of cost share practices implemented by the DNR. Two precautions can decrease the chance of oak wilt from invading a woodlot or a wooded homesite. Do not harvest, prune or otherwise wound oak trees from budbreak to 3 weeks past full leaf development (generally from April 1 to July 15). Secondly, do not move infected trees with the bark still attached (logs or firewood) into the woodlot or homesite.

Stem decay - *Various fungi*

All tree species are subject to stem decay by an array of fungi. Stem decays in all species increase as trees age. Wounds such as, dead branch stubs, fire scars, logging injuries, all serve as sites where decay enters the trees. Minimizing wounding during logging, maintaining a level of stocking to promote natural branch shedding, and rotation age management can be keys to controlling the amount of stem decay. The older a tree gets the more wounds it has accumulated and therefore the more stem decay it will have. As our forests age the amount of stem decay increases. Stem decay does not kill trees outright but it does lead to more stem breakage from wind and reduces the merchantable volume. Stem decay is an important ecological process involved in nutrient recycling, providing cavity nesters with cavities etc.

__ Decay tends to increase as tree age increases. Wounds that occur to residual trees during a partial harvest, pruning or other management activities can be critically important. An increase in the use of partial cuts and thinning may increase decay as a result of increased wounding.

White trunk rot - *Phellinus tremulae*

White trunk rot is the major cause of decay in aspen. It starts to show up in stands at about 20 years of age and continues to increase with age. A strong correlation to the genetic susceptibility of clones has prevented researchers from being able to correlate amount of decay to site factors. The best external indicator of decay is the presence of conks, but, in a recent study in Minnesota only 45% of the trees with advanced decay had external indicators of decay (Jones and Ostry, 1998). Therefore the amount of decay can be easily underestimated. Wounds serve as the infection site, so stands with more wounds i.e. fire scares, hail wounds, dead branch stubs, etc have higher levels of decay. Studies have indicated that the pathological rotation age (the age at which the loss of wood volume with decay begins to exceed the annual increment of sound wood) is from 40 to 50 years of age.(Schmitz and Jackson, 1927). Others indicate that in many parts of the Lake States, aspen stands begin to deteriorate rapidly when they reach 50 to 60 years of age (Ostry and Walters, 1984). However some stands (or clones) may have relatively little decay even when it exceeds 50 years of age while others may suffer high losses before 50 years. (Christensen et. al, 1951)

__ This disease is expected to increase as the age of aspen increases.

Stem cankers - *Various fungi*

A canker is a symptom caused by the death of the cambium in an area of the stem. The bark usually dies, too. In perennial cankers, new callus ridges a produced each year and the canker grows. These cankers limit the production of quality wood and increase the risk of stem breakage near or at the canker location. In diffuse cankers, the fungal infection rapidly killing the cambium and killing the tree. In either type of canker, if stem decay is also present, the tree is weakened rapidly and stem breakage occurs.

__Butternut canker, an exotic disease, causes top dieback leading to tree mortality and is

widespread on butternut in the Mille Lacs Upland Subsection. Expect losses to increase. Most of the other canker diseases cause < 1% losses over a 10 year period and commonly affect intermediate and suppressed trees. Removing cankered trees during partial harvest is a good, sanitation practice.

White pine blister rust - *Cronartium ribicola*

White pine blister rust is an exotic fungus, first found in Minnesota in 1916. Blister rust is found throughout Minnesota wherever white pine is grown.. It has changed where and how white pine grows in northern Minnesota. The fungus requires both white pine and the alternate host, species of *Ribes,* to complete it's life cycle. Injury to infected trees includes dead branches, stem cankers and mortality. Levels of infection of 80 percent and more have been reported in central and northern Minnesota. Levels of infection can vary greatly from site to site due to micro-site climate differences, age of trees, presence and abundance of *Ribes*, topography and forest stand structure. Fear of white pine blister rust is one of the main reasons that white pine has not been planted widely in the past. No major gene for resistance has been found in eastern white pine, but breeding efforts continue to try to produce a more resistant tree. Injury to *Ribes* species is not significant. Van Arsdel developed a hazard zone map for Minnesota based on the likelihood of infection. All four hazard zones occur in the Mille Lacs Upland and Glacial Lake Superior Plain Subsections. White pine (CSA) plantations and stands occur as follows:

Low hazard	4 acres
Moderate hazard	140 acres
High hazard	66 acres
Very high hazard	237 acres

See map Figure 6.8.

Damage from white pine blister rust will increase as the amount of white pine planting and regeneration increases. Trees of all ages can be infected and killed in zones 3 and 4, so 313 acres of white pine are very vulnerable to white pine blister rust.

Hypoxylon canker - *Entoleuca mammata (=Hypoxylon mammatum)*

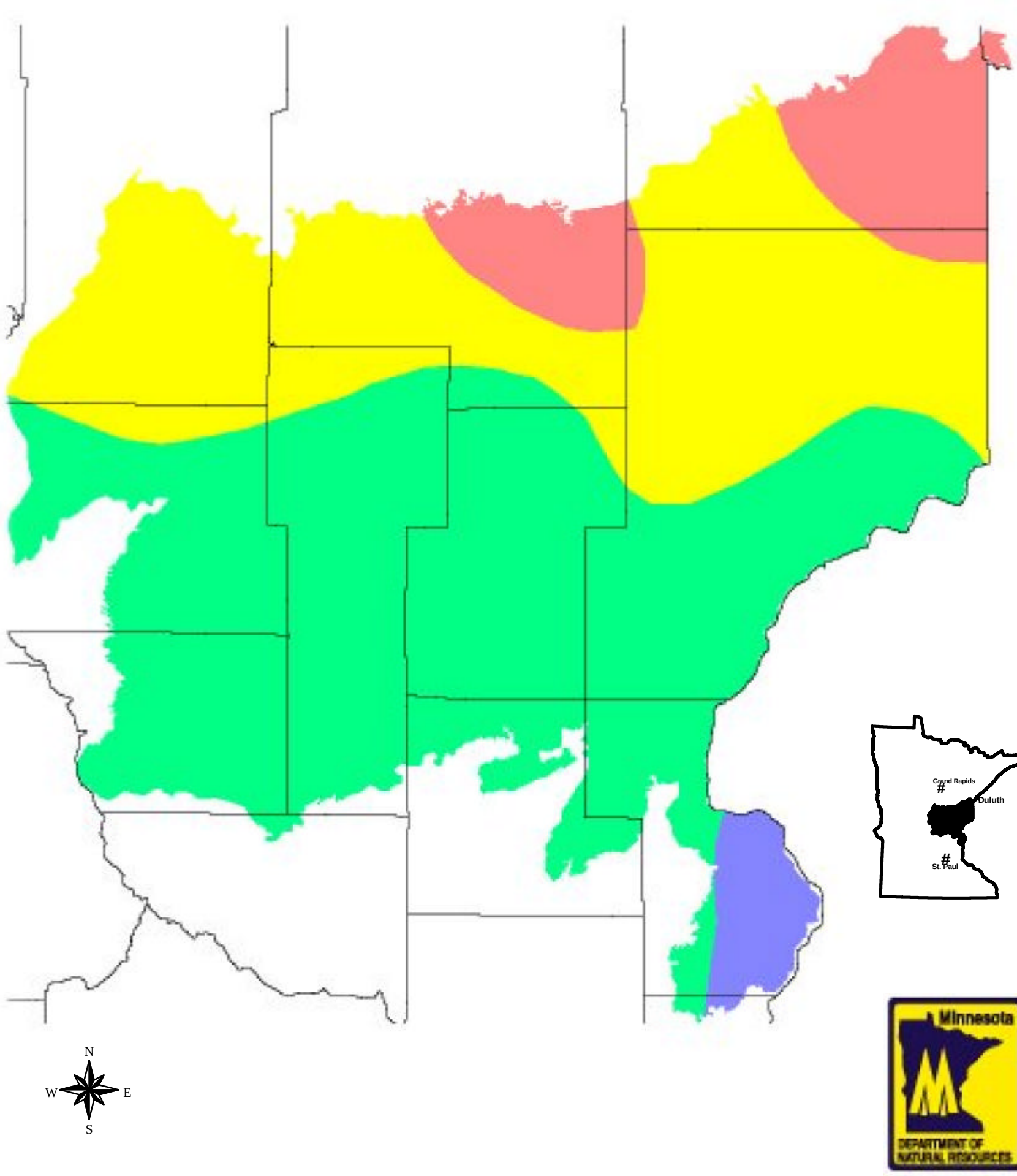
A common disease of aspen, Hypoxylon canker causes mortality and is the most destructive pathogen of young aspen in the Lake States. It is primarily a pathogen of quaking aspen. Aspen of all age classes are susceptible, however, mortality is usually greatest in young trees. Bigtooth aspen is occasionally infected. The fungus kills the trees by girdling the stem which leads to stem breakage. It is estimated that Hypoxylon canker kills 1 to 2 % of the aspen in the Lake States each year. However, some clones appear to be much more susceptible to Hypoxylon canker than others and mortality in susceptible clones may approach 100 percent. Infections are associated with wounds made by insects including cicadas, poplar-gall saperdas and tree hoppers which prefer open stands and stand edges. Infections levels are not strongly correlated to site productivity but do appear to be related to stand density.

6 Hypoxylon canker is common throughout the range of aspen and the level of damage is expected to remain stable. It has a significant impact on the aspen resource and damage to individual stands and clones can be very high as discussed above.

Root rots - *Armillaria spp. and others*

Root rots caused by fungi such as *Armillaria sp* are common but their impact is not well documented because the damage is hidden below ground. Root rots reduce the growth of trees and, if severe, can result

Mille Lacs Uplands
Glacial Lake Superior Plain Subsections
White Pine Blister Rust Hazard Zones



Low Hazard (1)
Moderate Hazard (2)
High Hazard (3)
Very High Hazard (4)

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in death or windthrow. Armillaria root rot is present on most or all sites and attacks both hardwoods and softwoods. It is able to use stumps as a food base and extends rhizomorphs through the soil infecting live roots. This is especially a concern when hardwood sites are converted to softwoods. Partial cutting has also been shown to increase Armillaria root rot. Trees weakened by drought, defoliation, wounding, soil compaction, old age, etc can be predisposed to Armillaria root disease.

— Stable or increase as stands age. Root rots would also be expected to increase as multiple stand entries and partial cutting increases.

Eastern dwarf mistletoe - *Arceuthobium pusillum*

Eastern dwarf mistletoe is a parasitic seed plant that primarily infects black spruce but occasionally also infects white spruce and tamarack. It causes witches brooms on infected trees and is the major mortality agent of black spruce. Trees of all sizes become infected and killed. Natural fires kept this disease in check in the past. Parasites and diseases are not effective in controlling the disease. Once a stand is infected it remains infected until all the mistletoe infected trees are killed by fire or through harvesting or shearing. Residual infected trees left behind after harvesting introduce the disease to the new stand. It spreads locally by seeds that are explosively discharged and travel up to 60 feet. Long distance spread is by birds carrying the sticky seeds on their feet and feathers. When a even-aged stand becomes infected the large trees are killed, young trees seed in and become infected. The stand gradually is changed to an all-aged stand with heavy infection of all ages and very little or no merchantable volume.

— Infection is increasing due to fire control and because there is no practical means of killing all infected trees on many sites at the time of harvest. Increased retention of infected black spruce as leave trees on harvest sites or within riparian areas next to harvested sites would also increase the acreage of dwarf mistletoe infected trees.

Dutch elm disease - *Ophiostoma ulmi*

Dutch elm disease is another exotic disease that has reshaped Minnesota's forested landscape. First detected in Minnesota in 1961, it quickly spread throughout the entire state. The disease kills individual branches and eventually the entire tree within one to several years. All species of elm in the state can be infected and killed by the disease. It remains active in the forest, killing most elm trees before they can reach a size much over 4 or 5 inches in diameter. It has not eliminated elm since many trees are able to grow long enough to set seed and reproduce before being killed. But it has eliminated elm as a tree of large stature.

6 It remains active throughout the state.

Birch decline - *multiple causal agents*

Birch decline is a complex disease caused by a combination of factors usually including stress such as drought, defoliation, site disturbance, etc., and the bronze birch borer, *Agrilus anxius.* Birch decline starts as a thinning of the crown with dieback of branches. With continued stress and the bronze birch borer, it often results in mortality. The amount of mortality due to birch decline can increase dramatically as a result of severe and lengthy drought. A study of the effects of the drought in the early 1990's estimated that 40% of the birch on FIA plots died in Minnesota from 1988 to 1992 as a result of birch decline, accounting for 228 million trees.

— The coming forest tent caterpillar outbreak, drought, increased urbanization, site disturbances due to road building, power lines, global warming and other stress factors will all increase the

amount of birch decline.

Additional information on these and other insects and diseases of forest trees in Minnesota can be obtained by referring to the Minnesota Forest Health Reports prepared by the MN DNR Division of Forestry, Forest Health Unit. They can be found in the DNR Library in St Paul and in various other libraries in the state. They have been printed on an annual basis since at least 1974. The title has varied over the years from the Forest Pest Report, to the Forest Insect and Disease Report, to the current title of Minnesota Forest Health Annual Report. They contain data on the insect and diseases included in this assessment as well as others. Observations as well as survey results on an annual basis are included. Current information can be found in the MNDNR Forest Insect and Disease Newsletter which is published 4 or 5 times during the growing season. The newsletter can be viewed on the MN DNR website at http://www.dnr.state.mn.us/forestry/publications/forestdi/index.html

Other sources of information include reports from the USDA Forest Service, University of Minnesota and MN Department of Agriculture.

Wildlife Habitat Management

Core Assessment Products	
1.	A list of forest vertebrates (e.g. breeding birds, mammals, amphibians, and reptiles) known to occur in the subsection.
2.	Identify forest vertebrates listed as endangered, threatened, or special concern (ETS).
3.	Matrix of forest vertebrate occurrence by habitat type (alliance) for species in the subsection.
4.	Trends in population estimates for species that are monitored.

Introduction

This document is a summary of the Minnesota Wildlife Resource Assessment Project. It is a work in progress. A more detailed document describing all aspects of this project is being developed. Any questions regarding this project should be directed to one of the personnel listed at the end of this document.

Project Overview

While Minnesota has a great wealth of information on Minnesota's wildlife in the form of numerous text books, species lists, and databases, a comprehensive information system for both professional and public access and use is lacking at this time. To better preserve, protect and manage all of Minnesota's terrestrial, vertebrate wildlife and their related habitats, the Minnesota DNR, Section of Wildlife proposes to create a wildlife resource information system that will act as a standard information source and clearing house for wildlife information in Minnesota. When completed, this project will provide database search and summary capabilities, graphic distribution and assessment maps, and geographic analysis capabilities for such items as an individual species (i.e. legal status, distribution, life history, special requirement, population data and management, etc.), or habitat/natural community associations (e.g. what suite of species exist in an Aspen type and what shift will occur if it's changed to Norway Pine). Results of this effort will provide critical baseline wildlife information needed to support numerous land management analysis and planning needs of the Department (i.e. Section of Wildlife assessments, Sub-section Forest Resource Management Planning, Conservation Connections); other statewide needs (i.e. Community planning, U.S. Forest Service plans, environmental review, etc.); and provide significant access and education to Minnesota's wildlife public.

Also, to further fill in data needed for the wildlife resource information system noted above, an significant opportunity exists at this time to partner with the U. S. Geological Surveys GAP Program. The mission of the Gap Analysis Program of the USGS Biological Resources Division is to: 1) provide regional assessments of the conservation status of native vertebrate species and natural land cover types, and 2) facilitate the application of this information to land management activities. Further information on the GAP program can be seen at http://www.gap.uidaho.edu

SOURCE AND REFERENCE INFORMATION

The final project will include a lengthy and detailed list of Minnesota specific field guides, atlases, museum collections, data and informational sources that will support this effort, primary source and reference information used to compile an initial list for this project includes the following:

TAXONOMY AND NOMENCLATURE

The taxonomy and nomenclature used to list species for this project has been standardized through the use of a data set downloaded from the Association for Biodiversity Information (ABI) at http://www.abi.org/. These standards will insure future usability of this project to other cross-state, regional and nation wide project such as the upcoming Minnesota Gap Analysis Program (MN-GAP)

WILDLIFE GROUP

All of Minnesota's 551 species of wildlife documented from the above sources have been categorized to one of the following eight wildlife groups: Amphibians, Forest Birds, Openland Birds, Water Birds, Casual/Accidental Birds, Mammals, and, Reptiles.

ELEMENT SPECIES CODE

To insure that species names are maintained in a phylogenetic order (i.e. class, order, family, genus, species) and to serve as a standard link between various tables, queries, forms, and reports in the data set, an element species code has been utilized. To further insure that this element species code sets a standard for Minnesota and can be utilized to cross reference other nation wide efforts, this code has been derived from data downloaded from the Association for Biodiversity Information (ABI) at http://www.abi.org/.

Selected examples are: *Spring Peeper* - AAABC05090, *American Bittern* - ABNGA01020, *Snowshoe Hare* - AMAEB03010, *Snapping Turtle* - ARAAAB01010

The following species were not listed in ABI's data set due to their introduced status. However, to maintain a complete listing of all wildlife in Minnesota, an element number has been created for each of these species within this project so as to maintain their phylogenetic order. These codes end with an alpha digit (a) and not a numeric digit (0) like ABI codes.

Mute Swan, Eurasian Wigeon, Gray Partridge, Ring-necked Pheasant, Black-headed Gull, Rock Dove, Fork-tailed Flycatcher, Fieldfare, European Starling, Brambling, Eurasian Tree Sparrow, House Sparrow, Eurasian Collared Dove

Also, the Woodland Deer Mouse and Prairie Deer Mouse were not listed in the ABI data set due to their non-recognized sub-species status in Minnesota. As with introduced species listed above, these two species have been given an element code (a) extension so as to place hold them in this data set until things can be cleared out on where they belong.

ALPHA SPECIES CODE

A short (four digit) alpha species code has been created for each species to act as a reference code for various needs in MnWRAP's database (e.g. sub-section range maps). For the Bird group, these codes were derived from USGS's North American Breeding Bird Survey (BBS) lists as noted on their web site at: http://www.mp2-pwrc.usgs.gov/bbs/bbs/species_lists.htm.

Alpha species codes for Amphibians, Reptiles and Mammals were created for this effort by MnWRAP staff using primarily the first two characters of a species name (e.g. SNHA - Snowshoe Hare). These new codes were then cross referenced with BBS codes to insure that no duplicate alpha species codes exist in the MnWRAP data set.

Selected examples are: SPPE - *Spring Peeper*, AMBI - *American Bittern*, SNHA - *Snowshoe Hare*, SNTU - *Snapping Turtle*

RESIDENT STATUS

Resident status is used to note the occurrence of a wildlife species in Minnesota. Based primarily on the dominate wildlife group (Birds) in Minnesota and related terminology used by the Minnesota Ornithologists Union (MOU), the following categories have been selected to note a resident status for each wildlife species in Minnesota.

Resident type category and alpha code

Permanent year-round resident (PR)

- Permanent resident, exists year-round in Minnesota.
- Includes all (20) Amphibians, 33 of 422 Birds, 76 of 80 Mammals, and all (29) Reptiles.

Regular (R)

< Regular resident (e.g. usually 8 out of every 10 years) in Minnesota. Normally occurs somewhere
in the state every year. Primarily notes species that migrate to Minnesota to breed and reproduce.
< Includes no (0) Amphibians, 280 of 422 Birds, 4 of 80 Mammals, and no (0) Reptiles.

Casual (C)
< Casual resident (e.g. acceptable records 7 or less out of every 10 years) in Minnesota. Normally does not occur in the state every year. An acceptable record is defined as a recognizable and preserved specimen, photograph, tape recording, or a documented sight record.
< Includes (0) Amphibians, 26 of 422 Birds, and no (0) Mammals or Reptiles.

Accidental (A)
< Accidental resident (three or less out of every 10 years) in Minnesota.
< Includes no (0) Amphibians, 82 of 422 Birds, and, no (0) Mammals or Reptiles.

Table 7.1. - Wildlife Resident Status in Minnesota

Wildlife Group	**TOTAL**	**Status > Permanent**	**Regular**	**Casual**	**Accidental**
Amphibians	**20**	20			
Birds	**422**	33	280	26	82
Mammals	**80**	76	4		
Reptiles	**29**	29			
Totals	**551**	**158**	**284**	**26**	**82**
	%	28.7	51.6	4.7	14.9

MINNESOTA LEGAL STATUS

To note a Minnesota state legal status for each wildlife species, the following categories and alpha codes have been used. A complete species list by category code is noted in Appendix 1.

State legal status categories and alpha codes

None (Blank) - Species does not have a legal status in Minnesota.

The following game species categories are referenced from various Minnesota Statutes as noted.

Big Game (BG)
< Noted in Minnesota statutes 97A.015 Subd 3 as a big game species in Minnesota.
< Includes 0 Amphibians, 0 Birds, 4 of 80 mammal species, and, 0 Reptiles..

Furbearer (F)
< Noted in Minnesota statutes 97A.015 Subd 22 as a furbearer species.
< Includes 0 Amphibians, 0 Birds, 17 of 80 mammal species, and, 0 Reptiles.

Small Game (SG)
< Noted in Minnesota statutes 97A.015 Subd 45 as a small game species.

< Includes 0 Amphibians, 13 of 422 Birds, 5 of 80 Mammals, and, 0 Reptiles.

Migratory game birds (MGB)

< Noted in Minnesota statutes 6240.0100, Subp. 3. **Migratory game birds.** "Migratory game birds" means coots, gallinules, sora and Virginia rails, American woodcock, common snipe, and migratory waterfowl.

< Includes 0 Amphibians, 37 of 422 Birds, 0 Mammals, and, 0 Reptiles.

The following endangered, threatened and special concern categories are referenced from Minnesota's Endangered Species Statute (Section 84.0895) and related listing in Minnesota Rules, Parts 6212.1800 to 6212.2300.

Endangered (E)

< Defined as a species that is threatened with extinction throughout all or a significant portion of its rang in Minnesota.

< Includes 1 Amphibian, 7 Birds, 0 Mammals, and 1 Reptile.

Threatened (T)

< Defined as a species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range in Minnesota.

< Includes 0 Amphibians, 6 Birds, 1 Mammal, and 3 Reptiles.

Special Concern (SC)

< Defined as a species that is extremely uncommon in Minnesota, or has a unique or highly specific habitat requirement and deserves careful monitoring of its status. Species on the periphery of their range that are 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

< Includes 1 Amphibian, 15 Birds, 12 Mammals, and 8 Reptiles.

Table 7.2 - Minnesota Legal Status

			Game				Nongame		
Wildlife Group	**Total**	**NA**	**BG**	**F**	**SG**	**W**	**E**	**T**	**SC**
Amphibian	**20**	**18**					**1**		**1**
Bird	**422**	**343**			**13**	**37**	**7**	**6**	**15**
Mammal	**80**	**41**	**4**	**17**	**5**			**1**	**12**
Reptile	**29**	**17**					**1**	**3**	**8**
Totals	**551**	**419**	**4**	**17**	**18**	**37**	**9**	**10**	**36**
	%	76.2	.7	3	3	6.7	1.6	1.8	6.5

Federal Threatened and Endangered Status

As referenced from the U.S. Fish and Wildlife Service, Endangered Species Program web site at http://endangered.fws.gov/endspp.html, the following species are listed in this data set as to their respective

Federal endangered and threatened status.

Threatened (T)

- Bald Eagle, Canada Lynx, Piping Plover, Gray Wolf.

Endangered - None

SITE/POPULATION DATA

To be used to note who the “keeper of the keys” is of site and/or population data pertinent to a specific species. Proposed codes and examples are listed as follows:

BBS (Breeding Bird Survey) - Forest song bird route data.
NG (Nongame Program) - Site and population data on Bald Eagles.
NH (Natural Heritage Program) - Site data for Yellow Rail sightings.
FaW (Farmland Wildlife Research Group) - Route and population data for Ring-necked Pheasants.
FoW (Forest Wildlife Research Group) - Trapping, harvest and population modeling data.
WeW (Wetland Wildlife Research Group) - Harvest and population data for numerous species of waterfowl.

MANAGEMENT SPECIES

To be used to note if a specific species is to be considered a management species for a particular sub-section. Management species at this time is loosely defined as a combination of the following.

- A wildlife species that has site or population information available or one that could be in the foreseeable future.
- Is important in Minnesota for its recreational value (i.e. hunting, bird watching, etc.).
- Through population monitoring, can be used to indicate changes in habitat types, alterations, degradation, etc.
- May be a species that is listed as endangered, threatened or special concern.

POPULATION TREND \ PERIOD

To be used to note a general population trend for each management species listed in a sub-section. Both a time frame (e.g. previous 10 years to date) and a value needs to be entered. Values entered can range from + (increasing) to - (decreasing) to actual values (+10%, -25%) depending on how detailed one wants to get. Also, a summary of the type of data (e.g. ruffed grouse drumming routes), number of routes (n=?) and confidence in the data (from statewide, regional or sub-section specific data) should be written up in any text information used to described this data.

STATEWIDE SUB-SECTION DIVERSITY (N=26)

To be used to note the species general distribution across the state of Minnesota. Species with a high diversity number (26 maximum) are widely distributed and are most likely habitat generalists. Species with low diversity are found only in selected areas and are most likely habitat specialists.

DISTRIBUTION and ABUNDANCE

For purposes of creating wildlife species maps that demonstrate the distribution (range) of a species across Minnesota, each wildlife species in the MnWRAP database will initially have a notation as to it's presence (P) or absence (blank) in each of Minnesota's twenty-six ECS sub-sections. These P values will eventually be replaced by the following abundance values thereby creating more useful and detailed species range and abundance maps.

Common (C)

< Present in good numbers in suitable habitats. Individuals or sign can usually be seen if you know where to look.

Uncommon (U)

< Present, but in lower numbers due to range limits, large home ranges, specific habitat requirements, or other factors. Usually more difficult to find because there are fewer individuals per acres.

Occasional (O)

< May not occur every year, but because of proximity to their regular range, individuals can be expected to wander into the region during some year, e.g., at intervals during periods of severe weather or food shortages.

Casual/Accidental (C/A)

< Species range does not typically include Minnesota. May casually (seven or less out of every 10 years) or accidentally (three or less out of every 10 years) range into Minnesota.

Not Present (Blank)

< Species has not been documented in this area (sub-section) of the State.

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Table 7.3 Mille Lacs Uplands ECS Subsection Amphibians

Species information >>>

Species common name	Species element code	Species alpha code	MN. resident status	State legal status	Federal legal status	Site / Population data	Management species	Population trend / Period	Statewide sub-section diversity (n=26)	*Mille Lacs Uplands* 212Kb
Blue-spotted Salamander	AAAAA01060	BSSA	PR						16	P
Tiger Salamander	AAAAA01140	TISA	PR						26	P
Four-toed salamander	AAAAD08010	FTSA	PR	SC		NH	X		1	P
Redback Salamander	AAAAD12020	RESA	PR						12	P
Mudpuppy	AAAAE01040	MUDP	PR						7	P
American Toad	AAABB01020	AMTO	PR						23	P
Cope's Gray Treefrog	AAABC02050	CGTR	PR						17	P
Gray Treefrog	AAABC02130	GRTR	PR				X		12	P
Western Chorus Frog	AAABC05070	WCFR	PR						14	P
Spring Peeper	AAABC05090	SPPE	PR						4	P
Green Frog	AAABH01090	GRFR	PR						8	P
Northern Leopard Frog	AAABH01170	NLFR	PR						26	P
Mink Frog	AAABH01190	MIFR	PR						16	P
Wood Frog	AAABH01200	WOFR	PR						24	P
Total number of amphibian species in Minnesota									**Amphibian subsection diversity**	
20									14	

ECS subsection distribution: P = species is present in subsection. Blank = species is not present in subsection.

Table 7.4 Mille Lacs Uplands ECS Subsection Forest Birds

Species information>>>

Species common name	TNC Element Code	MNWRAP Alpha Code	Resident Status	State legal status	Federal legal status	Site / Population data	Management species	Population trend / Period	Statewide subsection diversity (n=26)	*Mille Lacs Uplands* 212Kb
Turkey Vulture	ABNKA02010	TuVu	R						16	P
Sharp-shinned Hawk	ABNKC12020	SSHa	R						14	P
Cooper's Hawk	ABNKC12040	CoHa	R						22	P
Northern Goshawk	ABNKC12060	NoGo	R						14	P
Red-shouldered Hawk	ABNKC19030	RSHa	R	SC		NH	X		12	P
Broad-winged Hawk	ABNKC19050	BWHa	R						20	P
Red-tailed Hawk	ABNKC19110	RTHa	R						26	P
Merlin	ABNKD06030	Merl	R						14	P
Ruffed Grouse	ABNLC11010	RuGr	PR	SG		FoW	X		14	P
Wild Turkey	ABNLC14010	WiTu	PR	SG		FaW	X		24	P

American Woodcock	ABNNF19020	AmWo	R	SG		FoW	X		11	P
Black-billed Cuckoo	ABNRB02010	BBCu	R						26	P
Yellow-billed Cuckoo	ABNRB02020	YbCu	R						25	P
Eastern Screech-Owl	ABNSB01030	EaSO	PR						12	P
Great Horned Owl	ABNSB05010	GHOw	PR						14	P
Barred Owl	ABNSB12020	BaOw	PR						24	P
Long-eared Owl	ABNSB13010	LEOw	PR						19	P
Northern Saw-whet Owl	ABNSB15020	NSWO	R						16	P
Whip-poor-will	ABNTA07070	WPWi	R						23	P
Ruby-throated Hummingbird	ABNUC45010	RTHu	R						26	P
Red-bellied Woodpecker	ABNYF04170	RBWo	PR						13	P
Yellow-bellied Sapsucker	ABNYF05010	YBSa	R						23	P
Downy Woodpecker	ABNYF07030	DoWo	PR						26	P
Hairy Woodpecker	ABNYF07040	HaWo	PR						26	P
Northern Flicker	ABNYF10020	NOFL	R						14	P
Pileated Woodpecker	ABNYF12020	PiWo	PR						23	P
Olive-sided Flycatcher	ABPAE32010	OSFl	R						15	P
Eastern Wood-Pewee	ABPAE32060	EWPe	R						26	P
Yellow-bellied Flycatcher	ABPAE33010	YBFl	R						10	P
Alder Flycatcher	ABPAE33030	AlFl	R						11	P
Least Flycatcher	ABPAE33070	LEFl	R						26	P
Eastern Phoebe	ABPAE35020	EaPh	R						26	P
Great Crested Flycatcher	ABPAE43070	GCFl	R						26	P
Gray Jay	ABPAV01010	GryJ	PR						14	P
Blue Jay	ABPAV02020	BlJa	PR						26	P
American Crow	ABPAV10010	AmCr	PR						14	P
Common Raven	ABPAV10110	CoRa	PR						14	P
Black-capped Chickadee	ABPAW01010	BCCh	PR						14	P
Red-breasted Nuthatch	ABPAZ01010	RbNu	PR						15	P

White-breasted Nuthatch	ABPAZ01020	WbNu	PR						26	P
Brown Creeper	ABPBA01010	BrCr	R						16	P
Carolina Wren	ABPBG06130	CarW	R						24	P
House Wren	ABPBG09010	HoWr	R						26	P
Winter Wren	ABPBG09050	WiWr	R						3	P
Townsend's Solitaire	ABPBJ16010	ToSo	R						26	P
Veery	ABPBJ18080	Veer	R			FSB	X		22	P
Gray-cheeked Thrush	ABPBJ18090	GcTh	R						26	P
Hermit Thrush	ABPBJ18110	HeTh	R						10	P
Wood Thrush	ABPBJ19010	WoTh	R			FSB	X		8	P
American Robin	ABPBJ20170	AmRo	R						26	P
Varied Thrush	ABPBJ22010	VaTh	R						26	P
Gray Catbird	ABPBK01010	GrCa	R						26	P
Brown Thrasher	ABPBK06010	BrTh	R						20	P
European Starling	ABPBK0607a	EuSt	PR						26	P
Bohemian Waxwing	ABPBN01010	BoWa	R						14	P
Cedar Waxwing	ABPBN01020	Cwax	R						24	P
Yellow-throated Vireo	ABPBW01170	YTVi	R						22	P
Warbling Vireo	ABPBW01210	WaVi	R						14	P
Red-eyed Vireo	ABPBW01240	ReVi	R						26	P
Golden-winged Warbler	ABPBX01030	GWWa	R				X		14	P
Nashville Warbler	ABPBX01060	NaWa	R						14	P
Yellow Warbler	ABPBX03010	YWAR	R						21	P
Chestnut-sided Warbler	ABPBX03020	CSWA	R						17	P
Magnolia Warbler	ABPBX03030	MAGW	R						11	P
Yellow-rumped Warbler	ABPBX03060	YRWA	R						14	P
Black-throated Green Warbler	ABPBX03100	BTNW	R						14	P
Blackburnian Warbler	ABPBX03120	BLBW	R						14	P
Pine Warbler	ABPBX03170	PIWA	R						3	P
Blackpoll Warbler	ABPBX03230	BPLW	R						26	P

Black-and-white Warbler	ABPBX05010	BAWW	R						14	P
American Redstart	ABPBX06010	AMRE	R						24	P
Worm-eating Warbler	ABPBX08010	WEWA	R						25	P
Ovenbird	ABPBX10010	OVEN	R						11	P
Kentucky Warbler	ABPBX11010	KEWA	R						23	P
Connecticut Warbler	ABPBX11020	CONW	R						8	P
Mourning Warbler	ABPBX11030	MOWA	R						8	P
Common Yellowthroat	ABPBX12010	COYE	R						17	P
Canada Warbler	ABPBX16030	CAWA	R						14	P
Summer Tanager	ABPBX45030	SUTA	R						14	P
Scarlet Tanager	ABPBX45040	SCTA	R						22	P
Western Tanager	ABPBX45050	WETA	R						22	P
Northern Cardinal	ABPBX60010	NOCA	PR						24	P
Rose-breasted Grosbeak	ABPBX61030	RBGR	R						26	P
Indigo Bunting	ABPBX64030	INBU	R						26	P
Eastern Towhee	ABPBX74030	EATO	R						22	P
Chipping Sparrow	ABPBX94020	CHSP	R						26	P
Song Sparrow	ABPBXA3010	SOSP	R						22	P
White-throated Sparrow	ABPBXA4020	WTSP	R						4	P
Harris's Sparrow	ABPBXA4050	HASP	R						26	P
Common Grackle	ABPBXB6070	COGR	R						26	P
Brown-headed Cowbird	ABPBXB7030	BHCO	R						26	P
Baltimore Oriole	ABPBXB9190	BAOR	R						20	P
Purple Finch	ABPBY04020	PUFI	R						5	P
House Finch	ABPBY04040	HOFI	PR						17	P
Red Crossbill	ABPBY05010	RECR	R						14	P
White-winged Crossbill	ABPBY05020	WWCR	R						4	P
Hoary Redpoll	ABPBY06020	HORE	R						16	P
Pine Siskin	ABPBY06030	PISI	R						19	P

American Goldfinch	ABPBY06110	AMGO	R						14	P
House Sparrow	ABPBY0902a	HOSP	PR						17	P

Total number of forest birds in Minnesota 141

Total number of forest birds in subsection 100

ECS sub-section distribution: P = species is present in sub-section. Blank = species is not present in sub-section.

Table 7.5 Mille Lacs Uplands ECS Subsection Mammals

Species common name	TNC Element Code	MNWRAP Alpha Code	Resident Status	State legal status	Federal legal status	Site / Population data	Management species	Population trend / Period	Statewide sub-section diversity	*Mille Lacs Uplands* 212Kb
Virginia Opossum	AMAAA01010	VIOP	PR	F					13	P
Masked Shrew	AMABA01010	MASH	PR						26	P
Water Shrew	AMABA01150	WASH	PR						16	P
Arctic Shrew	AMABA01190	ARSH	PR						8	P
Pygmy Shrew	AMABA01250	PYSH	PR						18	P
Northern Short-tailed Shrew	AMABA03010	NSSH	PR						26	P
Star-nosed Mole	AMABB05010	SNMO	PR						6	P
Little Brown Myotis	AMACC01010	LBMY	PR						23	P
Silver-haired Bat	AMACC02010	SHBA	R						5	P
Big Brown Bat	AMACC04010	BBBA	PR						11	P
Eastern Red Bat	AMACC05010	ERBA	R						23	P
Hoary Bat	AMACC05030	HOBA	R						18	P
Eastern Cottontail	AMAEB01040	EACO	PR	SG					16	P
Snowshoe Hare	AMAEB03010	SNHA	PR	SG					11	P
White-tailed Jackrabbit	AMAEB03040	WTJA	PR	SG					14	P
Eastern Chipmunk	AMAFB02230	EACH	PR						17	P
Woodchuck	AMAFB03010	WOOD	PR						19	P
Thirteen-lined Ground Squirrel	AMAFB05090	TGSQ	PR						20	P

Franklin's Ground Squirrel	AMAFB05120	FGSQ	PR						20	P
Eastern Gray Squirrel	AMAFB07010	EGSQ	PR	SG			X		26	P
Eastern Fox Squirrel	AMAFB07040	EFSQ	PR	SG					14	P
Red Squirrel	AMAFB08010	RESQ	PR						24	P
Northern Flying Squirrel	AMAFB09020	NFSQ	PR						17	P
Northern Pocket Gopher	AMAFC01040	NPGO	PR	SC					24	P
Plains Pocket Gopher	AMAFC02010	PPGO	PR						14	P
American Beaver	AMAFE01010	AMBE	PR	F			X		22	P
White-footed Mouse	AMAFF03070	WFMO	PR						24	P
Woodland Deer Mouse	AMAFF0307a	WDMO	PR						8	P
Southern Red-backed Vole	AMAFF09020	SRVO	PR						15	P
Meadow Vole	AMAFF11010	MEVO	PR						26	P
Muskrat	AMAFF15010	MUSK	PR	F					14	P
Southern Bog Lemming	AMAFF17010	SBLE	PR						14	P
Meadow Jumping Mouse	AMAFH01010	MJMO	PR						15	P
Woodland Jumping Mouse	AMAFH02010	WJMO	PR						4	P
Common Porcupine	AMAFJ01010	CPOR	PR						5	
Coyote	AMAJA01010	COYO	PR						26	P
Gray Wolf	AMAJA01030	GRWF	PR	SC	T		X		3	P
Red Fox	AMAJA03010	REFO	PR	F					20	P
Common Gray Fox	AMAJA04010	CGFO	PR	F					26	P
Black Bear	AMAJB01010	BLBE	PR	BG		FoW	X		5	P
Common Raccoon	AMAJE02010	CRAC	PR	F					14	P
American Marten	AMAJF01010	AMMA	PR	F					14	P
Fisher	AMAJF01020	FISH	PR	F			X		4	P
Ermine	AMAJF02010	ERMI	PR	F					21	P
Least Weasel	AMAJF02020	LEWE	PR	F/SC					15	P
Long-tailed Weasel	AMAJF02030	LTWE	PR	F					14	P
Mink	AMAJF02050	MINK	PR	F					14	P

American Badger	AMAJF04010	AMBA	PR	F					26	P
Eastern Spotted Skunk	AMAJF05010	ESSK	PR	T			X		26	P
Striped Skunk	AMAJF06010	STSK	PR						16	P
Northern River Otter	AMAJF08010	NROT	PR	F		FoW	X		24	P
Lynx	AMAJH03010	LYNX	PR	F	T				12	P
Bobcat	AMAJH03020	BOBC	PR	F		FoW	X		21	P
Elk	AMALC01010	ELK	PR	BG/SC					15	P
White-tailed Deer	AMALC02020	WTDE	PR	BG		FoW	X		26	P
Moose	AMALC03010	MOOS	PR	BG					16	P
Total number of mammals in Minnesota								**Total number of mammals in subsection**		
80									56	

ECS sub-section distribution: P = species is present in sub-section. Blank = species is not present in sub-section.

7.6 Mille Lacs Uplands ECS Subsection Open Birds

Species information>>>

vide sub-section diversity (=26)

Species common name	TNC Element Code	MNWRAP Alpha Code	Resident Status	State legal status	Federal legal status	Site / Population data	Management species	Population trend / Period		*Mille Lacs Uplands* 212Kb
Northern Harrier	ABNKC11010	NoHa	R						23	P
Ferruginous Hawk	ABNKC19120	FEHA	R						14	P
Rough-legged Hawk	ABNKC19130	RLHA	R						18	P
Golden Eagle	ABNKC22010	GOEA	R						26	P
American Kestrel	ABNKD06020	AmKe	R						26	P
Gyrfalcon	ABNKD06080	GYRF	R						19	P
Prairie Falcon	ABNKD06090	PRFA	R						15	P
Ring-necked Pheasant	ABNLC1002b	RNPH	PR	SG		FaW	X		16	P
Sharp-tailed Grouse	ABNLC13030	STGr	PR	SG		FoW	X		9	P
Killdeer	ABNNB03090	Kill	R						14	P
Upland Sandpiper	ABNNF06010	UpSa	R						14	P
Semipalmated Sandpiper	ABNNF11040	SESA	R						15	P
Least Sandpiper	ABNNF11100	LESA	R						23	P
White-rumped Sandpiper	ABNNF11110	WRSA	R						14	P
Baird's Sandpiper	ABNNF11120	BASA	R						15	P
Pectoral Sandpiper	ABNNF11130	PESA	R						26	P
Stilt Sandpiper	ABNNF11190	STLS	R						25	P
Rock Dove	ABNPB0401a	RoDo	R						14	P
Mourning Dove	ABNPB04040	MoDo	R						26	P
Common Nighthawk	ABNTA02020	CoNi	R						26	P

Chimney Swift	ABNUA03010	ChSw	R						21	P
Red-headed Woodpecker	ABNYF04040	RHWo	R				X		25	P
Eastern Kingbird	ABPAE52060	EaKi	R						26	P
Horned Lark	ABPAT02010	HoLa	R						22	P
Purple Martin	ABPAU01010	PuMa	R				X		15	P
Tree Swallow	ABPAU03010	TreS	R						26	P
Northern Rough-winged Swallow	ABPAU07010	RWSw	R						21	P
Bank Swallow	ABPAU08010	BnkS	R						22	P
Cliff Swallow	ABPAU09010	ClSw	R						17	P
Barn Swallow	ABPAU09030	BarS	R						26	P
Sedge Wren	ABPBG10010	SeWr	R						26	P
Eastern Bluebird	ABPBJ15010	EaBl	R				X		22	P
Mountain Bluebird	ABPBJ15030	MoBl	R						14	P
American Pipit	ABPBM02050	AmPi	R						26	P
Northern Shrike	ABPBR01020	NShr	R						14	P
Orange-crowned Warbler	ABPBX01050	OCWa	R						26	P
American Tree Sparrow	ABPBX94010	ATSP	R						23	P
Clay-colored Sparrow	ABPBX94030	CCSP	R						24	P
Field Sparrow	ABPBX94050	FISP	R						24	P
Vesper Sparrow	ABPBX95010	VESP	R						26	P
Savannah Sparrow	ABPBX99010	SAVS	R						26	P
Grasshopper Sparrow	ABPBXA0020	GRSP	R						25	P
Le Conte's Sparrow	ABPBXA0040	LESP	R						17	P
Fox Sparrow	ABPBXA2010	FOSP	R						19	P
White-crowned Sparrow	ABPBXA4040	WCSP	R						17	P
Lapland Longspur	ABPBXA6020	LALO	R						22	P
Snow Bunting	ABPBXA8010	SNBU	R						14	P
Bobolink	ABPBXA9010	BOBO	R				X		26	P
Eastern Meadowlark	ABPBXB2020	EAME	R				X		10	P

Western Meadowlark	ABPBXB2030	WEME	R				X		14	P
Brewer's Blackbird	ABPBXB5020	BRBL	R						12	P

Total number of open birds in Minnesota

69

Sub-section species diversity

51

ECS sub-section distribution: P = species is present in sub-section. Blank = species is not present in sub-section.

Table 7.7 Mille Lacs Uplands ECS Subsection Reptiles

Species information>>>

Speciescommon name	TNC Element Code	MNWRAP Alpha Code	Resident Status	State legal status	Federal legal status	Site / Population data	Management species	Population trend / Period	Statewide subsection diversity (n=26)	*Mille Lacs Uplands* 212Kb
Snapping Turtle	ARAAB01010	SNTU	PR	SC			X		26	P
Painted Turtle	ARAAD01010	PATU	PR						26	P

Wood Turtle	ARAAD02020	WOTU	PR	T			X		13	P
Blanding's Turtle	ARAAD04010	BLTU	PR	T			X		13	P
Common Map Turtle	ARAAD05040	CMTU	PR						5	P
Spiny Softshell Turtle	ARAAG01030	SPTU	PR						10	P
Prairie Skink	ARACH01100	PRSK	PR						13	P
Western Hognose Snake	ARADB17010	WHSN	PR	SC					8	P
Eastern Hognose Snake	ARADB17020	EHSN	PR						6	P
Brown Snake	ARADB34010	BRSN	PR						7	P
Redbelly Snake	ARADB34030	RBSN	PR						26	P
Plains Garter Snake	ARADB36100	PGSN	PR						15	P
Common Garter Snake	ARADB36130	CGSN	PR						26	P
Smooth Green Snake	ARADB47010	SGSN	PR						16	P
Total number of reptiles in Minnesota								**Reptile sub-section diversity**		
29									14	

Table 7.8 Mille Lacs Uplands ECS Subsection Water Birds

Species information>>>

	TNC Element Code	MNWRAP Alpha Code	Resident Status	State legal status	Federal legal status	Site / Population data	Management species	Population trend / Period	Statewide subsection diversity (n=26)	*Mille Lacs Uplands*

Species common name										212Kb
Red-throated Loon	ABNBA01010	RTLO	R						5	P
Common Loon	ABNBA01030	CoLo	R			NG	X		18	P
Pacific Loon	ABNBA01050	PALO	R						10	P
Pied-billed Grebe	ABNCA02010	PbGr	R						26	P
Red-necked Grebe	ABNCA03020	RnGr	R						13	P
Double-crested Cormorant	ABNFD01020	DCCo	R						19	P
American Bittern	ABNGA01020	AmBi	R						20	P
Least Bittern	ABNGA02010	LeBi	R						15	P
Great Blue Heron	ABNGA04010	GtBh	R			NH	X		24	P
Green Heron	ABNGA08010	GrHe	R						17	P
Tundra Swan	ABNJB02010	TUSW	R						23	P
Trumpeter Swan	ABNJB02030	TruS	R	T		NG	X		7	P
Snow Goose	ABNJB04010	SNGO	R	W					21	P
Canada Goose	ABNJB05030	CaGo	R	W		WeW	X		26	P
Wood Duck	ABNJB09010	WoDu	R	W		WeW	X		26	P
Green-winged Teal	ABNJB10010	AGWT	R	W					26	P
Mallard	ABNJB10060	Mall	R	W					26	P
Blue-winged Teal	ABNJB10130	BWTe	R	W					26	P
Cinnamon Teal	ABNJB10140	ClTE	R	W					11	P
Ring-necked Duck	ABNJB11040	RNDu	R	W		WeW	X		21	P
Greater Scaup	ABNJB11060	GRSC	R	W					6	P
Bufflehead	ABNJB18030	BUFF	R	W					26	P
Hooded Merganser	ABNJB20010	HoMe	R	W					24	P
Osprey	ABNKC01010	Ospr	R			NG	X		16	P
Bald Eagle	ABNKC10010	BaEa	R	SC	T	NG	X		16	P
Virginia Rail	ABNME05030	ViRa	R	SG					23	P
Sora	ABNME08020	Sora	R	SG					26	P
American Coot	ABNME14020	AmCo	R	SG					26	P
Sandhill Crane	ABNMK01010	SaCr	R			NH	X		9	P

Black-bellied Plover	ABNNB02010	BBPL	R						25	P
American Golden-Plover	ABNNB02030	AGPL	R						20	P
Semipalmated Plover	ABNNB03060	SEPL	R						25	P
Greater Yellowlegs	ABNNF01020	GRYE	R						26	P
Lesser Yellowlegs	ABNNF01030	LEYE	R						26	P
Solitary Sandpiper	ABNNF01070	SOSA	R						26	P
Spotted Sandpiper	ABNNF04020	SpSa	R						26	P
Ruddy Turnstone	ABNNF09010	RUTU	R						25	P
Sanderling	ABNNF11030	SAND	R						4	P
Dunlin	ABNNF11170	DUNL	R						25	P
Long-billed Dowitcher	ABNNF16020	LBDO	R						25	P
Common Snipe	ABNNF18010	CoSn	R	SG					20	P
Little Gull	ABNNM03030	LIGU	R						13	P
Bonaparte's Gull	ABNNM03050	BOGU	R						18	P
Ring-billed Gull	ABNNM03100	RBGU	R						4	P
Caspian Tern	ABNNM08020	CATE	R						9	P
Common Tern	ABNNM08070	COTE	R	T					4	P
Black Tern	ABNNM10020	BlTe	R			NH	X		18	P
Belted Kingfisher	ABNXD01020	BeKi	R						26	P
Marsh Wren	ABPBG10020	MaWr	R						20	P
Swamp Sparrow	ABPBXA3030	SWSP	R						26	P
Red-winged Blackbird	ABPBXB0010	RWBL	R						26	P
Yellow-headed Blackbird	ABPBXB3010	YHBL	R						20	P

Total number of water birds in Minnesota 103

Sub-section species diversity 52

ECS sub-section distribution: P = species is present in sub-section. Blank = species is not present in sub-section.

Appendix A: Team Members

(Mille Lacs Uplands, Glacial Lake Superior Plain, and St. Croix Moraines Subsection Forest Resource Management Plan)

Team Leader
Lynn Mizner (Forest Resources Planner)

DNR Area Forestry Reps
Peter Willis (Little Falls)
Lillian Baker (Cambridge)
Daren Wysocki (Aitkin)
Dean Makey (Brainerd)
Brian Haugen (Sandstone)
Tony Miller (Sandstone)
Bruce Schoenberg (Cloquet)

DNR Area Wildlife Reps
David Kanz (Aitkin)
Gary Drotts (Brainerd)
Richard Tuszynski (Mille Lacs Wildlife Management Area)
Chris Balzer (Cloquet)
Beau Liddell (Little Falls)
David Pauly (Cambridge)
David Johnson (Sandstone)

DNR Region Reps (Active)
Doug Tillma (NE Region Silviculturist)
Paul Olson (GIS)
Mark Wurdeman (Central Region Timber)
Kevin Woizeschke (Nongame wildlife)
Tim Quincer (Forestry Wildlife Coordinator)
Mike Albers (NE Region Forest Health)

DNR Region Reps (Advisory)
John Grossbach (NE Region Forest Manager)
Wayne Damerow (Central Region Forest Manager)
Jeff Lightfoot (NE Region Wildlife Manager)

DNR Ecological Services
Kurt Rusterholz
Bruce Carlson

** Mille Lacs Band of Ojibwe asked that Rick Dunkley (Sandstone Area Forest Supervisor) represent Mille Lacs Band interests in this process.

**Geographic Information Systems*
†Private Forest Management
††*Scientific and Natural Area*

Appendix B. DNR Directions 2000 - Forest Resources Section

The complete document, *Directions 2000, The Strategic Plan,* September 2000, Minnesota Department of Natural Resources (DNR), can be found at the web site:
http://www.dnr.state.mn.us/about/directions2000.pdf

Forest Resources *(DIRECTIONS 2000)*

Directions 1997 identified four forest ***management*** priorities. Those priorities are:

- Protecting riparian areas
- Ensuring forest soils productivity
- Maintaining wildlife diversity
- Managing for healthy and resilient forest ecosystems across landscape scales

Working with partners, DNR has made considerable progress developing new approaches to address these priorities. The Sustainable Forest Resources Management Act established sustainable forest ecosystems as a priority goal for Minnesota. The act was based on recommendations of the Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota (GEIS). The GEIS studied the potential impacts from current and increased levels of timber harvesting and recommended strategies for the sustainable management of the state's forest resources.

DNR has become increasingly concerned about problems posed by land use ***conversion*** throughout rural areas of the state. Land-use conversion is the process of converting forest or other natural areas into housing and related uses (commercial development, parking lots, roads, etc.). At the same time, many larger blocks of land are being subdivided into smaller blocks. Increased fragmentation of the landscape is a critical threat to the state's natural resource base. Land conversion and fragmentation decrease the area in forest cover, destroy fish and wildlife ***habitat***, degrade water quality, and reduce the large blocks of ownership best suited to managing land holistically. This concern is greatest when it occurs within significant blocks of public ownership as the character and ability to manage the surrounding land is changed dramatically. Over the long term, a continuation of these patterns poses significant concerns for the health of forest resources and viability of industry dependent on healthy forest ecosystems. These concerns form the basis for DNR's approach to developing Smart Growth and Conservation Connections strategies. They also are the basis for DNR's investment in sustainable forest initiatives.

Forest Ecosystem Goals and Objectives

Building on the GEIS, the ***Minnesota Forest Resources Council*** (MFRC) identified three priority forest management goals. DNR has developed a fourth goal to address mineral development in forest ecosystems.

GOAL 1. Minnesota's forested land base will be enlarged and protected. No net loss of forest land will occur and some previously forested areas will be returned to forest cover. The forested land base will be protected from decreases and fragmentation by land-use changes.

> **Objective 1.1**. **Landowners will have viable options for restoring former farmland to forest and other open land conditions**. As use of some lands changes from the production of agricultural commodities to other uses, opportunities arise to direct new uses to serve natural resource purposes, including forestry.
>
> **Objective 1.2**. **Loss and fragmentation of private forest lands will be minimized.** Subdivision of forest lands or conversion of those lands to non-forest uses diminishes the capacity of forests to provide healthy public benefits and results in a net loss of forest acreage. The objective is to maintain the productive capacity of forests by minimizing the loss and fragmentation of private forest lands.

GOAL 2. Forest ecosystems will be healthy, resilient, and functioning. Forests will be composed of appropriate mixes of vegetative types and ***age classes*** that maintain wildlife and ***biological diversity***.

Objective 2.1. Forests will be managed for structural and plant species diversity. A forest with a variety of tree species, native plant communities, and ages provides habitat suitable for more species and has greater potential to provide a sustainable yield of timber. A diverse forest generally is healthier and more resilient than a less diverse forest. Landscape metrics provide useful tools for measuring vegetative spatial patterns across landscapes. The objective is to establish and manage toward landscape goals that provide a diversity of age classes, habitats, ***patch*** sizes, and spatial configuration using the natural range of variation as a guide.

Objective 2.2. Forest practices will ensure healthy forest soils and water resources. The objective is to ensure that forestry practices minimize damage to soils and maintain healthy aquatic ecosystems.

Objective 2.3. **Forests will support self-sustaining fish and wildlife populations.** Self-sustaining fish and wildlife populations -- game and nongame -- are important to the recreating public and as components of healthy ecosystems. The objective is healthy, self-sustaining populations of all native and desirable introduced plant, fish, and wildlife species, especially those species listed as threatened and endangered.

Objective 2.4. Forest habitat areas will be connected by natural corridors. Where forests are fragmented by other land uses such as agriculture or urban areas, corridors of forest, often along streams or trails, may connect larger forest habitat areas serving both wildlife and recreation uses. Where older forest blocks are fragmented by younger forest in a primarily forested landscape, corridors composed primarily of older or ***uneven-aged*** forests and careful planning of timber harvest patterns can provide continuous forest cover. The objective is to identify and maintain natural areas representative of the variety of the forested landscape and connect those areas by natural corridors.

Objective 2.5. Exotic species will have a minimal impact on forests and other native plant and animal species. Minnesota's forests are susceptible to significant impacts from exotic species. Examples of exotics that adversely affect Minnesota forest resources include white pine blister rust, Gypsy moth, and buckthorn. Management will seek to minimize impacts from these species while also minimizing the impact of control measures on vulnerable native species.

Objective 2.6. Damage from native insects, diseases, and wildlife will be managed at acceptable levels. Native insects, diseases and wildlife have both positive and negative impacts on forests. On one hand, they are a major source of ***mortality*** and reduce resistance of forests to other stresses. On the other hand, they promote diversity of tree species and forest structure and generate dead wood, which provides important habitat and soil nutrients. Widespread pest outbreaks cause high levels of tree mortality and can have significant ecological and economic consequences. The objective is to reduce vulnerability of forests to the effects of significant outbreaks and to manage impacts of native pests, including wildlife, at levels consistent with forest ecosystem sustainability.

Objective 2.7. **The acreage of healthy brushland landscapes will increase**. Large, open brushlands are some of the state's most productive wildlife habitat and are essential to the survival of several wildlife species, some of which are declining in Minnesota (e.g., sharptailed grouse, yellow rail, savanna sparrow, short-eared owl). Brushland acreage has declined due to conversion to agriculture and fire suppression.

GOAL 3. Forest-based economic and recreational opportunities will be numerous and wide-ranging. The contribution of forests to the state's economic and social well being will be acknowledged. Economic opportunities for Minnesota's forest-based industries, including tourism and wood-based businesses, will be large, sustainable, and diverse.

Objective 3.1. Commercial timber supply will be abundant and sustainable. DNR will manage state lands and work with other forest landowners to help provide a predictable and sustainable amount of quality wood to meet the raw material needs of a growing population consistent with the sustainability of forest ecosystems. Predictable and sustainable harvests of quality wood from forests will support a strong state economy by helping maintain a viable forest products industry in the state.

Objective 3.2. Use of nontimber forest products will expand. Nontimber products such as balsam boughs and birch bark help diversify local economies. DNR will expand use of nontimber forest products consistent with sustainability of forest ecosystems.

Objective 3.3. Forest management will minimize impacts on visual quality. The visual quality of forest landscapes is especially important in areas of significant public use, such as roadsides, shorelands, and park areas. Minnesota's Forest Resources Council (MFRC) has incorporated "*Visual Sensitivity Categories,*" developed by the Timber Tourism Visual Quality Committee, into site-level forest management guidelines. DNR will apply the appropriate guidelines so that visual quality is not adversely impacted during forest management activities.

Objective 3.4. Forests will support diverse recreation opportunities. Forests provide opportunities for many outdoor recreation activities, which in turn provide economic benefits to local communities. The objective is to meet the demand for forest related outdoor recreation where and when these activities are consistent with the sustainability of forest ecosystems.

Objective 3.5. Private forest land owners will be able to manage their forests to provide public benefits. Public lands cannot provide all benefits demanded from forests. Private lands will play a key role. The objective is for private landowners to have sufficient access to the technical assistance and other services they need to satisfy their own management goals, while also maintaining healthy forest ecosystems, providing timber and serving recreation needs.

Objective 3.6. Cultural resources will be protected. Cultural resources are scarce, nonrenewable features that provide physical links to our past. MFRC Voluntary Site-Level Guidelines protect cultural resources during forest activities. The objective is to increase the awareness and use of the guidelines by forest landowners, loggers, and resource managers.

Objective 3.7. Trust fund revenues from mining and forest management will continue. Trust fund and other DNR-administered state land management will be proactive in the identification of surplus parcels for an annual sale and will initiate land exchanges with private landowners within established natural resource management areas to consolidate state ownership. The DNR also will identify and remove some trust fund lands from nonrevenue-producing natural resource management units on an annual basis.

GOAL 4. Mineral resource use will be economically viable and environmentally sound. Extraction of subsurface resources on all lands will continue to be a significant component of the state's economy. DNR will manage mineral development to protect public health and safety, reduce environmental impacts, and restore land for post-mining uses.

Objective 4.1. Opportunities for mineral exploration will continue. Minnesota has excellent potential for nonferrous and industrial mineral deposits. These deposits are found throughout the state, though predominantly in the forested areas. Mineral exploration requires availability of land in areas of high mineral potential, preferably within regions with compatible land uses. The objective is to provide improved data on the quality and quantity of mineral deposits including a consideration of the ecological impacts of minerals extraction.

Objective 4.2. The diversity of the minerals industry will continue to expand. Areas for mineral development include peat, clay, stone, nonferrous minerals, and stockpiled material from

existing or previous mining. Value-added processing of taconite or iron ore will further add stability and diversity to the minerals industry. The objective is to develop uses, marketing, and transportation strategies in cooperation with industry and other partners in order to expand the diversity of the mineral industry.

Objective 4.3. Mining and exploration will have minimal environmental impacts. The objective has three components: 1) restoring expired mine lands to productive uses including recreation and fish and wildlife habitat, 2) minimizing the impact of new mining operations on areas with high biodiversity or where extractive operations will fragment significant native habitats, and 3) addressing the multiple concerns relating to how mining operations affect surface and subsurface water resource quality and flows.

Forest Ecosystem Management Strategies

DNR will employ the following management strategies to achieve forest lands resource goals and objectives.

Strategy 1. Develop landscape-scale management plans to guide timber harvest and biodiversity protection. DNR is developing ecosystem ***subsection*** plans for forest management. Plans will develop interdisciplinary approaches to meeting multiple forest objectives on state Forestry and Wildlife lands. Harvest, reforestation, and protection strategies will guide management in reaching a variety of objectives such as timber production, diversity of age classes, patch size distribution, native plant communities (forest land, wetland, and open brushland communities) and connectivity (to provide habitat corridors and wildlife habitat). DNR's *Old-Growth and Extended Rotation Forest Guidelines* will focus on maintaining older forests. DNR will coordinate landscape plans and priorities with other owners when possible, including MFRC's landscape planning effort. (This strategy applies to objectives 1.1-3.7.)

Strategy 2. Apply MFRC Site-level Forest Management Guidelines. DNR will apply the MFRC guidelines on DNR-administered land and encourage widespread adoption and use of the guidelines on other public and private lands to protect wildlife habitat, historic and cultural resources, riparian areas, soils productivity, water quality, and visual quality of forest lands across the state. The DNR will assist with education and training for guideline implementation and coordinate efforts to monitor the application of these guidelines in forest management practices. DNR will encourage land managers to use the guidelines whenever appropriate (e.g., road construction, forest harvest, pesticide use, reforestation, ***thinning***, fire management, and recreation management). In some cases, land managers may choose to apply land treatments that are more restrictive than the guidelines; in other areas, less restrictive standards may be appropriate. Specifics of local conditions and management objectives will determine appropriate application of guidelines. (This strategy applies to objectives 1.1-3.7.)

Strategy 3. Manage insect pests and forest diseases. Exotic insects (such as gypsy moth) and native insects (such as spruce budworm) as well as diseases (such as white pine blister rust and oak wilt) are major threats to forest resources. DNR will monitor exotic and native forest insects and diseases and seek to minimize damage on public and private lands, and will seek to minimize impacts of control efforts on nontarget organisms. DNR will coordinate management efforts with the Minnesota Department of Agriculture, the U. S. Forest Service, and the U.S. Dept. of Agriculture. (This strategy applies to objectives 2.1, 2.2, 2.3, 2.5-3.5, and 3.7.)

Strategy 4. Expand focus on corridor management and planning. Corridors provide opportunities to connect habitat, provide outdoor recreation, and protect scenic vistas. DNR, through the Conservation Connections initiative, will work closely with private landowners, other land management agencies, and local communities to identify corridor opportunities and to implement corridor management concepts. (This strategy applies to objectives 1.1-2.4, 2.7, and 3.3-3.5.)

Strategy 5. Provide habitat for rare and threatened species. Restoring populations of rare and threatened species requires information on the location and prevalence of suitable habitats and development of guidelines and plans to ensure that habitats are restored or maintained, such as DNR's ***old-growth forest*** guidelines. DNR will take a leadership role in advocating for maintaining habitat for rare and threatened species in all forests regardless of ownership. (This strategy applies to objectives 1.1-2.7, and 3.5)

Strategy 6. Enhance opportunities to use state forests for outdoor recreation. DNR will continue to seek a balance between intensive recreation uses (off-highway vehicles - OHVs) and activities that require nature and solitude in forests. DNR will maintain forest campgrounds and will complete its recreation trail system planning for OHVs. Additional focus on recreation opportunities in forest ecosystems appears in the Recreation Systems section of *Directions 2000, The Strategic Plan,* September 2000. (This strategy applies to objectives 1.1-2.7, and 3.3-3.7)

Strategy 7. Incorporate wildlife population targets in all forest management efforts. DNR will consider fish and wildlife population targets in forest ecosystem management as part of an integrated strategy to maintain healthy forest ecosystems. Fish and wildlife population goals will continue to be an important consideration in planning timber harvests, old-growth management, reforestation, and forest recreation. (This strategy applies to objectives 2.1-3.7)

Strategy 8. Provide appropriate access roads to forest lands. Access to forest lands is provided by an intermingled network of federal, state, county, and private forest access roads. Cooperation with other forest land owners will be critical in maintaining existing access to DNR forest lands and to coordinate future road access needs and road management direction. DNR balances a variety of considerations (e.g., biodiversity, wildlife management, fire suppression, timber harvest, and recreation) in developing access roads. DNR will continue providing access to forest lands consistent with management plans, MFRC site-level guidelines, and forest ecosystem sustainability. (This strategy applies to objectives 1.1 and 2.1-3.7)

Strategy 9. Manage fire to protect public safety and foster healthy, diverse forest and brushland ecosystems. Wildfire prevention and suppression will continue to be guided by statutory directives to protect public safety, property, and natural resources. Prescribed (i.e., ignited and controlled) fire will be used to mimic natural processes, alter forest or brushland composition, encourage ***regeneration*** of certain species, eliminate exotic species, and reduce risk/potential of wildfire (i.e., fuels reduction). DNR will increasingly use ***prescribed burning*** to manage wildlife habitats, plant communities, brushlands, and ***timberlands***. Fuels management (including prescribed fire, constructing firebreaks, and ***salvage harvesting***) will be a growing need to help reduce the risk of dangerous wildfires in forested areas damaged by natural events (e.g., blowdowns, insects, and diseases) and where residential and commercial development has expanded into forested areas. (This strategy applies to objectives 1.2-3.7)

Strategy 10. Accelerate management of brushland landscapes. Active management is required to maintain productive brushlands wildlife habitat. DNR will complete efforts to assess the extent and quality of large, open brushland landscapes. DNR will use the landscape planning process to identify priority brushland areas and will develop management plans across all ownerships for these areas. Management plans will specify appropriate use of controlled fire, mechanical ***disturbance***, and herbicide treatments to maintain the health of the priority brushlands using the ***range of natural variation*** as a guide. (This strategy applies to objectives 2.1, 2.2, 2.3, and 2.7)

Strategy 11. Increase focus on timber quality and productivity. Demand for more and higher-quality timber will continue as society's need for forest products continues to grow and Minnesota's forest industry seeks to remain competitive in a worldwide market. Focusing attention on timber productivity and quality will help increase the quality and quantity of wood available for harvest in Minnesota and will enhance the protection of nontimber values in forested landscapes. For example, increasing the wood fiber productivity of a certain portion of the forest will help reduce the intensity of harvest pressures on other forest land. DNR will increase efforts

in programs and initiatives that focus on increasing the amount and quality of timber produced from appropriate forest lands. (This strategy applies to objectives 1.1, 1.2, 2.1, 2.5, 2.6, 3.1, 3.2, 3.5, and 3.7)

Strategy 12. Continue acquisition of critical land parcels. DNR will continue to acquire parcels of land that are adjacent to or within blocks of existing DNR lands. This strategy is especially important in areas of growing recreation or residential/commercial pressures. (This strategy applies to objectives 1.2, 2.4, 3.1, 3.2, 3.4, and 3.7-4.2)

Strategy 13. Cooperate broadly with stakeholders and other agencies. Cooperative approaches to managing forest resources have expanded, especially with MFRC activities. DNR will continue to involve other agencies, stakeholders, and the public in forest management decisions. The forest subsection planning process provides opportunities to involve the public in providing input in developing management goals. (This strategy applies to all objectives.)

Strategy 14. Cooperate with other landowners in sale and exchange of DNR-administered land. DNR will be proactive in identifying surplus parcels for sale and will initiate land exchanges with public and private landowners within established natural resource management areas to consolidate state ownership. DNR will identify and remove trust fund lands from nonrevenue-producing natural resource management units on an annual basis. (This strategy applies to all objectives.)

Strategy 15. Cooperate with other agencies, local government, and stakeholders to help establish viable rural economies. DNR will work with other state agencies, especially the Minnesota Departments of Agriculture and Trade and Economic Development, and with other stakeholders to strengthen rural economies by minimizing the impact of land fragmentation and development on forest lands. (This strategy applies to all objectives.)

Strategy 16. Increase investments in information technology. Information technology includes data collection, research, ecosystem monitoring, inventory efforts, and acquisition of technology. The expansion of information management technology allows a better understanding of the relationships between management techniques and resource conditions.

Forest inventories and related data-gathering efforts provide information needed by all land owners to manage land in a sustainable manner. DNR will maintain and provide access to a wide range of databases (e.g., Forest Inventory and Analysis, ***Cooperative Stand Assessment***, ***Ecological Classification System***, Forest Health Monitoring, County Biological Survey, Natural Heritage, mineral potential, etc.) and coordinate access to other databases that provide information on forest composition, wildlife habitat, rare species, cultural resources, etc. DNR will develop compatible forest information across all ownerships, focusing on spatial features of landscapes (habitat patch size, shape, connectivity) not addressed in previous inventories and assessments.

Data assessment and applications, such as those made possible by the Native Plant Community Classification effort and the interagency effort to develop a Range of Natural Variation for forest age classes, provide important opportunities to better use databases. Monitoring of impacts from roads, timber harvests, and recreation use provide information needed to develop ***timber management plans*** and forest-use policies. DNR will intensify data collection, database development, information sharing, data assessment, and monitoring efforts so as to provide forest managers with the information tools needed to manage forest ecosystems in a sustainable manner. DNR will improve the state land records system so that ***Geographic Information Systems*** (GIS) technology can be better used to analyze land ownership records. (This strategy applies to all objectives.)

Strategy 17. Provide technical assistance and financial incentives to landowners. DNR will use private landowner assistance and easement programs (e.g. private ***forest stewardship plans***, Conservation Reserve Program, and Forest Legacy Program) to help landowners manage

their lands to meet personal and broader forest ecosystem objectives for timber production, maintaining forest ownership parcel size, recreation, wildlife habitat, and other forest resources. DNR will provide technical assistance to builders and developers to assist them in developing land in ways that are compatible with the limitations and opportunities provided by natural settings. DNR will coordinate stewardship programs with other entities such as soil and water conservation districts.

DNR will provide technical assistance for mineral processing projects and for reclamation of mineral extractive sites. Long-term management planning will provide communities with information and advice for mineral resources development and associated land-use practices. DNR will assist private landowners in developing mineral product marketing efforts. (This strategy applies to all objectives.)

Strategy 18. Continue forest restoration and improvement. DNR will encourage restoration of ***nonforest*** land to forest cover where appropriate. DNR will assist private landowners in considering options for using land once in nonforest cover, for timber and other beneficial uses. DNR will restore the presence of some forest types such as Big Woods and white pine, which are less common than they once were. Other restoration strategies (removal of buckthorn and prescribed fire) will restore and maintain the ecological health of forest habitats. (This strategy applies to all objectives.)

Measuring Progress

Measuring progress toward forest management goals and objectives requires regular collection of forest resources information, including information on how those resources benefit society. In order to demonstrate forest resource accountability, DNR also must document how strategies have been implemented. Information (and specific indicators, where appropriate) will allow DNR to measure: 1) the ecological status of forests; 2) the economic status of forest-based industries; and 3) progress in implementing management strategies.

Goal One: Minnesota's forest land base will be enlarged and protected. Maintaining the state's forest land base is fundamental to achieving all of DNR's goals, including those associated with forests. To ensure that forest land is protected for the long term, DNR needs information on the extent of forest land, ownership, and productive capacity. Examples of performance measures are:

- Acres of forest land categorized by ownership type (public, private industrial, private nonindustrial) and productivity class (timber producing, nontimber producing)
- Average size of nonindustrial private forest land ownership

Goal Two: Forest ecosystems will be healthy, resilient, and functioning. Forest ecosystem health and resilience insures that forests can respond to disturbances and the demands society place on them. Measures of forest composition and ecosystem functions are useful in documenting forest health. Examples of performance measures that focus on the distribution of forest plant communities, species, and ages are:

- Acres of old-growth forest by type, or
- Acres of forest by community or forest type and age class

Examples of performance measures that focus on forest health are:

- Number of species of plants and animals with significantly reduced geographic ranges or population sizes (compared to historic conditions)
- Tree growth rates

Goal Three: Forest-based economic and recreational opportunities will be numerous and wide-ranging. Performance measures for this goal focus on uses of forests and the benefits of those uses for Minnesotans. Examples of performance measures are:

- Quantity of timber available
- Quantity of timber harvested
- Implementation of Visual Quality Guidelines
- Number of state forest campground user nights

Appendix C. Glossary and Commonly Used Acronyms

Acre: An area of land containing 43,560 sq. ft, 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.

Age Class: An interval 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 (ECS) subsection).

All-Aged: A forest stand in which all ages or age classes from seedlings to mature trees are represented.

Annual Allowable Cut: Annual allowable cut determination begins with the Cooperative Stand Assessment (CSA) inventory of state-owned lands. During subsection planning process, the team determines desired future forest conditions (DFFCs) for a 50 year planning horizon. This includes percentages of desired covertypes (including patch size, and orientation) age structure, and establishing a percentage of each major covertype to be managed on extended (longer) rotation periods. The team then determines the AAC (in acres) for each covertype; that can be harvested within the constraints of ERF, current age structure, and the DFFC covertype goals for the next seven year period. It is important to note, that ACC levels for some covertypes during a specific planning cycle may be determined to address a particular forest management goal and are not necessarily considered sustainable for the long term

Annual Stand Examination List: Stands selected from the seven-year stand examination list to be considered for treatment in a particular year. 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) level for the fiscal year (July 1 to June 30).

Area Forest Resource Management Plans (AFRMP): These evolved from Timber Management Plans (TMP), because of recognition that TMP discussions and decisions affected, or included, a lot more than the decision to harvest. They should not be confused with the comprehensive Forest Resource Management Plans (FRMPs) developed for a number of areas in the mid-to late-1980s.

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. For the initial round of Subsection Forest Resource Management Plans (SFRMPs), the focus will be 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 an 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).

Bearing Tree: A tree market to identify the nearby location of a survey corner – a synonym is "witness tree".

Biological Diversity (or "Biodiversity"): 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.

Board Foot: A unit of measuring wood volumes equaling 144 cubic inches which is commonly used to measure and express the amount of wood in a tree, saw log, 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 1,000 board feet (1 MBF). A piece of lumber 1 foot x 1 foot x 1 inch contains 1 board foot (1BF) of lumber.

Browse: Portions of woody plants including twigs, shoots, and leaves used as food by such animals as deer; to feed on leaves, young shoots, and other vegetation.

Brushland - A complex of vegetation consisting of greater than one-third total cover by shrubs and/or trees.

Clear-cut harvest: The removal of all or most trees during harvest to permit the re-establishment of an even-aged forest. A management option used to regenerate shade-intolerant species such as aspen and jack pine. Regeneration may be accomplished either naturally or artificially by planting or seeding.

Comprehensive DNR Subsection Plans: Address Minnesota Department of Natural Resources (DNR) programs and activities within the subsection. These address program 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, private forest management).

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 5 million acres (7,800 sq. mi.) owned and administered by the state.

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 4 feet x 4 feet x 100 inches and contain 133 cubic feet of wood. Pulpwood volume of standing trees is estimated in cords. For example, a 10 inch DBH tree that is 70 feet tall is about 0.20 cords, or 5 trees of this size would equal 1 cord of wood.

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 or proportionate representation, or both, of cover types in a forest or a given geographic area.

Crown-Release Thinning: The removal of trees from the dominant and codominant crown classes in order to favor the best trees of those same crown classes; synonyms are thinning from above and high thinning.

Cruise: A survey of forest land to locate timber and estimate its quantity by species, products, size, quality, or other characteristics. Also refers to 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 1 foot on a side. A cubic foot of wood contains approximately 6-10 usable board feet of wood. A cord of wood equals 128 cubic feet.

Desired Future Forest Composition (DFFC): Broad vision of landscape conditions in the long-term future. For the purposes of the initial round of subsection planning, DFFCs will focus on future desired forest composition looking ahead 50 years. Among other things, this could include the amount of various forest cover types within the subsection, age-class distribution of forest cover types, the geographic distribution of these across the subsection, and the related level of management for even-aged forest, extended rotation forest, etc.

Disturbance: Any relatively discrete event that disrupts the stand structure and/or changes resource availability or the physical environment.

Disturbance Regime: Natural or human-caused pattern of periodic disturbances such as fire, flooding, grazing, or timber harvest.

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

Drumlin: A streamlined hill or ridge composed of glacial drift.

Early Successional Species: A new arrival in the early stages of succession, with particular reference to certain species whose presence appears to promote the establishment of more exacting (in many cases more shade tolerant) 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.

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 socio-economic needs.

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).

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

Extended Rotation Forests (ERF): Forest stands for which the harvest age is increased beyond the economic harvest age (e.g., increasing the harvest age of an aspen stand from 40 years to 50 or 60 years) to provide larger trees, wildlife habitat, and other nontimber values. Additional detail on management of ERF on DNR-administered lands is contained in DNR Extended Rotation Forest Guidelines (1994).

"Effective" ERF: the percentage of designated ERF stands that is actually over the normal rotation age for the cover type.

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

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.

Forest Stewardship Program: A program administered by the USDA Forest Service that provides funding to state forestry agencies for the purpose of assisting nonindustrial private forest owners in the development of Forest Stewardship Plans.

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

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.

Habitat: Place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristic.

High Risk (HR): HR stands were identified based on one or more of the following reasons: stands coded as high risk in CSA forest inventory; significant insect or disease damage to the main species in the stand; or very old stands, e.g., aspen over 60 years old.

Intermediate Harvest: The removal of trees from the forest some time after establishment and prior to final harvest, with the primary objective of improving the growth, quality, vigor, and composition 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, Wildlife, and Parks and Recreation. 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 will be whether the issue can be addressed in whole or substantial part by vegetation management decisions on DNR-administered lands.

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 appropriate scale is usually defined by the issue being addressed.

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

Leave Tree: A tree (marked to be) left standing for wildlife, seed production, etc., in an area where it might otherwise be felled; a synonym for reserve tree.

Legacy Patch: An area within a managed site that protects soil organic matter and the organisms associated with it, and that will aid in recolonization of the adjacent managed land.

Lek: An open area where male sharptailed grouse gather in the spring of the year to perform a courtship dance intended to attract females. The birds use the area for courtship and breeding, then disperse. These sites are often used year after year for this purpose.

Management: The implementation of planned activities designed to provide a certain product or amenity from an ecosystem or to develop or maintain a certain set of conditions within that ecosystem. Forest management activities range from intensive silviculture to protection of natural areas from human disturbance.

Mast: The fruit of trees considered as food for livestock and certain kinds of wildlife – *note* hard mast is the fruits or nuts of trees such as oak, beech, walnut, hazelnuts, and hickories; soft mast includes the fruits and berries of plants such as dogwood, viburnum, elderberry, huckleberry, hawthorn, grape, raspberry, and blackberry.

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.

Mean Annual Increment (MAI): The average growth of the stand up to the age in question. It is calculated by dividing yield at that age by the age itself (e.g., net mean annual increment at age 60 equals 8,700/60, or 145 cubic feet per year).

Mesic: Of sites or habitats characterized by intermediate moisture conditions, i.e., neither decidedly wet nor dry.

Minnesota Forest Resources Council (MFRC) Regional Landscapes: MFRC established eight regional landscapes covering Minnesota based on ecological and socio-economic and administrative factors. Landscapes are established to undertake landscape based planning and coordination across all forest ownerships.

Minnesota Forest Resources Plan (MFRP): Statewide DNR strategic forest resources plan. Includes statewide vision, mission, preferred future, goals, strategies and objectives. Includes goals, statewide direction, and major strategies and objectives for each of the Division's programs.

Moraine: An accumulation of boulders, stones, or other debris carried and deposited by a glacier.

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

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

Natural Regeneration: Renewal of a forest stand by self-sown seed or by vegetative means such as root sprouting or suckering.

Nonforest 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.

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

Open Landscape Complex: - A complex of vegetation consisting of less than two-thirds total cover by trees; does not include open water or urban, industrial, transportation or rural developed areas.

Operational Planning: "What specifically will happen." These are the specific actions (i.e., projects, programs, etc.) that will be taken to move toward 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 forested area artificially established by planting or direct seeding.

Prescribed Burn: To deliberately burn wildlands (e.g., forests, prairie, or savanna) in either their natural or modified state 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.

Prescribed ERF: The percentage of stands in a cover type that are designated as ERF, regardless of current age.

Prescription: A planned treatment (clear-cut harvest, 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-inch to 12-inch DBH are used.

Range of Natural Variation (RNV): The range, identified from a variable (e.g., number of fires, number of trees, etc.), of a natural habitat based upon what was previously created by the natural disturbance regime. RNV describes the spatial and temporal variability of forest ecosystems prior to European settlement. Key aspects of the RNV are presettlement fire frequency and fire intensity and the size and distribution of areas burned. The rationale for using RNV as a frame of reference for forest management is that plants and animals are adapted to a range of conditions found within the ecosystems they have inhabited for centuries.

Regeneration: The act of renewing tree cover by establishing young trees either naturally (e.g., stump sprouts, root suckers, natural seeding) or artificially (e.g., tree planting, seeding). Regeneration usually maintains the same forest type and is done promptly after the previous stand or forest was removed.

Regeneration Harvest (or Regeneration Cut): Any removal of trees intended to assist regeneration already present, or to make regeneration possible.

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

Releve [method]: A method of vegetation classification that groups classes by presence and abundance of characteristic species that are neither ubiquitous nor rare. Plots used in this method.

Representative Wildlife Management Species: wildlife species that are considered to be representative either of important habitats or an important public benefit. The intent is that by identifying such species and addressing their needs, the needs of other species will be protected simultaneously.

Research Natural Area (RNA): Areas within national forests that the USDA Forest Service has designated as 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).

Reserved Forest Land: Forest land 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): The 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 Harvest (or cut): A harvest made to remove trees killed or damaged by fire, insects, fungi, or other harmful agents to utilize available wood fiber before further deterioration occurs.

Salvage Pool: A pool of stands identified for priority examination due to excess mortality, insect or disease damage, or physical damage. The salvage pool is considered separately during stand selection from the remainder of stands that meet selection criteria.

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

Sapling: A tree 1-inch to 5-inch DBH.

Saw Log: 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, i.e., saw logs.

Scarification: Breaking up the forest floor and top soil in preparation for 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.

Secondary Species: In Minnesota DNR's CSA forest inventory system, a species second in abundance or volume (depending on size of trees) to the dominant species in a forest stand.

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

Seed Tree: Any tree that bears seed; specifically, a tree left standing primarily to provide 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 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 due to shading by surrounding vegetation. Tolerant species are tolerant of shade, intolerant species require full sunlight.

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

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

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

Site Preparation: Treatment of a site with mechanical clearing, prescribed burning, or herbicides, to prepare a site for planting or artificial seeding.

Slash: The unutilized 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.

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 ten 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 groups.

Stand Density: The quantity of trees per unit area. Density usually is evaluated in terms of basal area, numbers of trees, volume, or percentage 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 will be used to help identify stands to be treated as determined by the subsection team. Criteria will likely include rotation age, site index, basal area, cover-type composition, understory composition, location, etc. Factors considered in developing stand-selection criteria will include DFFC goals; timber growth and harvesting; old-growth forests; extended- and normal-rotation forests; riparian areas; wildlife habitat; age and cover-type distributions; regeneration, thinning, and prescribed burning needs, etc.

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: "What we ideally would like to happen or be." Aspects of a plan, or planning process, that provide statements to guide future direction. The geographic, programmatic, and policy focus can range from very broad and general to more specific in providing tiers (or levels) of direction. Strategic planning is usually long term (i.e., at least five years, often longer) and it 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.

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

Subsection: A subsection is one level within the Ecological Classification System (ECS). From largest to smallest in terms of geographic area, the ECS is comprised of the following levels: Province --> Section --> Subsection --> Landtype Association --> Landtype --> Landtype Phase. Subsections are generally 1-4 million acres in size in Minnesota, with the average being 2.25 million acres. Seventeen subsections are scheduled for the SFRMP process.

Subsection Forest Resource Management Plans (SFRMP): A DNR plan for vegetation management on forest lands administered by DNR Forestry 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 seven-year plan. There is potential to be more comprehensive in the future.

Succession: The gradual supplanting of one plant community by another, e.g., a cover type of one species gradually changing over to a different cover type over time.

Timber Management Plans (TMP): Evolved from TMPIS in recognition of the fact that the entire timber management planning process is more than just the computerized system. Incorporated GIS technology and an interactive process with other resource managers.

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

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. Precommercial 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.

Timberland: Forest land 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., the Boundary Waters Canoe Area Wilderness (BWCAW) 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 (Sx), tamarack (Tx), and cedar (Cx), offsite aspen, or nonforest land.

Timber Management Plan: In conjunction with the SFRMP process, it means the same thing as the vegetation management plan described below.

Timber Stand Improvement (TSI): A practice in which the quality of a residual forest stand is improved by removing less desirable trees, vines, and occasionally, 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.

Tree Improvement Techniques: The application of genetics (forest tree breeding) and cultural techniques to the development of improved trees.

Underplant: To plant 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 three or more distinct age classes, either intimately mixed or in small groups.

Uneven-aged Management: A planned sequence of treatments designed to maintain and regenerate an uneven-aged stand (with three or more age classes).

Vegetation Management Plan: In the process of developing the seven-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, aesthetics, and other concerns. Prescriptions assigned to CSA 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.).

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 apart to prevent competition yet closely enough to utilize the entire site.

Wildlife Management Areas (WMAs): Areas established by the DNR Division of 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.

Common Acronyms

Cooperative Stand Assessment	CSA
Department of Natural Resources	DNR
Desired Future Forest Conditions	DFFCs
Diameter at Breast Height	DBH
Ecological Classification System	ECS
Endangered, Threatened, or Special Concern	ETS
Extended Rotation Forestry	ERF
Forest Inventory and Analysis	FIA
Geographic Information Systems	GIS
Minnesota County Biological Survey	MCBS
Minnesota Department of Natural Resources	DNR
Minnesota Environmental Quality Board	EQB
Minnesota Forest Resources Council	MFRC
Nonindustrial Private Forest	NIPF
Scientific and Natural Areas	SNAs
Subsection Forest Resource Management Plan	SFRMP
Landtype Association	LTA
Timber Management Plan	TMP
Wildlife Management Areas	WMAs
Minnesota Gap Analysis Program	Minn-GAP
Minnesota Wetlands GIS cover	Minn-WET

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Appendix E. Brief Descriptions of Landtype Associations (LTAs) in the Mille Lacs Uplands Subsection (212Kb) and Glacial Lake Superior Plain (212Ja)

(*Included in Open Landscape Assessment)
(‡Designated as priority open landscape LTA by SFRMP team)

Glacial Lake Superior Plain (212Ja)

***‡Douglas Lake-Modified Till Plain (212Ja01) 60,080 acres**

General Description. This LTA is in the deep-water portion of a basin formed by Glacial Lake Duluth, that has been deeply eroded by post glacial lake streams. Uplands occupy 92 percent, wetlands occupy 7 percent, and lakes occupy 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Soil parent material is red clay with small scattered areas of silts and sand (Natural Resources Conservation Service (NRCS) 1994). The majority of the upland presettlement vegetation was lowland hardwood-conifer (white pine) with minor amounts of ***mesic*** northern hardwoods (Shadis, 1999; Heinselman,, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse ***lek*** surveys and the Natural Heritage database of rare animal records, four sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), this LTA comprises 15 percent openland and 3 percent brushland ***habitat*** types, for a total open landscape composition of 18 percent. None of the 133 Public Land Survey (PLS) sections within the LTA has had brushland management activities. Based upon the Minnesota Gap Analysis Program (Minn-GAP) stewardship classified acres, landownership within the LTA consists of approximately 41 percent public lands and 59 percent private lands.

***‡Duesler Lake Plain (212Ja09) 33,366 acres**

General Description. This LTA is in the shallow water portion of the Glacial Lake Duluth basin. Uplands occupy 79 percent, wetlands occupy 20 percent, and lakes occupy 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Soil parent material is a complex of fine sand, silt, and loams over sand (NRCS 1994). The majority of the upland presettlement vegetation was lowland hardwood-conifer (white pine) and with minor amounts of mesic northern hardwoods (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, four sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), this LTA comprises 47 percent openland and 2 percent brushland habitat types, for a total open landscape composition of 49 percent. None of the 92 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 15 percent public lands and 85 percent private lands.

***‡Nemadji Lake Plain (212Ja10) 16,103 acres**

General Description. The Nemadji Lake Plain is in the shallowest portion of the Glacial Lake Duluth basin. This is the transition between lake sediment and glacial till. Uplands occupy 68 percent, wetlands occupy 32 percent, and there are no lakes in this LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Soil parent material is sand (fine and medium), sandy loam over sand, and silt over loamy till. The majority of the upland presettlement vegetation was lowland hardwood-conifer (white pine) with minor amounts of jack pine and mixed white pine-red pine (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, one sharp-tailed grouse lek and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning 1999), this LTA comprises 50 percent openland and no brushland habitat types, for a total open landscape composition of 50 percent. None of the 47 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 14 percent public lands and 86 percent private lands.

Mille Lacs Uplands (212Kb)

***‡Bruno Moraine (212Kb01) 76,777 acres**

General Description. The Bruno Moraine is a hummocky end ***moraine*** formed by the Superior Lobe. Uplands occupy 65 percent, wetlands occupy 35 percent, and lakes occupy less than 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Soil parent material in the uplands is loamy. A hardpan commonly exists in the subsoil. The majority of the upland presettlement vegetation was mixed white pine-red pine, dry-mesic pine-hardwood, and lowland hardwood-conifer (white pine) (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, six sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), this LTA comprises 37 percent openland and 1 percent brushland habitat types, for a total open landscape composition of 38 percent. Brushland management activities have taken place on 2 percent (4 sections) of the 175 PLS sections in this LTA. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 34 percent public lands and 66 percent private lands.

***Duxbury Moraine (212Kb02) 283,006 acres**

General Description. The Duxbury Moraine is a hummocky end moraine formed by the Superior Lobe. Patches of rolling outwash are common. Uplands occupy 66 percent, wetlands occupy 34 percent, and lakes occupy less than 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Soil parent material in the uplands is loamy over sandy loam (NRCS, 1994). A hardpan commonly exists in the subsoil. The majority of the upland presettlement vegetation was lowland hardwood-conifer (white pine), mixed white pine-red pine and dry-mesic pine-hardwood (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, 21 sharp-tailed grouse leks and 4 open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning 1999), this LTA comprises 33 percent openland and 1 percent brushland habitat types, for a total open landscape composition of 34 percent. Brushland management activities have taken place on 1 percent (4 sections) of the 520 PLS sections within the LTA. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 42 percent public lands and 58 percent private lands.

***Malmo Peatlands (212Kb03) 46,684 acres**

General Description. The Malmo Peatlands are a landscape characterized by peatlands interspersed with upland areas with level to gently rolling terrain. Uplands occupy 49 percent, wetlands occupy 46 percent, and lakes occupy 5 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Stream density is 0.63 miles per square mile (46 miles total). The majority of the upland soil materials are sand with scattered areas of loamy textures (NRCS 1994). The majority of the upland presettlement vegetation was l wet-mesic hardwood-conifer (white pine), mixed white pine-red pine, and mesic northern hardwoods (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, two sharp-tailed grouse leks and one open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning; 1999), this LTA comprises 61 percent openland and 4 percent brushland habitat types, for a total open landscape composition of 65 percent. Brushland management activities have taken place on 5 percent (5 sections) of the108 PLS sections in this LTA. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 22 percent public lands and 78 percent private lands.

Kathio Moraine (212Kb04) 40,052 acres

General Description. A rolling end moraine formed by the Superior lobe. Uplands occupy 54 percent, wetlands occupy 40 percent, and lakes occupy 6 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.)
Soil parent material in the uplands is stoney sandy loam. A hardpan commonly occurs in the subsoil. Wetlands are acid peat over sandy loam. The majority of the upland presettlement vegetation was wet-mesic hardwood-conifer (white pine), mixed white pine-red pine, and mesic northern hardwoods (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

***Eastside Till and Outwash Plain Complex (212Kb05) 68,578 acres**

General Description. This LTA is characterized by areas of rolling to hilly terrain (till plain) separated by areas of level to gently rolling terrain (outwash plain). Uplands occupy 64 percent, wetlands 34 percent, and lakes 2 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Stream density is 0.39 miles per square mile (total of 39 miles). Soil parent material in the uplands is commonly sandy loam in texture. A hardpan commonly occurs in the subsoil. Scattered areas of sand or sandy loam over sand also occur. The majority of the upland presettlement vegetation was wet-mesic hardwood-conifer (white pine) in the northern two thirds and dry-mesic pine-hardwood in the southern third (Shadis, 1999; Heinselman, 1974). Minor amounts of mixed white pine-red pine and mesic northern hardwoods also occurred. Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open LandscapeAssessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, one sharp-tailed grouse lek and one open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning 1999), this LTA comprises 53 percent openland and 2 percent brushland habitat types, for a total open landscape composition of 55 percent. None of the 153 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 12 percent public lands and 88 percent private lands.

***‡Three Rivers Peatlands (212Kb06) 46,705 acres**

General Description. This LTA is a landscape characterized by peatlands interspersed with upland areas of level to rolling terrain. Uplands occupy 25 percent, wetlands occupy 75 percent, and lakes occupy less than 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Stream density is 0.68 miles per square mile (50 miles total). The majority of the upland soil materials are sandy loam; small areas with sand and gravel also occur. A hardpan commonly occurs in the subsoil. The majority of the lowland presettlement vegetation was conifer bog and swamp with minor amounts of wet prairie (Heinselman, 1974). The majority of the upland presettlement vegetation was wet-mesic hardwood-conifer (white pine) with minor amounts of mixed white pine-red pine (Shadis, 1999; Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, two sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning 1999), this LTA comprises 75 percent openland and 2 percent brushland habitat types, for a total open landscape composition of 77 percent. Brushland management activities have taken place on 4 percent (5 sections) of the143 PLS sections in this LTA. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 81 percent public lands and 19 percent private lands.

***Solana Till Plain (212Kb07) 177,310 acres**

General Description. The Solana Till Plain is a landscape characterized by hilly terrain with steep slopes. Uplands occupy 60 percent, wetlands 40 percent, and lakes less than 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Stream density is 0.46 miles per square mile (128 miles total). The soil material is quite variable and ranges from loam to sand. A hardpan commonly occurs in the subsoil. The majority of the lowland presettlement vegetation was conifer bog and swamp (Heinselman, 1974). The majority of the upland presettlement vegetation was wet-mesic hardwood-conifer (white pine) or mixed white pine-red pine (Shadis, 1999; Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, two sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning 1999), this LTA comprises 35 percent openland and 3 percent brushland habitat types, for a total open landscape component of 38 percent. Less than 1 percent of the 399 PLS sections within the LTA have had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 63 percent public lands and 37 percent private lands.

***Pine Lake Till Plain (212Kb08) 93,547 acres**

General Description. The Pine Lake Till Plain is a landscape characterized by rolling hills. Uplands occupy 69 percent, wetlands 28 percent, and lakes 3 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Stream density is 0.79 miles per square mile (115 miles total). Roughly half of the uplands have sandy loam texture. A hardpan is commonly found in the subsoil. The remaining areas contain a variety of soil textures ranging from sand to loam to loam over sand. The majority of the upland presettlement vegetation was wet-mesic hardwood-conifer (white pine) with minor amounts of mixed white pine-red pine and dry-mesic pine-hardwood (Shadis, 1999; Heinselman, 1974). The majority of the lowland presettlement vegetation was conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, six sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning 1999), this LTA comprises 38 percent openland and 3 percent brushland habitat types, for a total open landscape composition of 41 percent. None of the 194 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 16 percent public lands, 84 percent private lands, and less than 1 percent tribal lands.

Ann Lake Drumlin Plain (212Kb09) **376,352 acres**

General Description. This landscape that is characterized by rolling hills formed by the Superior Lobe. Long cigar-shaped ridges called ***drumlins***, oriented southwest-northeast, are common. Uplands occupy 71 percent, wetlands 28 percent, and lakes 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Wetlands are commonly long and narrow. Stream density is .85 miles per square mile (total of 476 miles). The majority of the upland land has sandy loam parent material. A hardpan in the subsoil is common. The remaining uplands contain a variety of soil textures ranging from sand, loam, to loam over sand. The majority of the upland presettlement vegetation was mesic northern hardwoods in the southern three quarters, dry-mesic pine-hardwood in the north central part, and wet-mesic hardwood-conifer (white pine) in the northeast portion (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

‡**Nokay Sand Plain (212Kb10**) 85,713 acres

General Description. This LTA is a nearly level outwash plain formed by the Rainy lobe. Uplands occupy 59 percent, wetlands occupy 29 percent, and lakes occupy 12 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Stream density is .36 miles per square mile (total of 47 miles). The majority of the uplands have sandy and gravelly soil parent material without hardpans in the subsoil. Scattered areas contain a variety of soil textures ranging from sandy loam with hardpans to silt over loam. The majority of the upland presettlement vegetation was dry-mesic pine-hardwood with minor amounts of mixed white pine-red pine and wet-mesic hardwood-conifer (white pine) (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

***Brainerd Drumlin Plain (212Kb11) 267,552 acres**

General Description. This LTA is a rolling till plain formed by the Rainy and Superior lobes. Long cigar-shaped ridges oriented southwest-northeast, called drumlins, occupy 79 percent of the landscape, wetlands occupy 20 percent, and lakes occupy 2 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Soil parent material is

usually sandy loam, with subsoil hardpans, in the till plains. In the outwash channels, the soil parent material is sand, sand over gravel, or sand over sandy loam. The majority of the upland presettlement vegetation was dry-mesic pine-hardwood, mesic oak, and dry pine (red and jack pine) (Shadis, 1999). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, zero sharp-tailed grouse leks and nine open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), openland and brushland habitat types comprise 61 percent and 4 percent of this LTA respectively, for a total open landscape composition of 65 percent. None of the 498 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 4 percent public lands and 96 percent private lands.

***Kettle River Drumlin Plain (212Kb12) 122,784 acres**

General Description. This LTA is a landscape characterized by rolling hills formed by the Superior Lobe. Long, cigar-shaped ridges (drumlins) oriented southwest-northeast, are abundant. Wetlands are commonly found between the ridges. Uplands occupy 71 percent, wetlands occupy 28 percent, and lakes occupy less than 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) The majority of the soil parent material is silt loam or loam over sandy loam in the till plains. Hardpans in the subsoil are common. The remaining uplands contain a variety of soil textures ranging from sandy loam over sand to silt over loam. The majority of the upland presettlement vegetation was wet-mesic hardwood-conifer (white pine) and mixed white pine-red pine (Shadis 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, 15 sharp-tailed grouse leks and 2 open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), openland and brushland habitat types comprise 46 percent and 1 percent of this LTA respectively, for a total open landscape composition of 47 percent. Less than 1 percent (1 section) of the 250 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 12 percent public lands and 88 percent private lands.

***Willow River Sand Plain (212Kb13) 41,449 acres**

General Description. The Willow River Sand Plain consists of rolling outwash plains and channels formed by the Superior Lobe. Uplands occupy 68 percent, wetlands occupy 24 percent, and lakes occupy 8 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Sandy soil is the parent material on 74 percent of the uplands. Hardpans in the subsoil are not common. The remaining uplands contain a variety of soil textures ranging from silt loams, loams, to sandy loam over sand. The majority of the upland presettlement vegetation was dry jack pine with minor amounts of wet-mesic hardwood-conifer (white pine) and mixed white pine-red pine (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database, which contains rare animal records, one sharp-tailed grouse lek and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning;

1999), openland and brushland habitat types comprise 36 percent and 1 percent of this LTA respectively, for a total open landscape composition of 37 percent. None of the 94 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 20 percent public lands and 80 percent private lands.

***Nickerson Moraine (212Kb14) 154,525 acres**

General Description. The Nickerson Moraine is a complex of steep end moraines and outwash plains formed by the Superior Lobe. Uplands occupy 68 percent, wetlands occupy 29 percent, and lakes occupy 3 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) The soil parent material in the uplands is quite variable. Roughly one-third is silt loam over loam with hardpans. Another third is sandy loam over sand. The remaining uplands contain a variety of soil textures ranging from silt loam over sandy loam to sand. The majority of the upland presettlement vegetation was mixed white pine-red pine with minor amounts of dry-mesic pine-hardwoods and wet-mesic hardwood-conifer (white pine) (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, five sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), openland and brushland habitat types comprise 41 percent and 1 percent of this LTA respectively, for a total open landscape composition of 42 percent. None of the 319 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 17 percent public lands, 83 percent private lands, and less than 1 percent tribal lands.

***Finlayson Till Plain (212Kb15) 76,160 acres**

General Description. The Finlayson Till Plain is a rolling till plain formed by the Superior Lobe. Uplands occupy 78 percent, wetlands occupy 21 percent, and lakes occupy 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Roughly 80 percent of the uplands have silt loam over loam or sandy loam soil material. Hardpans are common in the subsoil. The remaining uplands contain a variety of soil textures ranging from sandy loam to sand. The majority of the upland presettlement vegetation was mixed white pine-red pine and wet-mesic hardwood-conifer (white pine) (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, twelve sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), openland and brushland habitat types comprise 57 percent and 1 percent of this LTA respectively, for a total open landscape composition of 58 percent. Brushland management activities have taken place on 3 percent (4 sections) of the156 PLS sections in this. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 10 percent public lands and 90 percent private lands.

Mille Lacs Lake (212Kb16) 126,632 acres

St. Croix Terraces (212Kb18) 123,921 acres

General Description. A landscape of rolling outwash terraces formed by the Superior lobe and modified by the St. Croix River. Uplands occupy 71 percent, wetlands occupy 29 percent, and lakes occupy less than 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Roughly one third of the LTA has soils that have sandy textures. The remaining upland areas contain a variety of textures ranging from sand over sandy loam (with hardpans), sandy loam (with hardpans), to silt over sandy loam (with hardpans). The majority of the upland presettlement vegetation was wet-mesic hardwood-conifer (white pine), mixed white pine-red pine and mesic northern hardwoods (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

***‡Cloverdale Sand Plain (212Kb19) 63,400 acres**

General Description. This LTA is a level to gently rolling landscape that is dominated by outwash plains formed by the Superior Lobe. Uplands occupy 73 percent, wetlands occupy 26 percent, and lakes occupy 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Sandy loam over sandy textured soil occurs on 40 percent of the uplands, ranging from silt over sandy loam to sandy loam. The majority of the upland presettlement vegetation was lowland hardwood-conifer (white pine), mixed white pine-red pine and dry-mesic pine-hardwoods (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, eight sharp-tailed grouse leks and three open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), openland and brushland habitat types comprise 50 percent and 1 percent of this LTA respectively, for a total open landscape composition of 51 percent. None of the 164 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 14 percent public lands and 86 percent private lands.

***Stanchfield Lake Plain (212Kb20) 79,625 acres**

General Description. This LTA is a gently rolling to level lake plain formed by Glacial Lake Hugo. Uplands occupy 71 percent, wetlands occupy 27 percent, and lakes occupy 2 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Clayey or silty soils occur on 60 percent of the uplands. The remaining areas contain a variety of textures ranging from sandy loam, sand, to silt over sand. The majority of the upland presettlement vegetation was mesic northern hardwoods with minor amounts of wet-mesic hardwood-conifer (white pine), dry-mesic pine-hardwood, and wet prairie (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, zero sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), this LTA comprises 73 percent openland and 7 percent brushland habitat types, for a total open landscape composition of 80 percent. None of the 196 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 4 percent public lands and 96 percent private lands.

Elm Park Till Plain (212Kb21) 52,252 acres

General Description. A rolling till plain formed by the Superior lobe. The LTA comprises 73 percent uplands, 25 percent wetlands, and 2 percent lakes by area (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Roughly three quarters of the LTA has soils with loamy textures. Hardpans are common in the subsoil. The remaining uplands contain a variety of soil textures ranging from sandy loam with hardpans to sand. The majority of the upland presettlement vegetation was mesic northern hardwoods with minor amounts of aspen-oak lands, oak openings-barrens, wet prairie, and wet-mesic hardwood-conifer (white pine) (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

***Pierz Drumlin Plain (212Kb22) 234,726 acres**

General Description. This LTA is a rolling drumlin field formed by the Superior Lobe. Uplands occupy 79 percent, wetlands occupy 21 percent, and lakes occupy less than 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Soils with sandy loam textures occur on 85 percent of the LTA. Hardpans are common in the subsoil. The remaining uplands contain a variety of soil textures ranging from sand to sand over gravel. The majority of the upland presettlement vegetation was mesic northern hardwoods, mesic oak, and oak openings-barrens with minor amounts of wet prairie and brush prairie (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, zero sharp-tailed grouse leks and five open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), this LTA comprises 79 percent openland 4 percent brushland habitat types, for a total open landscape composition of 83 percent. None of the 438 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately less than1 percent public lands and 99 percent private lands.

Mora Sand Plain (212Kb23) 48,605 acres

General Description. This is a nearly level outwash plain formed by the Superior lobe. Uplands occupy 87 percent, wetlands occupy 11 percent, and lakes occupy 2 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Just over 75 percent of the LTA has mineral soils with sandy loam over sand textures. The remaining uplands are predominantly sandy loam soils with hardpans. The majority of the upland presettlement vegetation was mesic northern hardwoods and dry-mesic pine-hardwood with minor amounts of white pine, oak openings-barrens, and river bottom forests (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Milaca Till Plain (212Kb24) 179,476 acres

General Description. This LTA is a rolling loess-covered till plain formed by the Superior Lobe. Drumlin features are present but not abundant. Uplands occupy 83 percent, wetlands occupy 17 percent, and lakes occupy less than 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Mineral soils with sandy loam textures occur on 85 percent of the LTA. Hardpans are common in the subsoil. The remaining uplands contain a variety of soil textures ranging from sand, to loam over sand. The majority of the upland presettlement vegetation was mesic northern hardwoods with minor amounts of wet prairie, wet-mesic hardwood-conifer (white pine), mesic oak, and

oak openings-barrens (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

*‡**Brook Park Till Plain (212Kb25) 132,590 acres**

General Description. This LTA is a rolling till plain formed by the Superior Lobe glacier. Uplands occupy 74 percent, wetlands occupy 25 percent, and lakes occupy 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Roughly two-thirds of the LTA has mineral soils with sandy loam textures. Hardpans are common in the subsoil. The remaining uplands are predominantly sand. The majority of the upland presettlement vegetation was lowland hardwood-conifer (white pine) in the northeast half and mesic northern hardwoods in the southwest half with minor amounts of oak openings-barrens (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, eight sharp-tailed grouse leks and two open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), the LTA comprises 64 percent openland and 4 percent brushland habitat types, for a total open landscape composition of 71 percent. Brushland management activities have taken place on 1 percent (4 sections) of the 280 PLS sections in this LTA. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 2 percent public lands and 98 percent private lands.

***Rush City Moraine (212Kb26) 196,356 acres**

General Description. This LTA is a rolling to hummocky end moraine formed by the Superior Lobe glacier. Uplands occupy 75 percent, wetlands occupy 20 percent, and lakes occupy 5 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Mineral soils with loamy textures occur on 65 percent of the LTA. Hardpans are common in the subsoil. The remaining uplands contain a variety of soil textures ranging from sandy loam to sand to silt over loam. The majority of the upland presettlement vegetation was mesic northern hardwoods and oak openings-barrens with minor amounts of wet-mesic hardwood-conifer (white pine) and wet prairie (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, zero sharp-tailed grouse leks and three open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning 1999), openland and brushland habitat types comprise 70 percent and 2 percent of this LTA respectively, for a total open landscape composition of 72 percent. None of the 378 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 1 percent public lands and 99 percent private lands.

Riverton Moraine (212Kb27) 30,562 acres

General Description. Rolling to steep end moraine formed by the Rainy Lobe. Uplands occupy 68 percent, wetlands occupy 19 percent, and lakes occupy 13 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Stream density is 0.93 miles per square mile (total of 45 miles). Small areas of outwash plains are common. Soil parent material is a mixture of sand, gravel, and sandy loam till in the moraine and sandy in the outwash plains. The majority of the upland presettlement vegetation was dry-mesic pine-hardwood and jack pine with minor amounts of wet prairie (Shadis, 1999;

Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Mille Lacs Moraine (212Kb28) 61,222 acres

General Description. A rolling to hummocky end moraine formed by the Rainy Lobe. Lakes occupy 13.3 percent (8143 acres) of the LTA. Stream density is 0.2 miles per square mile (total of 19 miles). Uplands occupy 61 percent, wetlands occupy 26 percent, and lakes occupy 13 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Mineral soils with silt over loam textures occur on 80 percent of the LTA. Hardpans are common in the subsoil. The remaining uplands contain a variety of soil textures ranging from stony sandy loam till with a hardpan, sand, or gravel. The majority of the upland presettlement vegetation was dry-mesic pine-hardwood with minor amounts of mesic northern hardwoods and mesic oak (Shadis, 1999; Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Chisago Moraine (212Kb31) 58,697 acres

General Description. A gently rolling to steep end moraine formed by the Grantsburg Lobe. Lakes are abundant. Uplands occupy 71 percent, wetlands 14 percent, and lakes 15 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Mineral soils with sandy loam over clay loam textures occur on 87 percent of this LTA. Hardpans are not common in the subsoil. The remaining uplands contain a variety of soil textures ranging from sandy loam with hardpans to sand. The majority of the upland presettlement vegetation was mesic northern hardwoods, with minor amounts of oak openings-barrens (Heinselman, 1974). Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Almelund Moraine (212Kb32) 49,941 acres

General Description. Almelund Moraine is a gently rolling to steep end moraine formed by the Grantsburg Lobe. Uplands occupy 87 percent, wetlands occupy 12 percent, and lakes occupy 1 percent of the LTA (Minnesota DNR, 1998, Minnesota Wetlands GIS Cover.) Mineral soils with sandy loam over clay loam textures occur on 96 percent of this LTA. Hardpans are not common in the subsoil. The remaining uplands are predominantly sandy. The majority of the upland presettlement vegetation was mesic northern hardwoods with minor amounts of wet prairie. Lowland presettlement vegetation was commonly conifer bog and swamp (Heinselman, 1974).

Open Landscape Assessment Summary. Based upon sharp-tailed grouse lek surveys and the Natural Heritage database of rare animal records, zero sharp-tailed grouse leks and three open landscape-dependent wildlife species have been recorded in or within one mile of the LTA. Based upon 1990s land use and cover (Loesch and Orning, 1999), this LTA comprises 73 percent openland and 2 percent brushland habitat types, for a total open landscape composition of 75 percent. None of the 105 PLS sections within the LTA has had brushland management activities. Based upon Minn-GAP stewardship classified acres, landownership within the LTA consists of approximately 1 percent public lands and 99 percent private lands.

Appendix F. Roads and Trails

Wildlife/Forestry Coordination Policy Reference:
Specific Procedural Policy No. 3 – Roads and Trails.

General Guidelines

1. Determine if a road or trail is needed for either forest or wildlife management purposes. A road or trail is desirable if it assures better dispersion and proper utilization of timber and wildlife with minimal negative impacts. The DNR Divisions of Wildlife or Forestry may build roads or trails where construction is too expensive for a logger to undertake.

2. All road and trail (new and reconstruction) projects will have input by Area Wildlife and Forestry personnel on construction plans and subsequent use and regulations. Items to consider:
   a. Existing access, and impact of new access on resources.
   b. Should the system be a dead-end or loop?
   c. The season of use.
   d. Is access open or controlled?
   e. Construction methods and design.
   f. Funding sources.
   g. Long range planning of area habitat needs such as wildlife openings and timber sale design.
   h. Other important wildlife features such as deer yards, eagle nests, turkey roosts, heron colonies, etc.
   i. Seeding clover for erosion control and wildlife forage.
   j. Impact on wetlands by road and culvert placement.

3. The classes of roads are as follows:

   Class 1: Multi-purpose, two-lane roads with a roadway width of 26 feet. These are heavy-use roads.

   Classes 2 and 3: Multi-purpose, two-lane roads. Class 2 roadway width of 22 feet; Class 3, 18 feet. Major timber haul use.

   Class 4: Multi-purpose, one-lane roads with a roadway width of 14 to 16 feet. Access to areas for continued management.

   Class 5: Timber haul roads for seasonal or temporary use. Roadway width of less than 14 feet.

APPENDIX G. Red Shouldered Hawk Habitat in the Planning Area

The Red-shouldered Hawk *(Buteo lineatus)* is distributed throughout much of eastern North America, with an isolated population in California. The range for this species apparently expanded into Minnesota during the early 1900s. Red-shouldered hawks require extensive, relatively mature, well-stocked lowland hardwood or upland hardwood stands in close proximity to wetlands or other water bodies. Surveys in central and north-central regions of Minnesota have shown that red-shouldered hawks are more commonly found in upland deciduous forests, particularly those found on moraine topography with rolling hills covered by mature forest interspersed with numerous small wetlands.

Nesting habitat primarily consists of well-stocked pole or sawtimber stands (stocking densities 30 to 45 cords per acre) with a closed canopy (80-100%) and basal area of at least 80 square feet per acre. An additional recommendation would be to retain and restore (R/R) all native species common to the Northern Hardwood type including some of moderate shade tolerance.

The Red-shouldered Hawk is listed as a species of Special Concern in Minnesota, but in adjacent states is listed as Endangered (Iowa and Illinois) and Threatened (Wisconsin and Michigan). Because forest management practices have the potential to significantly impact the species in much of the state, planning team members agreed to consider habitat requirements for Red-shouldered Hawk when planning forest management. Two ways these data were considered were in the identification of areas for management as “large patches”, and identification of areas for management as “Extended Rotation Forest”.

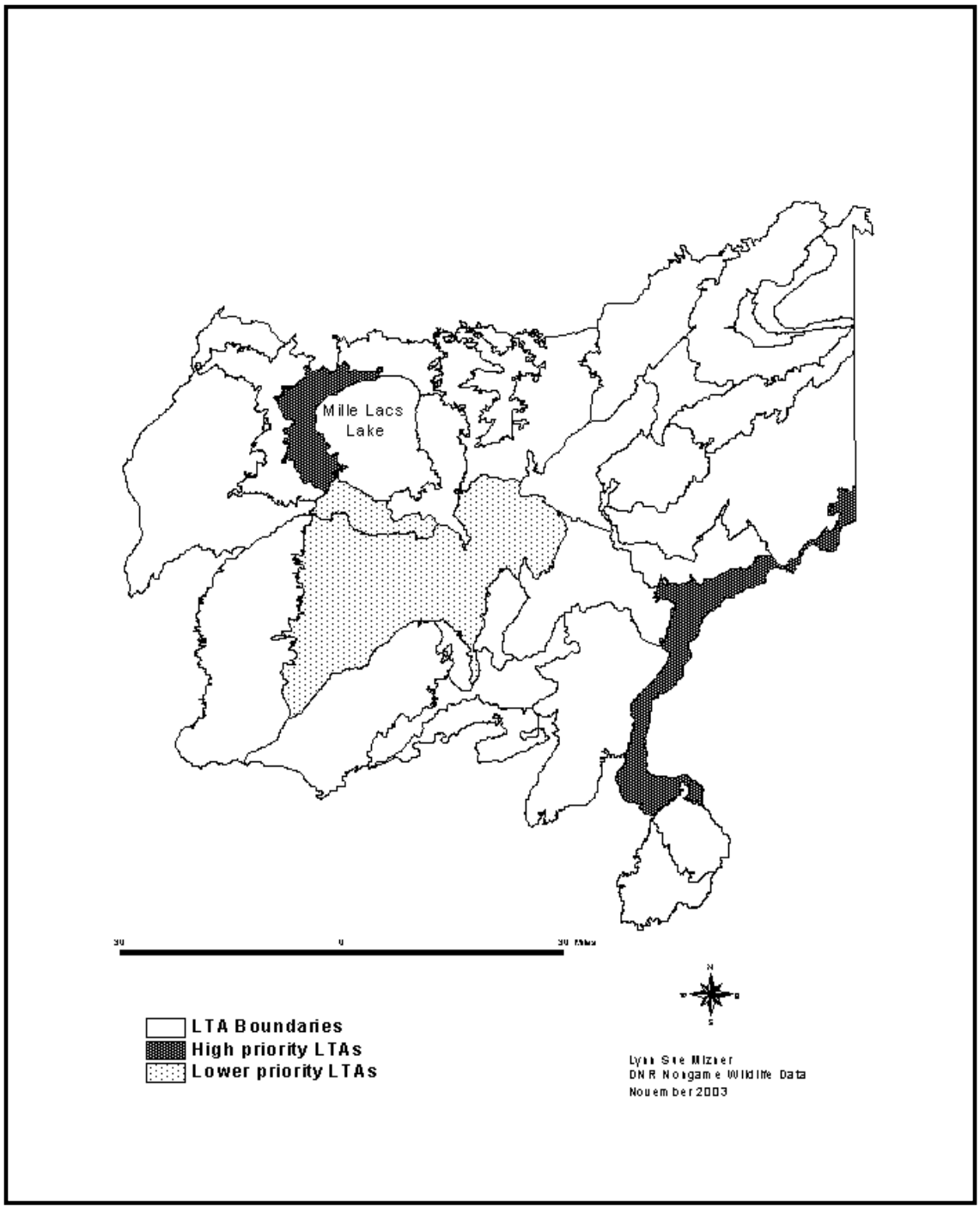
Figure 14. Shows Landtype Associations (LTAs) in the planning area that have been assigned one of three levels of importance as Red-shouldered Hawk habitat:

High: These are LTAs where existing soils, topography, and habitat conditions (closed canopy forest) currently support the highest concentrations of Red-shouldered Hawks in the state.

Moderate: These are secondary areas where Red-shouldered hawks are regularly found, but numbers may be limited by forest age, fragmentation, or other factors.

Lower: Additional LTAs within the state where Red-shouldered Hawk breeding has been documented.

Figure 14. High and lower-priority LTAs for RSH habitat in the planning area (there are no LTAs in the planning area with the Moderate ranking).



APPENDIX H. Management of Open Landscapes

Open Landscape Complexes in the planning area: The Mille Lacs Uplands SFRMP team, including representatives of DNR Divisions of Fisheries and Wildlife, and Ecological Services, considered a proposal to designate fourteen Landtype Associations (LTAs) in the MLU and GLSP for management as Open Landscape Complexes[1]. A case was presented for each LTA, based on number of open landscape-dependent wildlife species thought to be present, current amount of open landscape, and some adjacency issues i.e., to existing wildlife or waterfowl management areas. Discussion resulted in agreement among team members to designate nine LTAs as priority open landscape management areas, and five (5) LTAs were designated as not being priority open landscape areas. Many of the LTAs recommended for priority open landscape designation were heavy to nonindustrial private land ownership, so the management would emphasize collaboration with Stewardship planning efforts. The team agreed it would be appropriate to emphasize open landscape management goals through Stewardship Planning, modified timber sale ***prescriptions***, and adjustment of ***rotation age***, in areas designated Open Landscape Complexes. A map of the current status of LTAs included in the Open Landscape Assessment is included here.

Priority Open Landscape LTAs

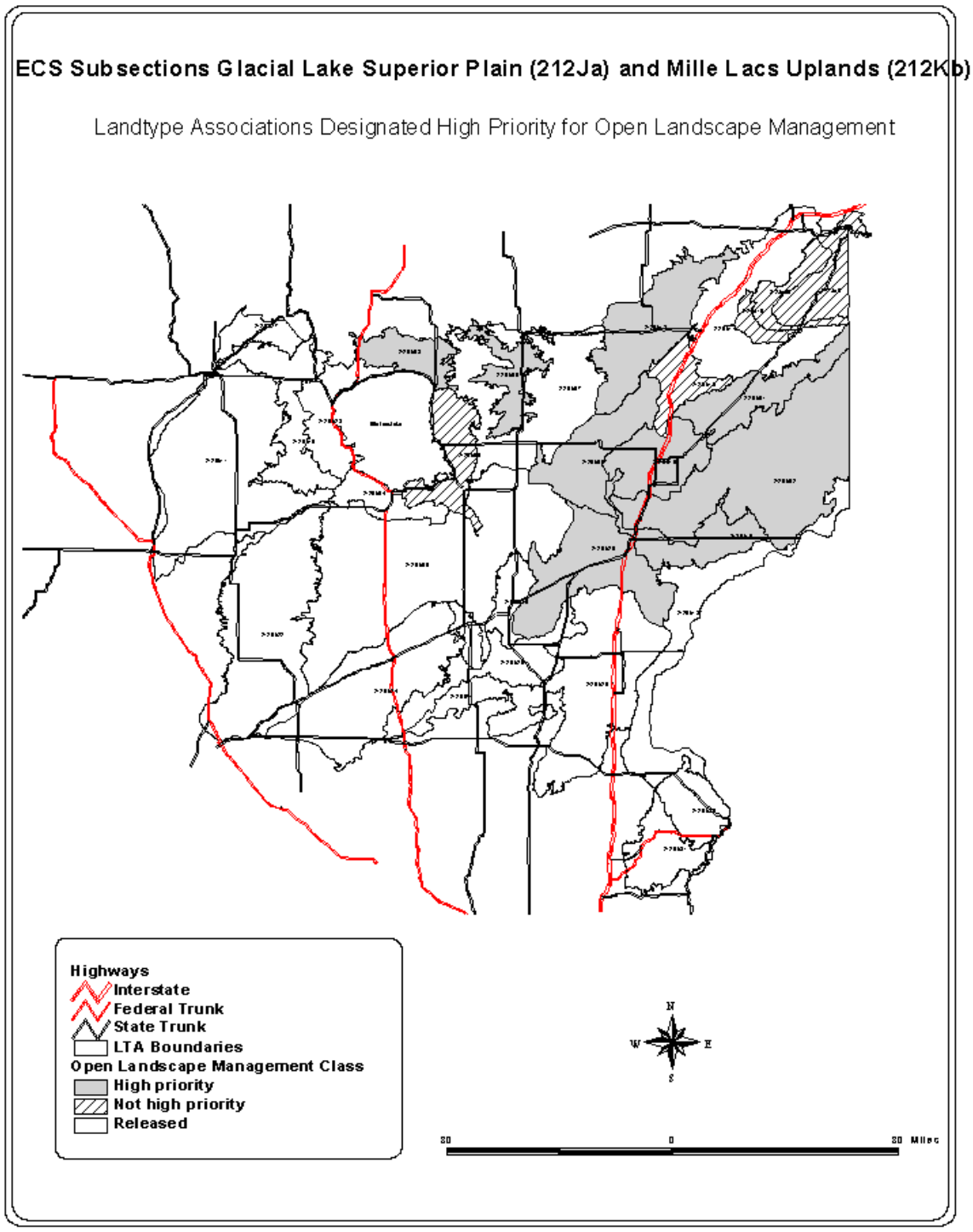
212Kb01	Bruno Moraine
212Kb02	Duxbury Moraine
212Kb03	Malmo Peatlands
212Kb06	Three Rivers Peatlands
212Kb08	Pine Lake Till Plain
212Kb12	Kettle River Drumlin Plain
212Kb15	Finlayson Till Plain
212Kb19	Cloverdale Sand Plain
212Kb25	Brook Park Till Plain

Not Priority Open Landscape LTAs:

212Ja01	Douglas Lake Modified Till Plain
212Ja09	Duesler Till Plain
212Ja10	Nemadji Lake Plain
212Kb05	East Side Till Plain
212Kb13	Willow River Sand Plain

[1] Minnesota Department of Natural Resources, Division of Wildlife. 2002. An assessment of open landscapes for management of brushland wildlife habitat in northern and central Minnesota. Minnesota Department of Natural Resources Wildlife Resource Assessment Report 1. Minnesota Department of Natural Resources, St. Paul, Minnesota. 572 pp.

Figure 15. Landtype Associations (LTAs) Identified as Priority Open Landscapes



Appendix I. Patch size determination for the planning area

The following seven forest-type combinations were used to group stands into "***patches***":
1. Aspen, birch, and Balm of Gilead
2. Northern hardwoods, central hardwoods, and oak
3. Ash, lowland hardwoods, cottonwood, and willow
4. Red pine and jack pine
5. White pine
6. Tamarack, white cedar, lowland black spruce
7. White spruce, balsam fir, and upland black spruce

Two size class categories for each of the above groups were identified (class 1, 2, and 3; Class 4, 5, and 6), resulting in a total of 14 possible combinations.

No rivers large enough to break up patches occur on state land within the Mille Lacs Uplands. However, state, county, and township roads do break up a number of patches. Data on ***state forest roads*** were not available. The group determined that class 4, 5, and 6 forest roads were not significant in the fragmentation of patches, although class 1, 2, or 3 forest roads could be.

A map of the entire planning area was produced, showing patch sizes on state land.

Agreement was reached that the plan would use data in Table 8 as a long term goal for patch sizes; although these percentages were modified to accommodate the CSA data format, the starting point was data from Malcolm L. Hunter, Wildlife, Forests, and Forestry. There was some feeling in the group that definite numbers would be important for interim goals, but numbers associated with ***desired future forest conditions*** (DFFCs) could be a little more vague, due to uncertainty about the ideal patch size distribution and lack of data specific to Minnesota.

Agreement was reached that the interim goal will be to maintain the percentage of large patches (250 acres and larger), combine or conduct adjacent harvests in patches smaller than forty acres to create patches in the size class 100-249 acres. A 2 percent reduction in patches less than forty acres will be the seven-year goal. There was some question about how this would influence ***management*** in the woods; the group agreed that goals would alert foresters to look for opportunities to conduct adjacent cuts (creating a larger patch), or avoid fragmenting existing large patches with harvest activities.

It was agreed that data on all ownerships should be acquired at some time in the near future, to provide a more realistic picture of patch sizes on the landscape.

Table 8 shows current patch size distribution, and possible goals, with percentages and numbers of acres. The numbers confirmed that Minnesota DNR resource managers have tended in the past to create smaller patches (Cloquet Area average harvest size is about 18 acres). Team members pointed out that harvest size and patch size were not the same thing; a large patch could contain a number of smaller adjacent harvests occurring over a period of time.

Table 8. Current and Desired Patch Sizes in the Planning Area

Patch size Class	Goal % In class	Current % In class	No. of Patches In class	Acres in Class
640+	10%	18%	65	68,572
250-639	15%	20%	210	79,958
100-249	40%	20%	505	77,852
40-99	25%	20%	1,238	76,934
<40	10%	23%	6,634	88,226
	Totals		8,652	391,542

Appendix J. Historical Disturbance Regimes

Historically, fire and wind were the most important stand-replacing disturbances in the planning area. The severity of these disturbances ranges from light surface fires and blowdown of individual trees to catastrophic crown fires and windthrow that kill most trees in a stand and allow regeneration of a new stand. Although fire was historically the most important catastrophic disturbance, its role has decreased within the last century due to fire exclusion resulting from human-caused changes in vegetation in combination with direct fire suppression. Historically, rotation periods for catastrophic fires were shortest (80 – 130 years) in the western portion of the planning area, near the St. Croix River, and in the pine-dominated Willow River Sandplain LTA. (Figure 16a). The central portion of the planning area experienced the longest rotations (800 – 1150 years), whereas the northwestern portion generally experienced intermediate disturbance regimes of 370 – 600 years. In general rotation periods for stand-replacing windstorms were longest in those areas with the shortest rotation period for catastrophic fires (compare Figures 16b and 16a) because older and larger trees are more susceptible to windthrow than younger, smaller trees. Figure 16b also show pattern of increasing blowdown rotation periods from southwest to northeast, reflecting an increasing rotation period for winds >112 m/h from southwest to northeast (Frelich, L.E., 2002. Forest dynamics and disturbance regimes: studies from temperate evergreen-deciduous forests. Cambridge University Press.)

Disturbance regimes provide a benchmark to compare with current and potential future ecosystem conditions, and can form part of a suite of tools useful for developing sustainable resource management strategies and evaluating trade-offs among management activities[2]

Even though it may not be practical or desirable to recreate historical conditions, examining options for managing ecosystems in the light of knowledge about those conditions can provide benefits for resource managers. Natural disturbance cycles influenced the adaptations of the native plants and animals, therefore, ecosystems operating nearer to the range of natural variation tend to be more diverse, resilient, and in some cases more productive than ecosystems that have significantly departed from those conditions.[3]

As Minnesota DNR works through its planning processes, its resource managers are attempting to understand how these newly available data can contribute to better management of Minnesota's natural resources. Historical disturbance regimes were considered during the development of this plan, and were used to help locate extended rotation forests; otherwise they did not significantly affect the selection of stands for examination or the development of management prescriptions in this planning area.

[2] Carlson, Daren. 2003. Range of Natural Variation: Information for Sustainable Forest Management. Minnesota DNR Office of Management and Budget Services Science Policy Section. St. Paul, Minnesota.
[3] Id.

Figure 16a. Historical Fire Disturbance Regimes in the Planning Area.

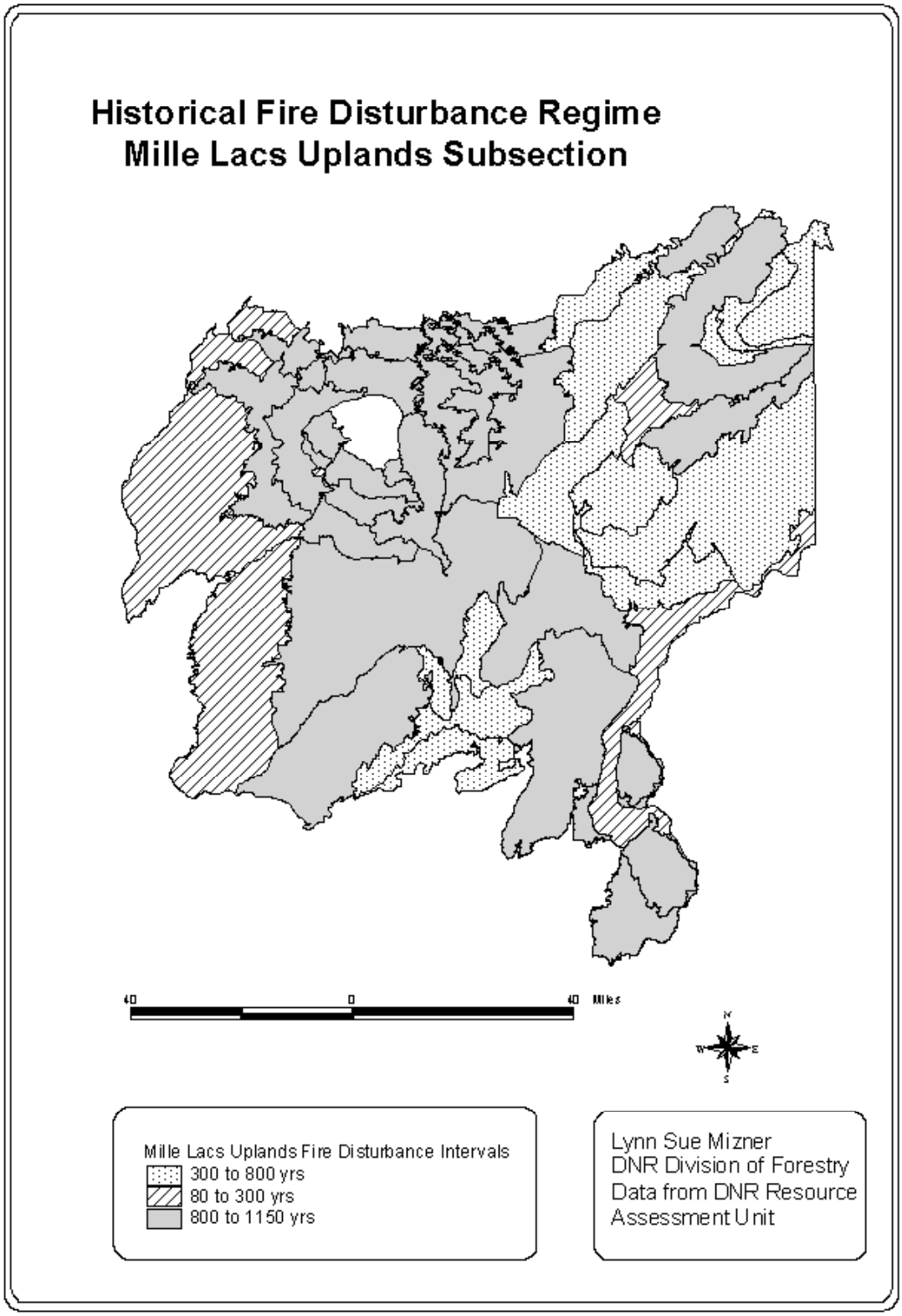
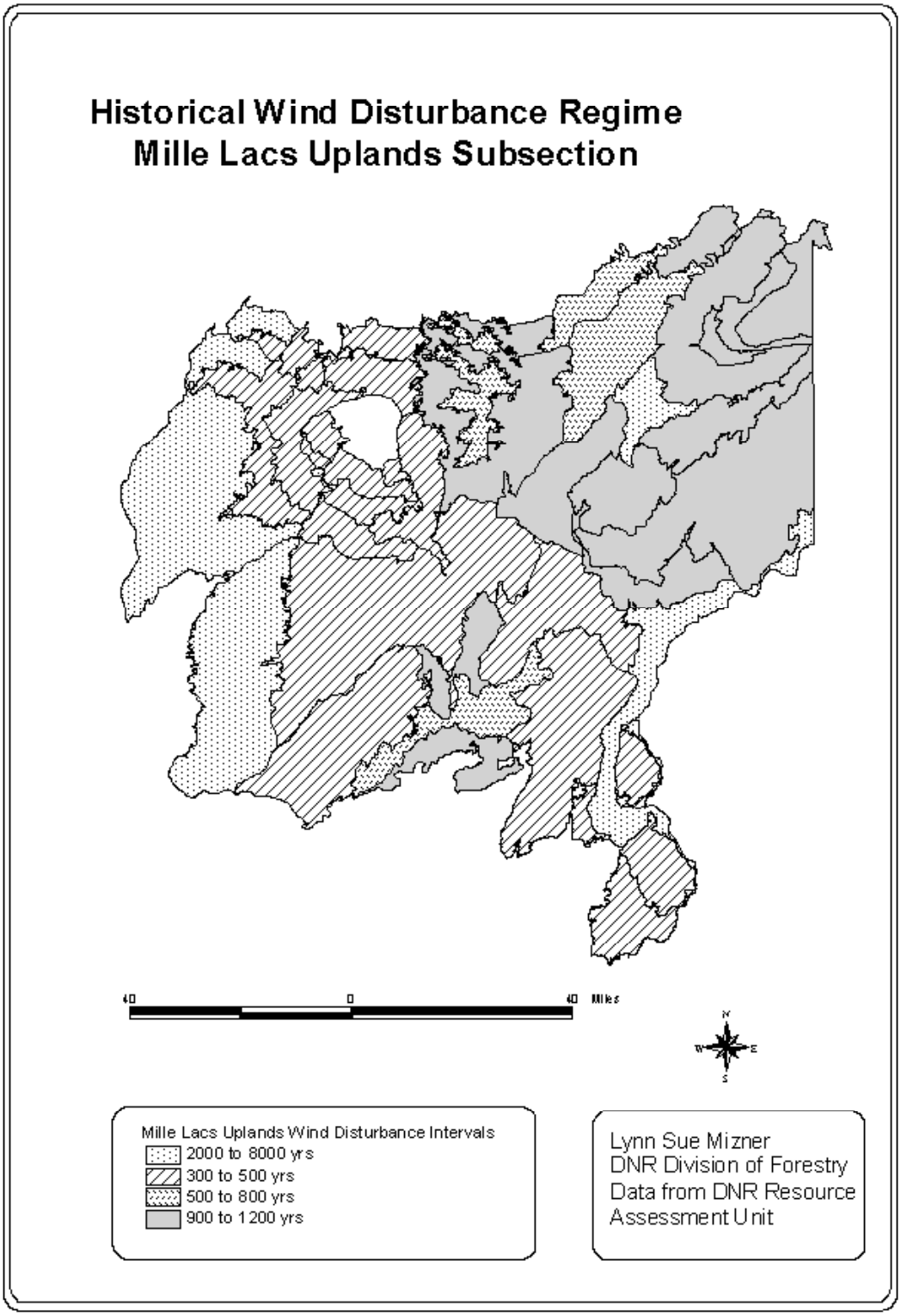


Figure 16 b. Historical Wind Disturbance Regimes in the planning area.



Appendix K. Early Successional Habitat in the Planning Area

Figure 17. Percentages of Aspen-Birch Forest in LTAs in the Planning Area.

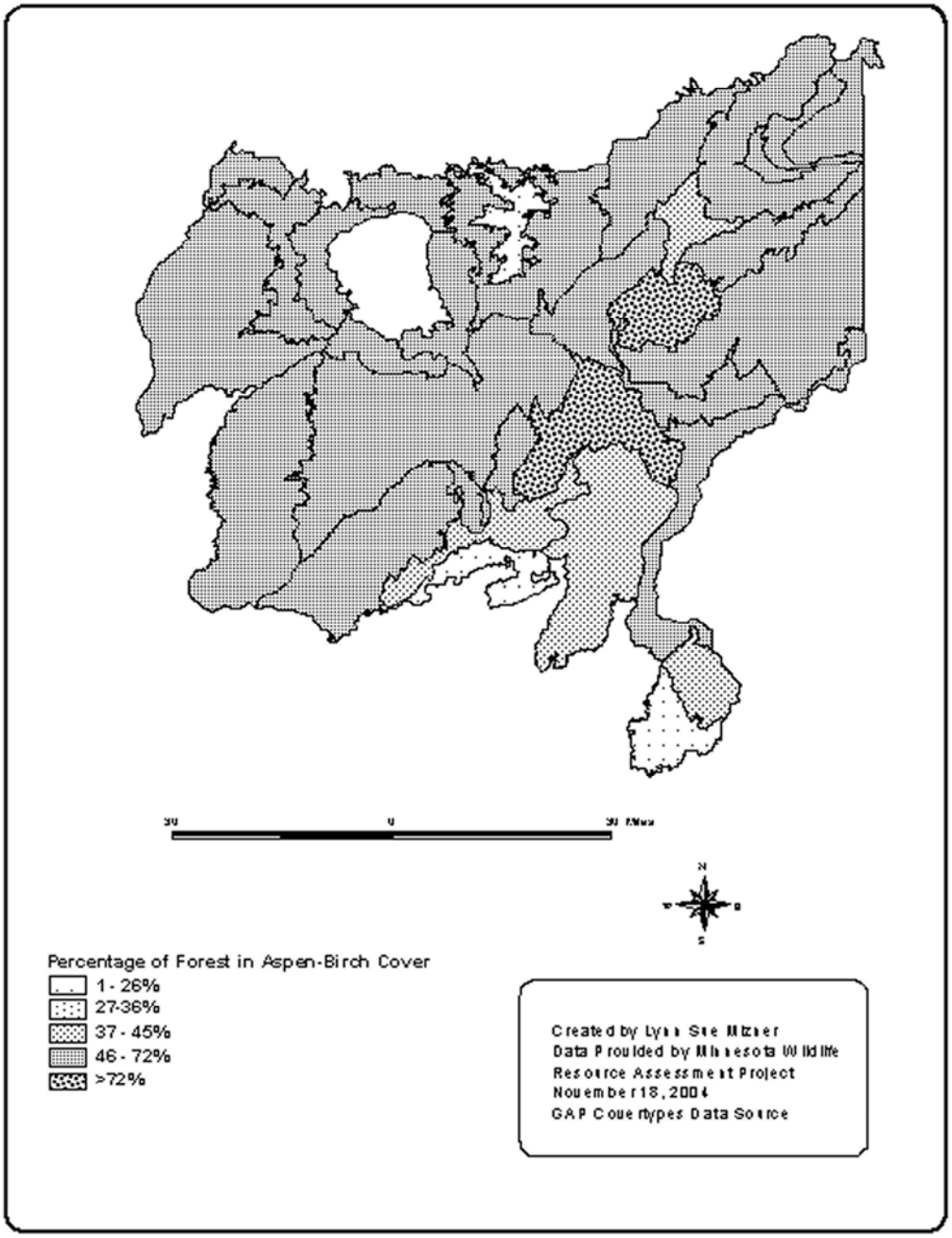


Table 9. Percentage of Forested land in Aspen-Birch Forest Type by LTA

LTA NUMBER	LTA ACRES	LTA FORESTED ACRES	ASPEN/BIRCH PERCENTAGE OF FORESTED ACRES	OPEN LANDSCAPE PRIORITY LTA
212Ja01	60,151	47,470	71.28%	No
212Ja09	33,401	18,290	63.59%	No
212Ja10	16,126	7,467	59.33%	No
212Kb01	76,800	48,448	66.75%	Yes
212Kb02	276,231	182,978	68.40%	Yes
212Kb03	46,716	17,826	45.61%	Yes
212Kb04	40,050	20,909	46.07%	Not proposed
212Kb05	68,586	30,458	45.93%	No
212Kb06	46,718	23,112	23.96%	Yes
212Kb07	177,366	122,479	48.55%	Not proposed
212Kb08	93,557	52,553	65.83%	Yes
212Kb09	376,361	180,883	62.64%	Not proposed
212Kb10	85,706	33,417	55.58%	Not proposed
212Kb11	267,623	74,458	46.34%	Not proposed
212Kb12	122,816	66,193	64.02%	Yes
212Kb13	41,449	17,498	43.01%	No
212Kb14	154,610	85,420	60.64%	Not proposed
212Kb15	76,162	32,056	79.44%	Yes
212Kb16	126,631	0	0.00%	Mille Lacs Lake
212Kb18	123,933	67,843	60.96%	Not proposed
212Kb19	63,396	27,967	69.78%	Yes
212Kb20	79,627	10,312	42.27%	Not proposed
212Kb21	52,251	8,817	21.91%	Not proposed
212Kb22	234,810	25,282	49.55%	Not proposed
212Kb23	48,598	10,204	67.60%	Not proposed
212Kb24	179,486	24,849	56.97%	Not proposed
212Kb25	132,591	34,907	72.59%	Yes
212Kb26	196,429	33,018	43.83%	Not proposed
212Kb27	30,565	16,381	69.16%	Not proposed
212Kb28	61,220	36,370	47.20%	Not proposed
212Kb31	58,697	10,293	11.32%	Not proposed
212Kb32	49,958	8,938	38.33%	Not proposed

Appendix L. Oak Regeneration Plan

Work group members
Project leader: Bill Foss, Sandstone Area Forestry Technician
Tim Quincer: Central Region Forestry-Wildlife Coordinator
Daren Wysocki: Aitkin Area Timber Program Forester
Peter Willis: Little Falls Area Timber Program Forester
Steve Lane: Aitkin Area Forest Supervisor
Bill Barnacle: Central Region Silviculturist
Advisory personnel
Rich Staffon: Cloquet Area Wildlife Manager
Nick Reindl: Division of Wildlife Depredation Specialist
Lynn Sue Mizner: Subsection Plan Team Leader
Doug Tillma: Northeast Region Timber Program Leader

Analysis of the oak resource indicates that to prevent a future age-class imbalance, and provide a consistent supply of this valuable resource, approximately 1,120 acres will need to be regenerated during the seven-year planning period. The task of this group is to determine criteria for identifying appropriate ***stands*** in which to focus this work during the planning period and create a plan for protection and enhancement of the regenerating resource.

Oak ***management*** in the planning area will follow the management recommendations in the body of the plan (e.g., retention of ***mast***, ***rotation ages***, etc.). This work group's focus is on the correction of the perceived lack of recruitment in the oak ***cover type***.

Criteria for selecting stands to be regenerated
As noted in the cover-type notes in the ***subsection*** plan, oak will be primarily managed using a ***shelterwood harvest***. This entails ***thinning*** young stands for quality and vigor, and later a heavy thinning at rotation age to promote natural or ***artificial regeneration*** under the remaining canopy. These residuals are then removed at such time when they are no longer necessary to provide a microclimate for the regenerating stand. It is this ***regeneration*** that is the subject of current concern over depredation.

Initially, the following criteria will be used to identify oak stands that are good candidates for implementation of a shelterwood harvest.

- ✓ Site has a high incidence (50 percent+) of environmental damage (e.g., frost cracks, blowdown, high grading, poor form, animal damage)
- ✓ Site has greater than 20 percent affected by insect and disease problems
- ✓ Site has good accessibility for tending, fence maintenance, bud capping, etc.
- ✓ Site classification indicates appropriate quality and native plant community classification to support quality oak forest (e.g., MHc36)

A preliminary sort of the data indicated that 363 acres of oak type met the first criterion alone. Additional acres will no doubt be identified during field visits.

In addition to sites that meet the criteria above, sites where existing ***regeneration*** exists will be candidates for implementation of protective measures.

Exclosure costs

Deer exclosures are the most effective, and also the most costly, means of protecting regeneration. Fence materials may have potential for re-use when trees reach a height where they are safe from depredation. Exclosures have the added benefit of protecting herbaceous vegetation and other trees in addition to the target oak seedlings.

An eight foot fence with posts every twenty feet is required to exclude deer. Here is a picture of the standard deer fence with twelve foot treated wood posts, buried between three and four feet, with fence ready to be installed. Several fence manufacturers make appropriate high tensile fences in different heights and stay distances. This wire is eight foot high with 6-inch stays. The roll is approximately 330 feet long and weighs over 300 pounds. It can be unrolled on the ground and then tightened with fence stretchers; the fence will stand itself up as it is tightened. Special fencing tools are required to install this type of fence (high tensile).

Costs for fence construction vary, but estimates for materials for this kind of fence range from $1.25 to $2.00 per lineal foot, plus labor. Corners and gates are the most expensive part of fence construction. This, and the fact that fencing costs do not increase linearly with size of area enclosed, makes it advantageous to work with larger enclosures/exclosures wherever possible. We estimate a total cost for materials to be $2 per lineal foot, or about $582 per acre to enclose a 10-acre parcel and $374 per acre to enclose a 20-acre parcel. These figures include one eight-foot gate per enclosure. The estimates can be doubled if labor is included.

Alternatives to the standard twelve foot wood post and high tensile welded mesh pictured above include a high density polyethelene welded plastic 2-inch x 2-inch mesh fence that comes in a roll. This material, called Deer II Extra Strength Deer Fence, is 8 feet x 330 feet and has a breaking load of 685 lbs. The cost is about $249 per roll. Possible advantages include light weight for application on remote sites, cheaper installation cost, ease of repairing tears, lower cost, possible ability to attach to existing trees on some sites, and ability to use a lighter (steel “T”) post that can be pounded in. This mesh is very strong, but could be cut by a determined vandal more easily than could a high tensile fence. Gates may be optional with this type of fence, but should gates be needed, an access gate (4 feet x 7 feet) is $169 plus $70 for a frame.

Using this HDPE material, it would be possible to enclose ten acres for $4,050 or twenty acres for $4,648 (materials cost only). This is $232.40 per acre for a twenty-acre block or $405 per acre for a ten-acre block, excluding labor costs, site prep costs, and gates.

Other methods of protection

Current protection efforts include experimental contract bud-capping of oak seedlings using drywall tape. The efficacy of this method has yet to be determined.

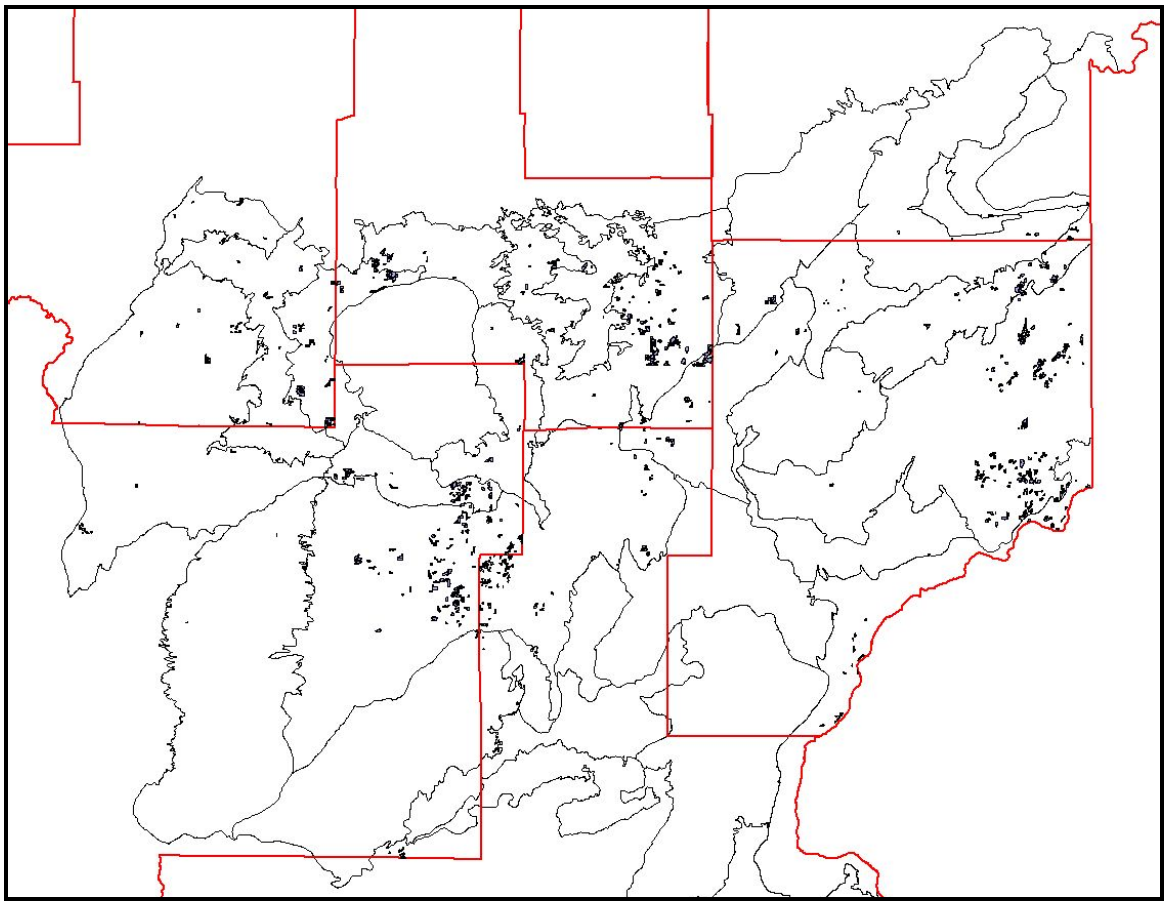
Contracting costs for bud-capping ranges from about $50-$60 per acre, and must be done annually for at least five years. This results in an estimated cost of $200 per acre to achieve protection. Itasca State Park has experimented with bud capping using volunteer labor and recycled paper; this has greatly reduced the annual cost of bud capping to a total of about $100 for 30,000 trees.

The use of deer repellents was discussed. This means of protecting seedlings has been used with varying levels of success. Weather and time investments make this a less certain method of protection, however, any means of protection that is appropriate for the site and conditions will be considered. Materials cost estimates for repellant use include the cost of a specialized sprayer ($85) and the repellant itself, which is fairly inexpensive.

Access

Both bud-capping and fencing require reasonable access, but to bud cap smaller acreages, access is less critical a factor than it is for fencing. Fences need monitoring and occasional maintenance.

Figure 18 . Oak Forest in the Mille Lacs Uplands



2002 DNR Division of Forestry Area Boundaries

Conclusions:

The work group determined depredation to be a problem of such magnitude in the planning area that other management investments, e.g., planting, site preparation, weeding and tending, or herbicide treatments, should not be undertaken if resources are not available to protect regeneration. The group suggested that if fencing, bud-capping, or other appropriate protection methods are not possible, no final harvest should be considered for oak in vulnerable areas. Stand quality improvement thinnings would, of course, continue.

To this end, the work group will prepare a proposal in an attempt to obtain sufficient funding to protect approximately 1,200 acres of oak regeneration in the subsection. Other divisions in DNR and partners external to Minnesota DNR will be approached (e.g., nonprofit entities) to assist with funding for this effort.

Appendix M. The Two-Lined Chestnut Borer

This summer (2002) it is fairly common to see oaks that are dying due to infestation by two-lined chestnut borers (TLCB) from Bemidji to Grand Rapids to Mora. TLCB have attacked oak trees stressed by the recent forest tent caterpillar outbreaks, local droughts and/ or construction damage.

The two-lined chestnut borer, *Agrilus bilineatus,* is an opportunistic insect that attacks weakened oak trees. It is a native beetle known to attack all oak species found in Minnesota, red oak being its preferred host. When trees and ***stands*** are healthy, TLCB confines its attack to low-vigor trees or broken branches. When drought stress, construction, and/or defoliation have reduced tree vigor, oaks are predisposed to TLCB attack. Under severe stress conditions, widespread outbreaks of TLCB can occur.

Adult beetles seek out and lay eggs on weakened oaks in late May and June. From June to August, larvae feed on the inner bark of live branches and stems, which destroys nutrient- and water-conducting tissues causing the foliage to turn brown and hang on the branches. Larvae create meandering galleries on the surface of the wood that are visible if patches of bark are cut off infested branches or stems. Larvae are white with an enlarged head and slender segmented body, are about 1.25 inches long when fully grown, and have two spines at the tip of their abdomens. Larvae pupate under the bark where they overwinter. They emerge as adults through D-shaped exit holes in the bark the next May and June

In mid-July, the first visible symptoms of TLCB infestation occur. Infested oaks may be recognized by sparse, small, and discolored foliage that is followed by the dieback of branches. Leaves of infested branches turn uniformly red-brown. The leaves on noninfested branches remain green. Infested oaks have a distinctive pattern of dead and live leaves on them. Branches in the upper crown are dead and leafless; branches in the middle crown are dying and have red-brown wilted leaves; branches in the lower crown are alive and have green leaves. In other words, TLCB-infested oaks have a “dead, red and green” pattern from the top of the tree down its branches.

By the time branch flagging becomes fully evident in August and September, the attack is finished for the year. The dead, brown leaves usually remain attached to the tree, even after normal leaf drop in the fall. When a tree is killed, surrounding oaks are often attacked by TLCB and Armillaria root disease and killed in the following year, which creates a pocket of dead trees.

Management Options

There is a big difference in how a TLCB infestation is handled, depending on whether the trees are in a wood lot or in a back yard. In either case, Minnesota DNR Forest Health Specialists recommend replanting oaks to replace the ones that were lost.

Forested Stands

Oak stands that have been stressed by drought and defoliation are vulnerable to damage and ***mortality*** caused by two-lined chestnut borers and Armillaria root disease. Management options for these stressed stands should be limited to (1) postponement of any activities in the stand, or (2) ***salvage harvest*** of high-value, damaged trees to reduce economic impact. The choice of option to use depends on the potential for continuation of stress due to drought, defoliation, or pest infestation and the ***volume*** and quality of wood in the stand.

Management activities should cease when oaks are under severe stress from drought and/ or defoliation since any stand ***disturbance*** will further open up the stand and cause additional stress on the trees. Management activities could begin during the winter after a growing season with more normal precipitation patterns. However, oaks would be vulnerable to TLCB for a few years after the drought and defoliation ended as the trees slowly regain their vigor.

Salvaging does not control borers in outbreak situations, but it does reduce the economic impact by recovering timber while it still has its greater value. Salvaging is an option if the dead oak and

the oak with at least 50 percent dieback have a great enough volume to make a merchantable sale and the quality is high enough to produce veneer and grade lumber. Salvage the stand during the winter. Trees should be marked for salvaging during the leaf-on period since dead trees and trees with severe dieback will be impossible to identify during the dormant season. When salvaging, do not extend the harvest into areas of the stand untouched or lightly damaged by TLCB.

If the main product is firewood, delay any salvaging for at least a year after the oaks have died. Firewood quality will not deteriorate during this delayed period. This gives the borer larvae time to become adults and leave the tree and dead firewood will not be reinfested. If infested firewood is moved into back yards with oaks, the TLCB population will spread into the backyard oak trees.

Thinning will not control TLCB during an outbreak situation. In fact, thinning should be avoided during a TLCB outbreak, particularly if the outbreak has been triggered by drought. ***Thinning*** will open up the stand to drying winds that will increase the drought stress on the residual oaks. Thinning can also mechanically wound trees and cause serious damage to the tree roots. Even if thinning reduces ***stocking*** to optimum levels, the trees will not benefit from the reduced competition for a number of years until the roots and crowns are able to occupy the spaces created during thinning.

Thinning will also produce additional food supply for the Armillaria root disease organism. Fresh stumps and roots of cut trees will provide an additional food base for this fungal pathogen. It would be best to delay thinning for a few years until the oaks are more vigorous. Even at that time, thinnings should be kept light; do not remove more than 30 percent of the basal area.

Sanitation will not be effective in controlling damage during an outbreak. **A sanitation harvest simply cannot remove enough of the insect population to prevent future damage to the residual oak trees.** During an outbreak, there are vast numbers of low-vigor, vulnerable oaks that will perpetuate the outbreak. The best practice is to postpone all management activities until the conditions that caused stress have ended.

Remember, **stump sprouting will be virtually nonexistent in borer-infested stands.** In effect, the low vigor that created the TLCB problem will also decrease sprouting and enhance vulnerability to Armillaria root disease. To ensure future oak ***regeneration***, count on advanced regeneration or oak planting stock, not stump sprouts.

Armillaria root disease, caused by an opportunistic soil-borne fungus, attacks the root systems of weakened trees and will often lead to tree mortality. If Armillaria root rot is involved in damaging the root system, a white mat of fungal tissue growing between the bark and wood of the roots and root collar can be found. These white mats, however, may not be found until after the tree is completely dead.

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