Appendix A
North Central Landscape Planning Committee

This section provides an overview of the people involved with the North Central Landscape Plan Revision.

A. North Central Landscape Planning Committee Members

The North Central Landscape Plan Revision involved a large number of people representing a wide range of interests. The following list includes committee members arraigned alphabetically by last name. In addition to those on this list, there were many others who supported the effort in various ways.

Committee Member	Organization	Committee Member	Organization
Allen Lysdahl	Hubbard County Land Dept.	Lindsey Ketchel	Leech Lake Area Watershed Foundation
Craig Engwall	Minnesota Deer Hunters Association	Mike North	MN DNR - Wildlife
Dan Steward	Board of Soil and Water Conservation	Nick Jensen	MN DNR - Eco and Water Res.
Darren Mayers	Crow Wing County SWCD	Rachel Peterson	Minnesota Logger Education Program
Dennis Thompson	Aitkin County SWCD	Rich Courtemanche	Aitkin County Land Dept.
DJ Bakken	Beltrami County Land Dept.	Sam Maas	Molpus Woodlands Group
Gene Larimore	Audubon, Jack Pine Coalition	Samantha Jones	Bemidji State Uni. - Geography Dept.
Heather Baird	MN DNR - Fisheries	Sawyer Scherer	UPM Blandin
Jacob Horbacz	Mille Lacs Band of Ojibwe	Steve Bartz	MN DNR - Forestry
Jim Gries	USFS Chippewa National Forest	Tim Terrill	Mississippi Headwaters Board
John Wallin	Minnesota Forestry Association	Tom Strack	Crow Wing County Land Dept.
Keith Karnes	Leech Lake Band of Ojibwe – Forestry	Will Cooksey	The Trust for Public Land
Kyle Gill	U of MN Cloquet Forestry Center		

Additional members serving on the Committee for a portion of the landscape planning process:

- Jack Frie, Crow Wing County Land Department
- Todd Holman, TNC
- Chris Brokl, consulting forester
- Beth Jacqmain, Blandin
- Ben Bagdon, MFI
- Susan Schmidt, TPL

B. Staff Supporting the North Central Landscape Plan Revision

Minnesota Forest Resources Council
- Calder Hibbard, Executive Director
- Lindberg Ekola, Landscape Program Manager
- Clarence Turner, Forest Planner
- Jeff Reinhart, GIS Coordinator,
- Rachael Nicoll, Information Specialist

Dovetail Partners
- Kathryn Fernholz, Executive Director
- Jim Boyer, Director of Responsible Materials

Independent Contractors
- David Henkel-Johnson, Laurentian Resource Conservation and Development
- Mitch Brinks, Crow Wing County Land Services Department

Appendix B
Glossary

Definitions of terms used in this Plan:

Age Class. An interval into which the age range of trees or forest stands is divided for classification or use (e.g., 0-10 years, 10-20 years, etc.). (DNR-SFRMP Definitions)

Age Class Distribution. The proportionate amount of various age classes of a forest or forest cover type within a defined geographic area (e.g., ECS subsection). (DNR-SFRMP Definitions)

Asset. A benefit or strength that enables progress towards Desired Future Conditions.

Average Annual Mortality of Growing Stock. Volume of growing stock trees that were alive at the time of the previous inventory and are dead in the current inventory. Tree death associated with insects, disease, fire, animals, weather, and other factors are included. (FIA Definitions)

Average Annual Net Growth. The average annual change in the volume of trees during the period between inventories. Components include the change in volume of trees that have met the minimum size requirements over the inventory period, plus the volume of trees reaching the minimum size (≥ 5.0 inches dbh) during the period (ingrowth), minus the volume of trees that died during the period, minus the volume of cull during the period. Mortality removals (trees killed in the harvesting process and left on site) and diversion removals (trees removed from the forest-land base due to a change from forest to non-forest land) are not included. (FIA Definitions)

Average Annual Removals of Growing Stock. Trees that were growing-stock trees on timberland at the time of the previous inventory and were removed from timberland by the time of the current inventory. Removals are cut and utilized trees, trees killed as a result of harvest operations but not utilized and live trees associated with land-use reclassifications. (FIA Definitions)

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). (DNR-SFRMP Definitions)

Biological Diversity. The variety and abundance of species, their genetic composition, and the communities and landscapes in which they occur, including the ecological structures, functions, and processes occurring at all of these levels. (Minnesota Statute Chapters 89 and 89A. Sustainable Forest Resources Act).

Coordination Committee. Portion of the North Central Landscape Committee which will be responsible for coordinating the implementation of the North Central Landscape Forest Resources Plan. This group is composed of a diversity of stakeholders representing the range of interests and ownerships in the region (MFRC North Central Planning Committee).

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. (DNR-SFRMP Definitions)

Crosswalk Table. A crosswalk table is a kind of table that allows for references to be built that allows the way data is categorized and stored in one database to be matched up with data in another database.

Desired Non-Native Species. Those species of plants or animals that are not indigenous to an area but wanted for their contribution to high social, economic, or cultural value. (USDA – Forest Service, Superior National Forest Plan)

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. (DNR-SFRMP Definitions)

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). (DNR-SFRMP Definitions)

Forest Health. The perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects and disease, and resilience to disturbance—note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time. ("The Dictionary of Forestry", John A. Helms, editor, Society of American Foresters.).

Forest Land. Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and non-forested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 1 acre and 120 feet wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet wide. Forest land includes three sub-categories: timberland, reserved forest land, and other forest land. (FIA Definitions)

Forest Management. The regeneration, management, utilization, and/or conservation of forests to meet specific goals and objectives ("The Dictionary of Forestry", John A. Helms, editor, Society of American Foresters.).

Forest Resources. Those natural assets of forest lands, including timber and other forest crops; biological diversity; recreation; fish and wildlife habitat; wilderness; rare and distinctive flora and fauna; air; water; soil; climate; and educational, aesthetic, and historic values (Minnesota Statute Chapters 89 and 89A. Sustainable Forest Resources Act).

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. (DNR-SFRMP Definitions)

Forest Spatial Patterns. The size, shape and arrangement of landscape patches. Patches may be any feature that can be mapped such as: Forest types, habitats, and vegetation communities; Landforms, soils, and aquatic systems; or Disturbances – both natural and human caused (MN DNR – Jim Manolis):

Fragmentation. Changes across a landscape that break large continuous areas of a particular land cover (e.g. forest) into smaller isolated patches. (Michael Kilgore, U of MN)

Growing Stock. All live trees of commercial species that meet minimum merchantability standards (at least 5 inches d.b.h.). In general, these trees have at least one solid 8-foot section, are reasonably free from defect on the merchantable bole, and at least 34% or more of the volume is merchantable. Excludes rough or rotten cull trees. (FIA Definitions)

Issue. A problem, challenge, or unresolved conflict that requires resolution to improve progress towards Desired Future Conditions.

Multiple Use. The principle of forest management by which forest resources are utilized in the combinations that will best meet the needs of the people of the state; including the harmonious and coordinated management of the forest resources, each with the other, without impairment of the productivity of the land and with consideration of the relative values of the resources, and not necessarily the combination of uses resulting in the greatest economic return or unit output. (Minnesota Statute Chapters 89 and 89A. Sustainable Forest Resources Act).

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

Other Forest Lands. Lands not capable of producing industrial wood at a sufficient rate. (FIA Definitions)

Natural Area. A physical and biological area in nearly natural condition that exemplifies an ecological community and its associated vegetation and other biotic, soil, geologic and aquatic features. ("The Dictionary of Forestry", John A. Helms, editor, Society of American Foresters.)

Native Species. An indigenous species that is normally found as part of a particular ecosystem. ("The Dictionary of Forestry", John A. Helms, editor, Society of American Foresters.)

Parcelization. An increase in the number of land parcels in a given area (e.g. fragmentation of land ownership). Fragmentation does not necessarily result in parcelization and vice versa. (Michael Kilgore, U of MN)

Planning Committee. Portion of the North Central Landscape Committee which participated in the revision process. This group was composed of a diversity of stakeholders representing the range of interests and ownerships in the region (MFRC North Central Planning Committee).

Prescribed Burning. To deliberately burn wildlands (e.g., forests, prairie or savanna); in either their natural or their modified state) and under specified conditions within a predetermined area to meet management objectives for the site. (DNR-SFRMP Definitions)

Prescription. 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. (DNR-SFRMP Definitions)

Range of Natural Variation Analysis (RNV). The Range of Natural Variation analysis is a method in which current forest age structure and composition are compared with the range of conditions that would exist under natural disturbances regimes. The RNV concept can be used for understanding ecosystems, ecosystem changes, and for assessing the effects of proposed management. (NRRI – study prepared for the MFRC's NE Landscape)

Reforestation. The process of natural or artificial forest regeneration, including securing seed, growing seedlings, preparing sites, planting seed, planting trees, removing deleterious growth and underbrush and other activities related to forest regeneration. (Minnesota Statute Chapters 89 and 89A. Sustainable Forest Resources Act).

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

Regionally and Globally Significant Areas. Definition pending

Reproduction. Young stands of commercial tree species ranging from one foot high to 4.9 inches diameter at 4-1/2 feet above the ground and at least ten percent stocked. (Minnesota Statute Chapters 89 and 89A. Sustainable Forest Resources Act).

Reserved Forest Land. Lands on which timber harvest is prohibited by statute or administrative regulation. (FIA Definitions)

Riparian Areas. The area of land and water forming a transition from aquatic to terrestrial ecosystems along streams, lakes, and open water wetlands. (DNR-SFRMP Definitions)

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. (DNR-SFRMP Definitions)

Sampling Error Percent (FIA). Equals 100 multiplied by the square root of the variance divided by the sample estimate. Since sampling error is given in percent of the estimate, a large sampling error indicates that there is considerable uncertainty associated with the estimate. (FIA Definitions)

Silviculture. The theory and practice of controlling the establishment, composition, growth, and quality of forest stands to achieve certain desired conditions or management objectives. (DNR-SFRMP Definitions)

Spatial Analysis. The mapping and measuring of spatial patterns in a landscape or given area. (MN DNR – Jim Manolis)

Strategy. Strategies are general approaches or methods to accomplish the vegetative management goals which ultimately move the landscape toward achieving the overall vision or desired future conditions. Strategies provide land managers with written descriptions of the general tools and techniques suggested to accomplish the goals and provide a basis for the further development of the appropriate tactical methods.

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 > Land Type Association > Land Type > Land Type 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 (see subsection map and SFRMP schedule). (DNR-SFRMP Definitions)

Section Forest Resource Management Plans (SFRMP). A DNR plan for vegetation management on forest lands administered by DNR Forestry and Wildlife that uses ECS sections as the basic unit of delineation. Initial focus is 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. (DNR-SFRMP Definitions)

Sustainable. Meeting the needs of the present without compromising the ability of future generations to meet their own needs (Minnesota Statute Chapters 89 and 89A. Sustainable Forest Resources Act).

Sustainable Hydrology. Maintaining stable stream bankfull flow rates for 1.5 year average return interval runoff events (Proceedings of the MN Lake Superior Watershed Stream Science Symposium - 2014).

Sustained Yield. The principle of forest management for the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of forest resources without impairment of the productivity of the land; allowing for periods of intensification of management to enhance the current or anticipated output of one or more of the resources. (Minnesota Statute Chapters 89 and 89A. Sustainable Forest Resources Act).

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 (e.g., selective thinning, row thinning, etc.). (DNR-SFRMP Definitions)

Timber. Trees that will produce forest products of value, whether standing or down, and including but not limited to logs, bolts, pulpwood, posts, poles, cordwood, lumber and decorative material. (Minnesota Statute Chapters 89 and 89A. Sustainable Forest Resources Act).

Timberland. Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included, but these likely are a very small number of acres.) (FIA Definitions)

Watershed Health. Conditions which lead to functional and sustainable biology, connectivity, geomorphology, hydrology, and water quality (MN DNR – Ecological and Water Resources Division).

Appendix C
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This section lists documents referenced in the North Central Landscape Plan or otherwise used in its development.

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Appendix D
Native Plant Community Supplement

This section summarizes the ecological classification system used in this plan. For additional information see the Field Guide to Native Plant Communities of Minnesota, MN DNR 2003 or visit www.dnr.state.mn.us/ecs/index.html

A. Native Plant Communities (NPC)

A native plant community is a group of native plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by introduced organisms. These groups of native plant species form recognizable units, such as hardwood forests, pine forests, or marshes, that tend to repeat over space and time. Native plant communities are classified and described by considering 1) vegetation, 2) hydrology, 3) landforms, 4) soils, and 5) natural disturbance regimes. Examples of natural disturbances include: wildfires, severe droughts, windstorms, and floods.

Sometimes referred to as native habitats or natural communities, native plant communities are named for the characteristic plant species within them or for characteristic environmental features. Examples of native plant communities in the North Central Landscape include Central Rich Dry Pine Woodland, Northern Dry-Mesic Mixed Woodland, Northern Mesic Hardwood Forest, and Northern Wet Ash Swamp. There are many kinds of vegetated areas that are not native plant communities. These include places where native species have largely been replaced by exotic or invasive species such as smooth brome grass, buckthorn, and purple loosestrife, and planted areas such as orchards, pine plantations, golf courses, and lawns. Other areas not considered to be native plant communities include areas where modern human activities such as farming, overgrazing, non-sustainable logging, and development have greatly altered the vegetation.

More information on NPC Classes can be found in the 'Field Guide to the Native Plant Communities of Minnesota' or at www.dnr.state.mn.us/npc/classification.html

Native Plant Community Classification

In 2003, researchers in the Minnesota Department of Natural Resources (DNR) completed a classification of the native vegetation of Minnesota, Minnesota's Native Plant Community Classification (Version 2.0). The DNR's classification system is intended to provide a framework and common language for improving our ability to manage vegetation, to survey natural areas for biodiversity conservation, to identify research needs, and to promote study and appreciation of native vegetation in Minnesota. Version 2.0 of the DNR's native plant community classification is based strongly on plant species composition and was developed through analysis of extensive field data collected from sample plots in forests, prairies, wetlands, and other habitats. The classification is hierarchical, with vegetation units described at levels

ranging from broad landscape-level ecological systems to local communities. One of the most important features of the new classification is the inclusion of ecological processes as an organizing principle.

The NPC classification has six levels (Table D-1). **System Groups**, the highest level, were created to allow development of manageable field keys for lower levels of the classification. System Groups were formed by combining lower levels of the classification along major physiognomic and hydrologic splits in vegetation. **Ecological Systems** are groups of native plant communities that are unified by strong influence from a major ecological process or set of processes, especially nutrient cycling and natural disturbances. **Floristic Regions** are divisions within Ecological Systems that reflect the distribution of Minnesota's plant species into characteristically northern, northwestern, central, and southern groups, or floras. The important influences on these species distributions appear to be climate and paleohistory. **Native Plant Community Classes** are units of vegetation that generally have uniform soil texture, soil moisture, soil nutrients, topography, and disturbance regimes. For wooded vegetation, Native Plant Community Classes were developed by emphasizing understory vegetation more than canopy trees, under the hypothesis that in much of Minnesota understory plants are often more strongly tied to specific habitat conditions (such as levels of nutrients and moisture) than are canopy trees. **Native Plant Community Types** are defined by dominant canopy trees, variation in substrate, or fine-scale differences in environmental factors such as moisture or nutrients. Type distinctions were also made to describe geographic patterns within a Class. **Native Plant Community Subtypes** are based on finer distinctions in canopy composition, substrates, or other environmental factors. In some instances, Subtypes represent apparent trends within a Type for which more study and collection of data are needed. In other instances Subtypes are well-documented, fine-scale units of vegetation that are useful for work such as rare plant habitat surveys.

Table D-1. Native Plant Community (NPC) Classification Hierarchy.

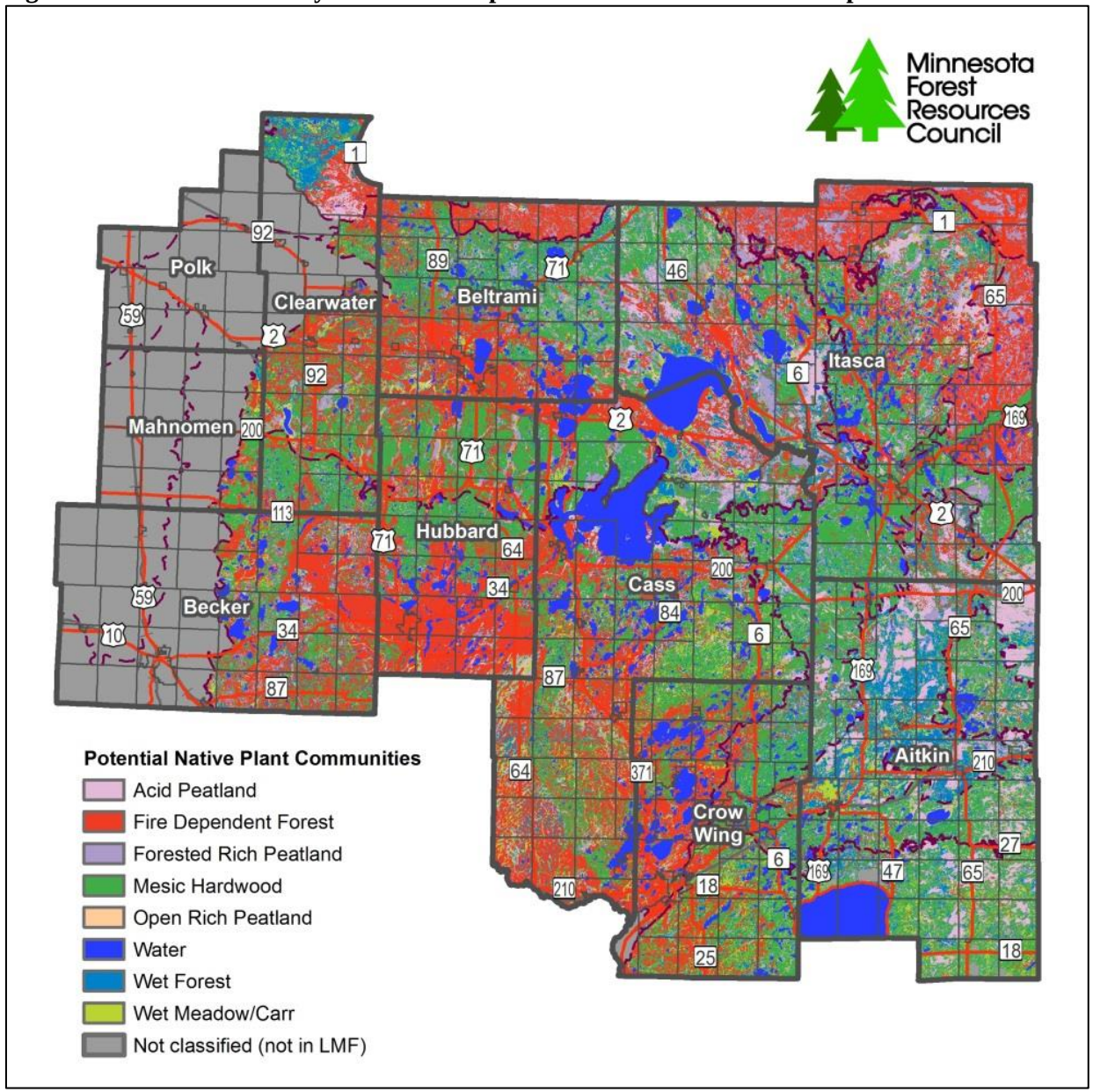
Classification Level	Dominant Factors	Example
System Group	Vegetation structure & geology	Upland Forest & Woodland Systems
Ecological System	Ecological processes	Fire-Dependent Forest/Woodland
Floristic Region	Climate & paleohistory	Central
NPC Class	Local environmental conditions	Central Dry Pine Woodland
NPC Type	Canopy dominants, substrate, or finer environmental conditions	Jack Pine-(Yarrow) Woodland
NPC Subtype	Finer distinctions in canopy dominants, substrate, or environmental conditions	Ericaceous Shrub

Source: Field Guide to the Native Plant Communities of Minnesota www.dnr.state.mn.us/npc/classification.html

B. Potential NPC Systems in the North Central Landscape Map

The North Central Landscape covers over 7.7 million acres. Within this region there are five forested NPC systems; three of which are generally represented in lowland areas and two systems that are in upland areas. The Natural Resources Research Institute integrated soil series, plant releveé, geomorphic, topographic, and other relevant geospatial data layers to create rough estimates of the extent and distribution of Native Plant Communities at the system and class level in the region.

Figure D-1. Potential NPC System Level Map for the North Central Landscape.



Source: Natural Resources Research Institute and MN Geospatial Commons.

C. Land Management Characteristics

In many cases land ownership and management or administration are the same; however there are several situations where this distinction can make a dramatic difference in understanding trends on the landscape. Therefore the tables below display NPC Systems and Classes by land management organizations. Private landowners the largest block of forests classified as mesic hardwood and the federal government is the largest owner of lands classified as fire dependent as well as the forested peatlands systems.

Table D-2. Potential NPC System Area Estimates by Land Management Category in the North Central Landscape.

Code	NPC Systems	Federal	State	County	Tribal	Industrial	Private	Other	Total	% of NC Landscape
Upland Systems										
FD	Fire Dependent	228,927	200,888	314,906	48,252	148,674	1,265,061	7,426	2,214,134	24.4%
MH	Mesic Hardwoods	284,031	300,664	506,797	23,507	124,383	1,026,853	4,504	2,270,738	25.0%
	Subtotal	**512,958**	**501,552**	**821,703**	**71,758**	**273,057**	**2,291,915**	**11,931**	**4,484,874**	**49.4%**
Lowland Systems										
AP	Acid Peatland	50,617	195,884	113,273	10,828	17,374	108,458	530	496,962	5.5%
FP	Forested Peatland	79,367	205,890	135,603	3,865	37,461	193,777	858	656,821	7.2%
OP	Open Rich Peatland	4,558	7,889	4,350	331	525	9,753	29	27,435	0.3%
WF	Wet Forest	63,452	156,513	107,890	46,256	22,981	324,241	747	722,079	8.0%
WM	Wet Meadow	52,021	113,167	106,066	16,549	14,685	257,384	1,022	560,895	6.2%
Wa	Water	44,682	32,900	23,987	4,017	5,955	694,531	352	806,424	8.9%
	Subtotal	**294,699**	**712,242**	**491,170**	**81,846**	**98,980**	**1,588,143**	**3,538**	**3,270,617**	**36.1%**
	Total	**807,656**	**1,213,794**	**1,312,872**	**153,604**	**372,038**	**3,880,057**	**15,469**	**7,755,491**	**85.5%**

Source: Natural Resources Research Institute.
Note: More information on NPC Classes can be found in the 'Field Guide to the Native Plant Communities of Minnesota' or at: www.dnr.state.mn.us/npc/classification.html

Table D-3. Potential NPC Class Area Estimates by Land Management Category in the North Central Landscape.

Code	NPC Class	Federal	State	County	Tribal	Industrial	Private	Other	Total
FD	Fire Dependent	0	2	0	0	0	19	0	20
FDc23	Central Dry Pine Woodland	8,268	8,117	18,706	547	10,909	171,013	1,148	218,708
FDc24	Central Rich Dry Pine Woodland	32,698	29,430	45,717	7,432	31,083	382,405	2,699	531,465
FDc34	Central Dry-Mesic Pine-Hardwood Forest	43,039	58,588	92,659	1,990	23,455	350,590	1,310	571,630
FDn12	Northern Dry-Sand Pine Woodland	1,295	1,765	6,369	121	1,443	8,407	30	19,431
FDn33	Northern Dry-Mesic Mixed Woodland	123,610	56,455	68,963	5,059	20,951	219,690	1,531	496,260
FDn43	Northern Mesic Mixed Forest	20,017	46,531	82,492	33,103	60,833	132,937	708	376,620
MH	Mesic Hardwoods	5,553	6,875	10,850	5,618	2,803	20,462	219	52,379
MHc26	Central Dry-Mesic Oak-Aspen Forest	21,140	71,998	158,513	2,756	8,278	216,450	1,221	480,356
MHc36	Central Mesic Hardwood Forest (Eastern)	51	3,369	3,988	0	759	59,808	273	68,248
MHc47	Central Wet-Mesic Hardwood Forest	332	581	1,326	9	20	3,913	2	6,184
MHn35	Northern Mesic Hardwood Forest	165,853	135,833	212,756	2,597	53,805	405,042	1,200	977,086
MHn44	Northern Wet-Mesic Boreal Hardwood-Conifer Forest	63,917	68,407	94,362	4,466	45,320	246,926	1,060	524,458
MHn45	Northern Mesic Hardwood (Cedar) Forest	0	494	1,197	0	5,159	2,018	0	8,869
MHn46	Northern Wet-Mesic Hardwood Forest	21,697	11,329	20,214	8,023	4,676	61,331	350	127,620
MHn47	Northern Rich Mesic Hardwood Forest	5,488	1,778	3,591	38	3,563	10,903	179	25,538
	Upland Subtotal	**512,958**	**501,552**	**821,703**	**71,758**	**273,057**	**2,291,915**	**11,931**	**4,484,874**
AP	Acid Peatland	44,990	195,677	112,654	1,083	17,367	106,730	530	479,030
APn80	Northern Spruce Bog	5,627	207	619	9,745	7	1,728	0	17,932
FP	Forested Peatland	72,601	179,085	121,643	2,539	32,725	174,307	836	583,736
FPn63	Northern Cedar Swamp	6,766	25,256	12,323	1,326	4,396	17,490	22	67,579
FPn71	Northern Rich Spruce Swamp (Water Track)	0	1,471	1,630	0	340	1,980	0	5,421
FPn81	Northern Rich Tamarack Swamp (Water Track)	0	78	7	0	0	0	0	85
OP	Open Rich Peatland	4,558	7,889	4,350	331	525	9,753	29	27,435
WF	Wet Forest	61,131	155,412	107,541	3,292	22,873	321,704	747	672,699
WFn55	Northern Wet Ash Swamp	1,795	0	0	42,897	0	1,923	0	46,615
WFn64	Northern Very Wet Ash Swamp	526	1,101	349	67	108	614	0	2,765
WM	Wet Meadow	52,021	113,167	106,066	16,549	14,685	257,384	1,022	560,895
Water	Water	44,682	32,900	23,987	4,017	5,955	694,531	352	806,424
	Lowland Subtotal	**294,699**	**712,242**	**491,170**	**81,846**	**98,980**	**1,588,143**	**3,538**	**3,270,617**
	Total	**807,656**	**1,213,794**	**1,312,872**	**153,604**	**372,038**	**3,880,057**	**15,469**	**7,755,491**

Source: Natural Resources Research Institute.

Note: More information on NPC Classes can be found in the *'Field Guide to the Native Plant Communities of Minnesota'* or at: www.dnr.state.mn.us/npc/classification.html

D. Interpreting NPC System Descriptions and the Tree Suitability Table

Sections D through I provide summaries of the five NPC systems in the North Central Landscape. A general overview is provided first along with a listing of the NPC classes and then followed by a silvicultural description. A map of the potential NPC systems is provided on page D-3.

For more information on NPC classes and the NPC classification methodologies, please refer to "Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province" at www.dnr.state.mn.us/npc/classification.html

Each native plant community summary includes a portion of the Minnesota DNR Tree Suitability Table (http://files.dnr.state.mn.us/forestry/ecssilviculture/treetables.pdf). These tables were developed by the Minnesota Department of Natural Resources, Division of Forestry, Ecological Land Classification Program. Please use the following information to interpret these tables:

- Row shading: ability of tree species to compete with all vascular plants within NPC class (**GREEN** =excellent, **BLUE** =good, **YELLOW** =fair, **T-N**= poor, **WHITE**=not suitable)
- Column numbers: rank of tree species in order of competitive ability within each NPC class; 1=most suited; -- indicates trace presence
- Row shading and column numbers are based upon the importance value (IV) of a tree in each NPC Class, which is the product of percent presence and percent cover when present (IV=% presence x mean % cover when present). Row shading (not suited to excellent) is based upon the rank order of a tree's IV compared to the full range of IVs expressed by all plants - a rough estimate of absolute suitability. Column numbers (1,2,3, ...) are the rank order of a tree's IV compared to other trees - a rough estimate of relative suitability.
- Letters:
  w = tree species with a warmer synecological score than the community mean.
  d = tree species with a drier synecological score than the community mean.

E. Climate Change Considerations

To meet the challenges brought about by climate change, a team of federal and state land management agencies, private forest owners, conservation organizations, and others were convened by researchers with the USDA Forest Service Northern Institute of Applied Climate Science to develop the Northwood's Climate Change Response Framework (CCRF). The project's overall goals are to help land managers:

- Adapt ecosystems to changing climate,
- Mitigate carbon emissions,
- Respond to climate change impacts across ownership boundaries, and
- Rapidly incorporate science and monitoring information into management activities.

This effort has led to the development of two documents which were integrated into the North Central Landscape Plan Revision.

- Forest Ecosystem Vulnerability Assessment and Synthesis (FEVAS)

– Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers (FAR)

Information from these documents provides baseline information on the potential impacts of climate change and strategies land managers can take to account for these potential changes. The North Central Landscape Committee utilized this information to guide their goal and objective development process and excerpts of the CCRF work for each forested NPC System are summarized in the tables below and in the following NPC System summaries. Please refer to www.nrs.fs.fed.us/niacs/ for more information.

CCRF Vulnerability Determinations for Individual Forest Systems

Climate-induced shifts in drivers, stressors, and dominant tree species will result in different impacts to forested systems within the assessment area. Some communities may have a greater capacity to adapt to these changes than others, whereas some may be susceptible to relatively minor impacts. Therefore, it is helpful to consider these factors for individual forest systems in addition to describing general principles related to vulnerability and adaptive capacity. The table below presents a summary of major drivers and stressors for each forest community covered in the CCRF assessment.

Table D-4. Forest Systems Considered in the CCRF Assessment, with a Summary of Current Major Drivers and Stressors for Each System.

Community Type	Major Drivers	Major Stressors
Fire-Dependent Forest	coarse-textured soils or shallow soils over bedrock, fire return intervals 20 to 150 yrs.	fire suppression, insect pests and diseases, understory hazel competition, deer herbivory
Mesic Hardwood Forest	mesic soils or deep impermeable layers, consistent moisture and nutrients, gap-phase disturbances with stand-replacing events every 400 to 2000 yrs.	exotic earthworms, invasive plants, insect pests, diseases, freeze-thaw cycles, drought, deer herbivory
Floodplain Forest	alluvial soils, annual or occasional floods, connectivity to river and water table	changes to flood regime, buckthorn and reed canarygrass, drought, deer herbivory
Wet Forest	wet-mesic soils, saturated in spring and dry in summer, periodic flooding	changes to soil moisture regime, ongoing ash decline, invasive species, insect pests, drought
Forested Rich Peatland	peat soils, saturated throughout growing season, moisture through precipitation and groundwater, pH greater than 5.5	changes to water table, roads and beaver dams, insect pests and diseases, winterburn, drought, deer herbivory
Acid Peatland	peat soils, saturated throughout growing season, moisture through only precipitation, pH less than 5.5, nutrient-poor environments	changes to water table, roads and beaver dams, insect pests and diseases, winterburn, drought
Managed Aspen	gradient of soil types and landforms, frequent disturbance, even-aged management on 35 to 60 yr. rotation	forest tent caterpillar and gypsy moth, drought, deer herbivory, hypoxylon canker, exotic earthworms

Managed Red Pine	sandy to mesic soils, limited by high summer temperatures, dependent on planting for regeneration, even-aged management on 60 to 120 yr. rotation	armillaria, red pine shoot blight, understory hazel competition, deer herbivory, bark beetles, drought stress in dense stands

The following vulnerability determinations draw on information presented other chapters of the FEVAS document, as well as an expert panel assembled from a variety of organizations and disciplines across the assessment area. The 23 panelists evaluated anticipated climate trends for the assessment area and ecosystem model projections (See Chapter 5 of FEVAS), in combination with their own expertise. For each forest system, panelists considered the potential impacts and adaptive capacity to assign a vulnerability determination and a level of confidence in that determination using the same confidence scale described above. For a complete description of the methods used to determine vulnerability, see FEVAS Appendix 5.

Overall vulnerability determinations ranged from low-moderate (Floodplain Forests) to high (Wet Forests, Forested Rich Peatlands, and Acid Peatlands). Panelists tended to rate the amount of evidence as medium (between limited and robust) for most forest systems. Incomplete knowledge of future wildfire regimes, interactions among stressors, and precipitation regimes were common factors limiting this component of overall confidence. The ratings of agreement among information also tended to be in the medium range. Contrasting information related to precipitation regimes under the high and low climate change scenarios was one factor that limited the level of agreement among information. In general, ratings were slightly higher for agreement than for evidence. This suggests that although evidence is not as robust as the experts would prefer, the information that is available leads them to reach a similar conclusion.

Table D-5. Vulnerability Determination Summaries for the Forest Systems Considered in This Assessment.

Forest System	Potential Impacts	Adaptive Capacity	Vulnerability	Evidence	Agreement
Fire-Dependent Forest	Negative	Moderate-High	Moderate	Medium	Medium
Mesic Hardwood Forest	Moderate	Moderate-High	Moderate	Medium	Medium
Floodplain Forest	Moderate-Positive	Moderate	Low-Moderate	Limited-Medium	Medium
Wet Forest	Negative	Low	High	Limited-Medium	Medium
Forested Rich Peatland	Negative	Low	High	Medium	Medium-High
Acid Peatland	Negative	Low	High	Medium	Medium-High
Managed Aspen	Moderate-Negative	Moderate	Moderate-High	Medium	High
Managed Red Pine	Moderate-Negative	Moderate-Low	Moderate-High	Medium	Medium

F. Fire-Dependent Forest/Woodland System (FD)

General Description

Fire-Dependent Forest/Woodland (FD) communities are common across the Laurentian Mixed Forest (LMF) Province, even after nearly 100 years of wildfire suppression. As the name implies, Fire-Dependent Forest/Woodland communities are strongly influenced by wildfires. Fires are the major source of species mortality and exert strong influence on patterns of plant reproduction by exposing mineral soil seedbeds, triggering dispersal of propagules, and increasing the amount of light reaching the ground or understory. Fires periodically remove much of the litter, duff, and other organic material from the community and can have a significant effect on nutrient cycling and nutrient availability. In the LMF Province, FD communities are characterized by prevalence of evergreen species, most visibly pines and other conifers. These species, like most of the species are adapted to survive repeated fires or to regenerate successfully following fire.

FD communities occur in the LMF Province on sites with coarse sandy or gravelly soils or with thin soils over bedrock. These sites are often drought prone, a condition that is enhanced by fire through the removal of organic material, such as litter and humus that retains soil moisture. Fires also can contribute to low nutrient availability in FD communities by releasing nutrients from plant material and making them susceptible to being leached below the plant rooting zone or carried away by runoff. In comparison with other communities, such as Mesic Hardwood Forests, in which nutrient availability changes predictably over each year and remains relatively stable from year-to-year, the random behavior of wildfires causes nutrient availability in FD communities to be episodic and unpredictable.

North Central Landscape Area

- 2,217,379 acres
- 24.4% of the North Central Landscape
- 28.5% of the Laurentian Mixed Forest in North Central Landscape
- 49.4% of the upland area in the Laurentian Mixed Forest in North Central Landscape

Disturbance Regime History

- High to very high rates of fire disturbances historically with return interval from 40 years to 100 years.
- The frequency and intensity of fires in fire dependent communities show a strong geographic pattern correlating to the local climate.

Silvicultural Description

Jack pine, red pine, and white pine are the dominant species in these areas. These species are often successful due to their ability to adapt their physical conditions to these sites. Quaking aspen was also native to some of these sites but occurred naturally at lower abundance. In some areas catastrophic fires killed most canopy trees and created young forests with clear dates of origin. Other sites were abundant with young seedlings recovering from stand-regenerating fire. Often crown fires and severe surface fires left a rather clean, mineral-soil slate for tree establishment.

Silvicultural systems such as clear-cutting or clear-cutting with reserves best matches our impression of natural fires and skips. Quaking aspen, big-toothed aspen, and jack pine are the species with open regeneration strategies able to succeed following clear-cutting and variable seedbeds ranging from mineral (jack pine, big-toothed aspen) to rather undisturbed duff (quaking aspen).

Although fires were historically present in these areas, these silvicultural practices are often our only choice in mimicking this natural disturbance on a large-scale. When possible, however, controlled burns are a preferred option. While clear-cutting and clear-cutting with reserves mimics the light distribution in an area fairly well, components left by fires such as burned snags, tree scars and accelerated nutrient cycling are missing.

Detailed silvicultural prescriptions for Northern Dry-Sand Pine Woodland (FDn12), Northern Poor Dry-mesic Mixed Woodland (FDn32), Northern Dry-Mesic Mixed Woodland (FDn33), Northern Mesic Mixed Forest (FDn43), Central Rich Dry Pine Woodland (FDc24), and Central Dry-Mesic Pine-Hardwood Forest (FDc34) are available on the MN DNR website. Please refer to:
http://www.dnr.state.mn.us/forestry/ecs_silv/interpretations.html

Table D-6. Suitability of Tree Species by Native Plant Community; Fire-Dependent.

NPC Class	FDn12	FDn22	FDn32	FDn33	FDn43	FDc12	FDc23	FDc24	FDc25	FDc34
	Northern Dry-Sand Pine Woodland	Northern Dry-Bedrock Pine (Oak) Woodland	Northern Poor Dry-mesic Mixed Woodland	Northern Dry-Mesic Mixed Woodland	Northern Mesic Mixed Forest	Central Poor Dry Pine Woodland	Central Dry Pine Woodland	Central Rich Dry Pine Woodland	Central Dry Oak-Aspen (Pine) Woodland	Central Dry-Mesic Pine-Hardwood Forest
Area Estimate (acres)*	19,431	--	--	496,513	378,704	--	218,697	532,404	--	571,610
Red pine	**2d**	**1d**	**3d**	**1d**	**4d**	**2d**	**6d**	**3d**	**6d**	**1d**
Jack pine	**1**	**2**	**1d**	**5d**	**10d**	**1**	**1**	**1d**	**2**	**9d**
Quaking aspen	**3w**	**-**	**4wd**	**4d**	**3wd**		**4**	**2d**	**3**	**3d**
White pine	**-**	**3**	**5wd**	**3d**	**2wd**					**2d**
Paper birch	**-**	**4**	**6wd**	**2d**	**1wd**		**5**	**5d**	**4**	**5d**
Northern red oak		**7w**		**11wd**			**2w**	**6wd**	**8w**	**4wd**
Red maple		**6w**	**-**	**8wd**	**8wd**				**9w**	**6wd**
Big-toothed aspen		**5wd**		**7wd**			**7wd**		**5wd**	**8wd**
Balsam fir	**5**		**7**	**6**	**6**					
Bur oak							**3w**	**4wd**	**7w**	**7wd**
Black spruce	**-**		**2**	**9**	**9**					
White spruce	**4**		**-**	**10**	**7**					
Northern pin oak									**1wd**	
White cedar					**5**					

Table D-6. Continued.

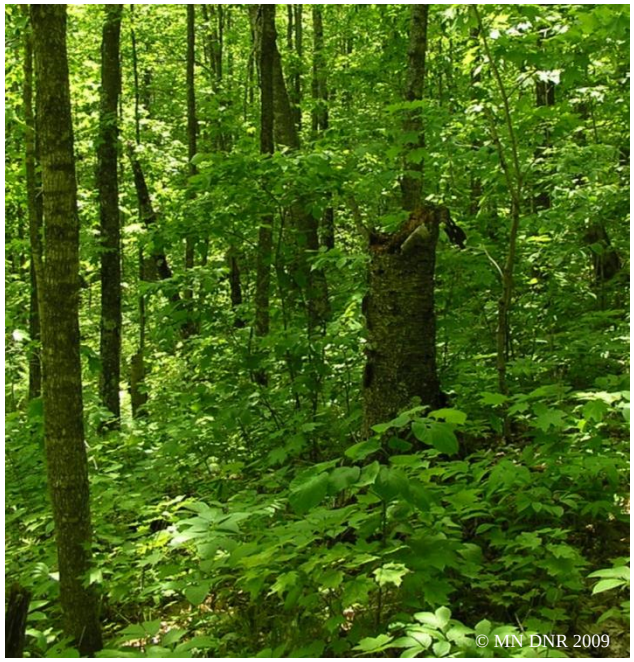
NPC Class	FDn12	FDn22	FDn32	FDn33	FDn43	FDc12	FDc23	FDc24	FDc25	FDc34
	Northern Dry-Sand Pine Woodland	Northern Dry-Bedrock Pine (Oak) Woodland	Northern Poor Dry-mesic Mixed Woodland	Northern Dry-Mesic Mixed Woodland	Northern Mesic Mixed Forest	Central Poor Dry Pine Woodland	Central Dry Pine Woodland	Central Rich Dry Pine Woodland	Central Dry Oak-Aspen (Pine) Woodland	Central Dry-Mesic Pine-Hardwood Forest
Basswood										10wd

Source: Minnesota Department of Natural Resources, Division of Forestry, Ecological Land Classification Program; Version 2.2, 2013.
Table interpretation information is available above on page D-6.
* Estimate from George Host, Natural Resources Research Institute.

Climate Change Projections

- Moderate Vulnerability. (medium evidence, medium agreement) Changes to the fire regime for northern Minnesota are particularly threatening for this system, in addition to the loss of suitable habitat for many key species and the potential for greater pest and disease activity. A high tolerance for disturbance increases the adaptive capacity of this system.
- Moderate-High Adaptive Capacity. Fire-Dependent Forests are generally tolerant of drought and disturbances and can contain a diversity of species, which lends these forests greater adaptive capacity to climate change. Additionally, these forests can persist on poor soils, so the possibility exists that Fire-Dependent Forests could "retreat" to favorable locations on the landscape even if overall conditions change. Southern portions of the assessment area may be more prone to shift to Mesic Hardwoods because fragmentation and broadleaf species will likely limit fire activity.
- Potential Impacts
    - Drivers. Fire-Dependent Forests are generally found on coarse-textured or shallow soils, and may be able to tolerate the projected shift toward drier soils during the summer months. Evidence indicates that wildfires may burn larger areas in northern Minnesota under climate change, and that the fire season may shift later into the growing season. Blowdown-causing wind events could also provide more fuel buildup for large fire events. Greater wildfire activity could be a positive impact for these forest types, but it is possible that too much change to the fire regime would hamper regeneration.
    - Stressors. Climate change is expected to intensify several key stressors for Fire-Dependent Forests. Insect pests and diseases may become more virulent and damaging under a warmer climate, and the possibility exists for new pests such as western bark beetles to arrive in the assessment area. The continued shift toward mesic species within Fire Dependent Forests may be encouraged by climate change if fire suppression activities continue and broadleaf species like red maple continue to spread. White-tailed deer populations are also anticipated to increase with warmer winters, so herbivory on preferred species may continue to hinder regeneration.
    - Dominant Species. Considering the range of possible climate futures, the majority of dominant species that make up Fire-Dependent Forests are expected to decline in suitable habitat and across the assessment area according to model projections (jack pine, quaking aspen, paper birch, balsam fir, and black spruce). The same modeling studies suggest red pine and white pine will remain relatively constant or experience slight increases across the assessment area, and that minor components of Fire Dependent Forests like northern red oak, bur oak, and red maple will also increase across the assessment area.

G. Mesic Hardwood Forest System (MH)



General Description

Mesic Hardwood Forest (MH) communities are present in the Laurentian Mixed Forest (LMF) Province on upland sites with moist soils, usually in settings protected from fire. They are characterized by continuous, often dense, canopies of deciduous trees, including sugar maple, basswood, paper birch, and northern red oak, and understories with shade-adapted shrubs and herbs.

Plants in MH communities have access to predictable supplies of water and nutrients, but they are often limited by light because of the dense forest canopy. Typical sites are buffered from seasonal drought by fine-textured, moisture-retaining soils or dense subsoil layers that perch snowmelt and rainfall. At the same time, soils are well drained and do not experience water logging or saturation except after spring snowmelt or heavy rains. Consequently, plants in MH communities rarely experience diminished respiration due to soil anoxia. Essential nutrients, especially nitrogen, are mineralized from decaying organic matter at twice the rate of that in either Fire-Dependent Forest/Woodland (FD) or Wet Forest (WF) communities. As a result, nutrients in dead plant material quickly become available again for uptake by plants.

Nutrient availability in MH communities follows an annual or seasonal pattern that is more predictable than in FD forests, where nutrients are released mainly following episodic fires. Tree mortality in MH communities is also rather constant, with stand-regenerating disturbances such as wildfires and windthrow uncommon. The death of established trees most often involves individual canopy trees or small patches that are affected by minor windthrow, disease, or other fine-scale disturbances.

North Central Landscape Area

- 2,271,643 acres
- 25.0% of the North Central Landscape
- 29.3% of the Laurentian Mixed Forest in North Central Landscape
- 50.6% of the upland area in the Laurentian Mixed Forest in North Central Landscape

Disturbance Regime History

- Low to very low rates of stand-replacing fire or wind disturbances historically with return intervals in excess of 400 years and often greater than 1,000 years.
- Moderate disturbances from light fires and patchy windthrow were frequent to occasional with return intervals ranging from 40 to 300 years.
- Many NPCs in this system, especially MHn45-47 have a very fine-grained disturbance pattern with few large patches of regenerating forest with small disturbance patches being the norm.

Silvicultural Description

Quaking aspen, paper birch, balsam fir, and white spruce were the dominant native trees that occupied this area historically. White pine, red maple, black ash, balsam poplar, white cedar, bur oak, and red oak are likewise native to some sites but occurred naturally at lower abundance. The consequence of fire suppression, commercial logging, and settlement in the past century has been to promote more balsam fir than usual at the expense of white spruce. Otherwise, most stands are similar to their historic counterparts, and management interpretations are not complicated by the ingress of atypical species.

Historically, senescence of the initial-cohort trees created regeneration opportunities for trees, ranging from single-tree gaps to large gaps up to an acre in size. Several silvicultural systems could be used to approximate the natural loss of initial-cohort trees and regeneration typical of transitioning forests. Selective harvesting matches best the small-gap mortality pattern, and would favor white spruce and balsam fir. Shelterwood variants or group selection would create the large-to-small openings that favor recruitment of white spruce, balsam fir, red maple, and black ash. Paper birch, red oak, bur oak, white cedar, white pine, and basswood should all do well in the larger gaps created by patch cutting or variants of seed-tree harvests.

Given that only minimal stands in the area were described as having been burned or windthrown, it is clear that destructive agents other than these obvious catastrophes were involved to create so much young, small diameter forests. We suspect chronic disease and possibly surface fire. What seems clear from the historic records is that young, re-initiated stands were patchy and offered a mixture of situations where seeding, sprouting, and release of advance regeneration worked together to initiate the next forest. It is highly unlikely that re-initiated forests resembled something as uniform as a clear-cut. Clear-cutting with reserves, patch cutting, and variants of seed-tree cutting could all approximate the natural pattern of disturbances that created young forests. Clear-cutting with reserves would favor quaking aspen and balsam poplar, which are primarily open regeneration strategists on sites. Patch cutting or variants of seed-tree harvests are silvicultural strategies that should work to re-initiate stands and favor trees that do well in the open or in large gaps such as paper birch, white cedar, and white pine.

Detailed silvicultural prescriptions for Northern Mesic Hardwood Forest (MHn35), Northern Wet-Mesic Boreal Hardwood-Conifer Forest (MHn44), Northern Mesic Hardwood (Cedar) Forest (MHn45), and Northern Rich Mesic Hardwood Forest (MHn47), Central Dry-Mesic Oak-Aspen Forest (MHc26), and Central Mesic Hardwood Forest (Eastern) (MHc36) are available on the MN DNR website. Please refer to: http://www.dnr.state.mn.us/forestry/ecs_silv/interpretations.html

Table D-7. Suitability of Tree Species by Native Plant Community; Mesic Hardwood.

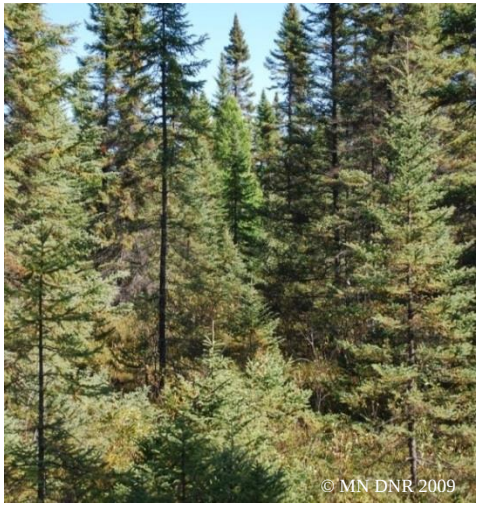
NPC Class	MHn35	MHn44	MHn45	MHn46	MHn47	MHc26	MHc36	MHc37	MHc47
	Northern Mesic Hardwood Forest	Northern Wet-Mesic Boreal Hardwood-Conifer Forest	Northern Mesic Hardwood (Cedar) Forest	Northern Wet-Mesic Hardwood Forest	Northern Rich Mesic Hardwood Forest	Central Dry-Mesic Oak-Aspen Forest	Central Mesic Hardwood Forest (Eastern)	Central Mesic Hardwood Forest (Western)	Central Wet-Mesic Hardwood Forest
Area Estimate (acres)*	977,138	524,785	8,872	127,619	25,540	480,353	68,251	--	6,183
Basswood	**2wd**	**5wd**	**5wd**	**2wd**	**2wd**	**5wd**	**3wd**	**2wd**	**1wd**
Sugar maple	**1wd**	**13wd**	**1wd**	**6wd**	**1wd**	**6wd**	**1wd**	**1wd**	**4wd**
Paper birch	**4d**	**4d**	**3d**	**7d**	**4d**	**3d**	**8d**	**5d**	**9d**
Quaking aspen	**5d**	**1d**	**9d**	**3d**	**11d**	**2d**	**5d**	**3d**	**8d**
Northern red oak	**3wd**	**11wd**		**9wd**	**5wd**	**1wd**	**2wd**	**4wd**	**5wd**
Red maple	**6wd**	**3wd**	**8wd**	**5wd**	**9d**	**4d**	**7d**		**6d**
Bur oak	**10wd**	**12wd**		**4wd**		**7wd**	**4wd**	**6wd**	**3wd**
Black ash		**9w**	**-**	**1w**	**6**		**13**		**2**
Yellow birch	**11w**		**2w**	**13w**	**3**				
Green ash		**14w**		**8w**	**10w**	**12w**	**6w**	**9w**	**7w**
Big-toothed aspen	**7wd**			**15wd**		**8d**	**9d**		
White cedar		**7**	**4**	**11**	**8**				
Balsam fir	**12**	**2**	**7**	**12**	**-**				
White spruce	**-**	**6**	**6**	**14**					
Ironwood	**8wd**				**7wd**	**13wd**	**14wd**	**7wd**	
White pine	**9d**	**8d**	**10d**			**9d**			
Balsam poplar		**10**		**10**					
American elm		**-**		**16w**			**-**	**8w**	**10w**
Red pine		**15d**				**10d**			
White oak						**11wd**	**11wd**		
Bitternut hickory							**10w**		
Butternut							**-**		**11w**
White ash							**12wd**		

Source: Minnesota Department of Natural Resources, Division of Forestry, Ecological Land Classification Program; Version 2.2, 2013.
Table interpretation information is available above on page D-6.
* Estimate from George Host, Natural Resources Research Institute.

Climate Change Projections

- Moderate Vulnerability. (medium evidence, medium agreement) Climate change may intensify several major stressors for this forest system, such as drought and forest pests. High species diversity may increase resilience to future change, and uncertainty regarding future moisture regimes and potential interactions between stressors limit the confidence in this determination.
- Moderate-High Adaptive Capacity. Mesic Hardwood Forests generally contain a large number of species, which leads to a high response diversity. These forests could also gain territory lost by other forest types under wetter or drier future conditions. This system contains several species at their northern range limits, such as sugar maple and northern red oak, which may benefit from gene flow between southern populations. Increased CO_2 concentrations may also increase the water-use efficiency of some species, reducing the risk of moisture stress. Stands with few species and reduced structural diversity may have lower adaptive capacity.
- Potential Impacts
    - Drivers. Mesic Hardwood Forests depend on relatively moist, nutrient-rich soils and a lack of wildfire disturbance. The potential for climate change to increase the frequency of extended droughts poses a threat to these forests for multiple reasons, including increased moisture stress, wildfire occurrence, and susceptibility to other stress agents. Hardwood forests occurring on moist, rich soils may be buffered from short-term droughts or seasonal moisture stress. Warming temperatures may also allow this system to expand into previously unsuitable areas.
    - Stressors. Climate change could amplify several major stressors to Mesic Hardwood Forests. Forest tent caterpillar and other pests may cause more frequent and severe damage in climate-stressed forests, and new pests such as gypsy moth and Asian longhorn beetle present unknown risks. White-tailed deer populations may also increase with warmer winters, which may hinder hardwood regeneration as well as the northward expansion of this system. The potential also exists for synergistic negative interactions between current stressors in this system, such as earthworms, herbivory, drought, and invasive species.
    - Dominant Species. Model projections indicate that the majority of dominant species that make up Mesic Hardwood Forests are expected to gain in suitable habitat and biomass across the assessment area (American basswood, sugar maple, red maple, green ash, bur oak). Deciduous forest types are also projected to have large potential productivity increases. Paper birch and quaking aspen are two key species anticipated to decline across the assessment area, and modeling results are mixed for northern oak and yellow birch. Several minority species in this system may also increase in biomass and suitable habitat across the assessment area (e.g., eastern white pine, ironwood, American elm, white oak, bitternut hickory). NPC Class MHn44 may be particularly vulnerable because this class contains boreal species such as quaking aspen, balsam fir, and paper birch.

H. Acid Peatland System (AP)



General Description

The Acid Peatland (AP) System is characterized by conifer, low-shrub, or graminoid-dominated communities that develop in association with peat-forming Sphagnum. AP communities are acidic (pH < 5.5), extremely low in nutrients, and have hydrological inputs dominated by precipitation rather than groundwater. These communities are floristically depauperate, with the flora composed primarily of a small subset of species characteristic of rich peatland systems that are able to survive in the harsh, low-nutrient environments typical in AP communities. The floristic differences between forested and open AP communities are subtle because of low species diversity in the AP System as a whole and because trees, when present, are usually sparse, making the boundary between forested and open AP communities diffuse. Therefore, this classification places all acid peatland communities into one System, unlike the rich peatland communities, which are divided into forested and open systems.

AP communities are widespread in the Laurentian Mixed Forest (LMF) Province because of cool climate, abundant precipitation, numerous poorly drained basins, and extensive poorly drained glacial lake plains, which produce favorable conditions for peat development across much of the Province. AP communities tend to be prevalent in basins in areas with non-calcareous soils and on lake plains underlain by impermeable clayey and loamy soils, which minimize movement of groundwater through the overlying peat.

North Central Landscape Area

- 497,070 acres
- 5.5% of the North Central Landscape
- 6.4% of the Laurentian Mixed Forest in North Central Landscape
- 15.2% of the lowland area in the Laurentian Mixed Forest in North Central Landscape

Disturbance Regime History

- Return interval of stand-replacing fires (rare) – over 1,000 years.
- Return interval of superficial or light fires – approximately 120 years.
- Return interval of catastrophic windthrows – over 700 years.

Silvicultural Description

The canopies of forests in the AP System are typically dominated by black spruce. Trees are usually stunted (<30 ft or 10m tall) with 25-75% cover. Some sites have scattered tamarack in addition to black spruce. The vegetation in the area is composed only of bog species, with very low species diversity. This environment occurs where a buildup of peat causes the peat surface to become isolated from mineral-rich runoff or subsurface flow so that all mineral inputs come from precipitation.

Although fires can occur in spruce bogs, they are not very common. Records indicate that the historic rotation of catastrophic fires in these areas was in excess of 1,000 years. Superficial fires appear to have been more common, occurring about every 120 years. Such fires can kill black spruce trees and favor nearly continuous cover of leatherleaf. Following lighter fires, some of the characteristic shade-tolerant understory species usually remain at the site. Severe, catastrophic fires can result in conversion of the peatland to an open bog community dominated by bog wire grass. If sufficient nutrients are released into surface waters by burning of peat and vegetation, the bog may be converted to a poor fen. Recovery to forested conditions may take decades in these peatlands. The ability of black spruce to send up new stems, or layer, from branches buried by peat has been interpreted as an adaptive trait for surviving windthrow. There is, however, little direct evidence that windthrow has a significant impact on spruce bogs. Records suggest the historic rotation of catastrophic windthrow in these areas was about 700 years. These trees are somewhat susceptible to windthrow because of structurally weak peat soils and shallow root systems, but this seems to be offset by short height (<30ft or 10m), sparse crowns, rootgrafting, and branch-layering.

There are several management options that are suggested to help support the conservation of particular species, and general diversity, in the area. The first is to use natural disturbance patterns to help guide rotation periods. Landscape disturbance patterns can also be mimicked by timber harvesting practices to help maintain the natural succession of these lowland species and environments. If timber is harvested in this area, regulation and monitoring of damage to the area, such as rutting and other negative impacts on the soils, vegetation and hydrology of the area need to be addressed. One advisable action is to harvest only in frozen-soil conditions to keep the impact on the environment at a minimum. Options such as harvesting spruce tops and boughs may produce extra revenue from the area.

Methods to mimic the natural disturbance of the area could be provided by several management options. The first is to leave reserve trees in the area after harvesting. While these trees leave some potential for seed dispersal they also act as future snag trees, and attempts to mimic the stratified vertical pattern natural to the landscape. Leaving downed logs in the area may also mimic the disturbance of windthrow. Regenerating the area may cause a problem due to a lack of knowledge on how to regenerate species in lowland bog areas. Some options include aerial seeding, which may only be possible if pathogens such as dwarf mistletoe aren't present in the area.

A detailed silvicultural prescription for the Northern Poor Conifer Swamp (APn81) is available on the MN DNR website. Please refer to: http://www.dnr.state.mn.us/forestry/ecs_silv/interpretations.html

Table D-8. Suitability of Tree Species by Native Plant Community; Acid Peatland.

NPC Class	APn80	APn81
	Northern Spruce Bog	Northern Poor Conifer Swamp
Area Estimate (acres)*	17,934	--
Black spruce	**1d**	**1d**
Tamarack	**2**	**2**
White pine		**3wd**
Paper birch		**-**

Source: Minnesota Department of Natural Resources, Division of Forestry, Ecological Land Classification Program; Version 2.2, 2013.
Table interpretation information is available above on page D-6.

* Estimate from George Host, Natural Resources Research Institute.

Climate Change Projections

- High Vulnerability. (medium evidence, medium-high agreement) Acid Peatlands are not resilient to changes in water tables and are not buffered by groundwater inputs. The dominant species in these forests are expected to decline under a range of climate futures. Future precipitation trends are the primary uncertainty for this system.
- Low Adaptive Capacity. Acid Peatlands receive water inputs through precipitation only, so these systems may be particularly susceptible to shifts in precipitation patterns and droughts. Increased winter and spring precipitation could possibly be retained in low-lying areas on the landscape and compensate for summer droughts. Acid Peatlands are more widely distributed across the assessment area than Forested Rich Peatlands, but are typically smaller and more confined to particular hydrologic regimes. These systems are slower to recover from disturbances like fires and blowdown events than Forested Rich Peatlands. Because of their acid conditions, however, these forests may face less competition from other forest types.
- Potential Impacts
    - Drivers: Acid Peatlands typically occur on perched water tables without connection to groundwater. Therefore, these systems are likely even more vulnerable to water level changes than Forested Rich Peatlands. Higher water levels could result in a transition to open peatland systems and lower water levels could cause greater drought stress and mortality in shallow-rooted forests.
    - Stressors: Roads, beaver dams, drainage ditches, or other watershed modifications that change flood regimes or water tables are already a negative impact in some parts of the assessment areas. These modifications may be intensified by climate change. Additionally, higher growing season temperatures may increase evapotranspiration rates and reduce the rate of peat accumulation in these systems as a result of increasing decomposition rates. Warmer winters may also increase the occurrence of winterburn in Acid Peatlands, and allow for more frequent outbreaks of pests like tamarack sawfly.
    - Dominant Species: The dominant tree species in Acid Peatlands, black spruce and tamarack, are projected to experience significant declines in suitable habitat and biomass across the landscape according to ecosystem models. Declines may be most severe for black spruce. These species are at the southern edge of their ranges in Minnesota, and therefore may not tolerate warmer conditions. The assessment area is also the southern range limit for sphagnum moss. Acid peatlands also contain a suite of rare and endemic plant species that are adapted to acidic, nutrient-poor conditions. These associated species are also presumably vulnerable to changes in water table level and the peat substrate.

I. Forested Rich Peatland System (FP)

General Description
Forested Rich Peatland (FP) communities are conifer- or tall shrub-dominated wetlands on deep (>15in [40 cm]), actively forming peat. They are characterized by mossy ground layers, often with abundant shrubs and forbs. FP communities are widespread in the Laurentian Mixed Forest (LMF) Province. The cool climate of the region, abundant precipitation, and presence of poorly drained basins and glacial lake plains result in extensive peat development relative to other parts of Minnesota. These communities are particularly prominent in the Northern Minnesota and Ontario Peatlands and the Minnesota Drift and Lake Plains sections within Minnesota.

North Central Landscape Area
- 657,527 acres
- 7.2% of the North Central Landscape
- 8.5% of the Laurentian Mixed Forest in North Central Landscape
- 20.1% of the lowland area in the Laurentian Mixed Forest in North Central Landscape

Disturbance Regime History
- Return interval of stand-replacing fires (very rare) – 400 to 1,000 years.
- Return interval of catastrophic windthrows – over 600 years.
- Return interval of patchy windthrows – approximately 80 years.

Silvicultural Description
This area's understory is comprised mostly of white cedar, balsam fir, black spruce, tamarack and paper birch, with a few elm and black ash. The canopy is made up by the same species composition with a variable 25-100% canopy cover.

This area very rarely experiences catastrophic fire disturbance, with an estimated rotation of about 400 years in some areas and up to almost 1,000 years in other areas. The areas that are more susceptible to fire disturbance are those with more poorly drained landscapes paralleled with extreme draught.

Because of structurally weak peaty soils and shallow root systems, trees in this area are susceptible to windthrow, resulting in somewhat shorter rotations for both stand-regenerating catastrophic windthrow (about 600 years) and windthrow of small patches of canopy trees (about 380 years). Smaller disturbances resulting in partial mortality of the canopy were somewhat common, with a rotation of about 80 years, and are presumed to have involved both patchy windthrow and surface fires. Hummocks of soil and peat are also somewhat common due to the

presence of tip-up-mounds found from fallen and wind-thrown trees. Recommended silvicultural methods in this area are similar to the Acid Peatland system, with a high presence of downed woody debris as well as snags.

A detailed silvicultural prescription for the Northern Rich Tamarack Swamp (Western Basin) (FPn82) is available on the MN DNR website. Please refer to: http://www.dnr.state.mn.us/forestry/ecs_silv/interpretations.html

Table D-9. Suitability of Tree Species by Native Plant Community; Forested Rich Peatland

NPC Class	FPn62	FPn63	FPn71	FPn72	FPn81	FPn82
	Northern Rich Spruce Swamp	Northern Cedar Swamp	Northern Rich Spruce Swamp (Water Track)	Northern Rich Tamarack Swamp (Eastern Basin)	Northern Rich Tamarack Swamp (Water Track)	Northern Rich Tamarack Swamp (Western Basin)
Area Estimate (acres)*	--	68,164	5,435	--	85	--
Tamarack	**2**	**4**	**2**	**1**	**1**	**1**
Black spruce	**1**	**2**	**1d**	**2**	**2d**	**2d**
White cedar	**4**	**1**	**3d**			**3d**
Balsam fir	**5d**	**3d**				
Paper birch	**3wd**	**5wd**		**3wd**		
White pine	-			-		-
White spruce	-			-		
Black ash				-		

Source: Minnesota Department of Natural Resources, Division of Forestry, Ecological Land Classification Program; Version 2.2, 2013.
Table interpretation information is available above on page D-6.
* Estimate from George Host, Natural Resources Research Institute.

Climate Change Projections

- High Vulnerability. (medium evidence, medium-high agreement) Forests in peat systems have limited tolerance to changes in water tables. Additionally, the dominant species in these forests are expected to decline under a range of climate futures. Low agreement on future precipitation trends is the primary uncertainty for this system.
- Low Adaptive Capacity. Forested Rich Peatlands typically receive water inputs through groundwater as well as precipitation, so these forests may be somewhat buffered from seasonal or short-term moisture deficits. Increased winter and spring precipitation could also be retained in low-lying areas on the landscape and compensate for summer droughts. Forested Rich Peatlands are widely distributed across the assessment area, but are confined to particular hydrologic regimes, soil types, and landscape positions. Therefore, they are unlikely to expand to new territory within the assessment area or out-compete other forest types. In some locations Forested Rich Peatlands occur within a matrix of Fire-Dependent Forests like jack pine systems, so they may be exposed to more frequent wildfire if climate change results in extended droughts and more active wildfire regimes in the assessment area.

- Potential Impacts
  - Drivers. Climate change has the potential to alter the water tables in low-lying areas across the assessment area. Forested Rich Peatlands function in a relatively narrow window of water table conditions, because higher water levels could result in a transition to open peatland systems and lower water levels allow other forest types to invade as peat layers dry and decompose.
  - Stressors. Roads, beaver dams, drainage ditches, or other watershed modifications that change flood regimes or water tables are already a negative impact in some parts of the assessment areas. These effects may be intensified by climate change. Additionally, higher growing season temperatures may increase evapotranspiration rates and reduce the rate of peat accumulation in these systems as a result of increasing decomposition rates. Warmer winters and reduced snowpack may also increase the occurrence of winterburn in these systems, and allow for more frequent outbreaks of pests such as tamarack sawfly and eastern larch beetle.
  - Dominant Species. Most species in this system are at the southern edge of their ranges in Minnesota, and therefore may not tolerate warmer conditions. The dominant species in Forested Rich Peatlands, tamarack and black spruce, are projected to experience declines in suitable habitat and biomass across the landscape. Declines may be most severe for black spruce. Other minor species like balsam fir and paper birch are also expected to decline under the hotter, drier climate scenario. The assessment area is also the southern range limit for sphagnum moss. Red maple, white pine, and speckled alder may become larger components of this system in the future, but it is unclear if Forested Rich Peatlands will maintain their inherent identity if that shift occurs.

J. Wet Forest Systems (WF)

General Description

Wet Forest (WF) communities occur commonly in narrow zones along the margins of lakes, rivers, and peatlands; they also occur in shallow depressions or other settings where the groundwater table is almost always within reach of plant roots but does not remain above the mineral soil surface for long periods during the growing season. Because of a cool climate characterized by regular precipitation and slow rates of evaporation, WF communities are common across the Laurentian Mixed Forest (LMF) Province. They are dominated most often by black ash or white cedar, with understories characterized by patches of shrubs such as speckled alder or mountain maple, mosses and upland forest herbs on raised hummocks, and sedges and wetland forbs in wet or mucky hollows.

WF communities are strongly shaped by steady fluxes of water and nutrients supplied to deep soil layers by moving groundwater. In basins or depressions connected to annually recharged shallow aquifers, the supply of groundwater peaks early in the growing season but persists at some level through much of the summer. In settings connected to deeper aquifers that discharge groundwater throughout the year, the supply of water and nutrients is steady through the growing season. The groundwater moves laterally below the surface but often upwells to create springs, seeps, or spring runs within and adjacent to WF communities. Varied micro-topography and variation in groundwater supply on sites fed by shallow aquifers result in the alternating presence of water-logged and dry conditions in upper soil layers. This variability in soil moisture in both space and time is a hallmark of the WF System and controls the availability of the oxygen needed for roots to respire, for decomposition of organic litter, and for release of nutrients in forms usable by plants.

North Central Landscape Area

- 722,300 acres
- 8.0% of the North Central Landscape
- 9.3% of the Laurentian Mixed Forest in North Central Landscape
- 22.1% of the lowland area in the Laurentian Mixed Forest in North Central Landscape

Disturbance Regime History

- Return interval of catastrophic fires – 800 to >1,000 years.

Silvicultural Description

Species present in the sub-canopy of this area include white cedar, balsam fir, black ash, basswood, red maple, yellow birch quaking aspen, paper birch sugar maple and green ash. The canopy is composed mostly of the same species with a small component of black spruce, white spruce and tamarack.

In the past, catastrophic disturbances were infrequent in WFn53. An analysis of Public Land Survey records indicates that the rotation of catastrophic fires was more than 800 years, and the rotation of catastrophic windthrow was more than 300 years. Events that result in partial loss of trees, such as patchy windthrow or light surface fires, were also rare, with a rotation of about 340 years.

Succession is evident in this system, with various species growing at varying times under the canopy. Different sites differ by species located within the canopy and sub-canopy at any point in time. In order to preserve the species diversity in the area and mimic natural selection, harvesting while leaving reserves and underplanting other species at certain time intervals would best replicate the natural growth and establishment in the area.

Detailed silvicultural prescriptions for Northern Wet Cedar (WFn53) and Northern Very Wet Ash Swamp (WFn64) are available on the MN DNR website. Please refer to: http://www.dnr.state.mn.us/forestry/ecs_silv/interpretations.html

Table D-10. Suitability of Tree Species by Native Plant Community; Wet Forests.

NPC Class	WFn53	WFn55	WFn64
	Northern Wet Cedar Forest	Northern Wet Ash Swamp	Northern Very Wet Ash Swamp
Area Estimate (acres)*	--	46,620	2,842
Black ash	**2w**	**1wd**	**1w**
White cedar	**1**	**4**	**4**
Quaking aspen	**9d**	**2d**	**3d**
Paper birch	**3d**	**8d**	**7d**
Yellow birch	**8wd**	**3wd**	**5wd**
Balsam fir	**4d**	**9d**	**9d**
Red maple		**6wd**	**6wd**
Balsam poplar	**7d**	**7d**	
Green ash		**5wd**	
Tamarack	-	-	**2**
White spruce	**6d**	**15d**	-
American elm		**11wd**	**8wd**
Black spruce	**5**	**13**	
Basswood		**10w**	
White pine		**12d**	
Bur oak		**14wd**	
Red elm			**10wd**
Sugar maple		-	

Source: Minnesota Department of Natural Resources, Division of Forestry, Ecological Land Classification Program; Version 2.2, 2013.
Table interpretation information is available above on page D-6.
* Estimate from George Host, Natural Resources Research Institute.

Climate Change Projections

- High Vulnerability. (limited-medium evidence, medium agreement) On-going ash decline and emerald ash borer present serious existing threats to this system. These stressors may be exacerbated by climate change impacts to the precipitation regime. Limited research and management history and uncertainty for future precipitation reduce confidence in this determination.
- Low Adaptive Capacity. There is a lack of knowledge and management history in these forests compared to other forest systems in the assessment area, so we know less about how they function and respond to disturbance. Many species that exist in Wet Forests can tolerate intermittent wet and dry conditions, so this system might be adaptable to short-term floods and droughts. Extended droughts would likely cause significant damage to these shallow-rooted forests. Increased winter and spring precipitation could buffer summer moisture stress if excess water is retained in low-lying areas on the landscape. Additionally, Wet Forests often exist as large complexes of a single species or few species, so they have low response diversity. These forests also exist as isolated pockets on the landscape in some areas, so they may be disconnected in terms of migration and gene flow.
- Potential Impacts
    - Drivers. Wet Forests depend on wet-mesic soils with saturated conditions in the spring and dry conditions in the summer months. Climate change has the potential to alter precipitation patterns across the assessment area, particularly during the growing season. The regeneration requirements of several species within this system are also linked to the timing of these wet and dry periods. Shifts in the timing or amount of precipitation could disrupt the function of these forests.
    - Stressors. The ongoing decline in black ash in the assessment area already presents problems for the health of Wet Forests. Invasive species such as reed canarygrass and European buckthorn are existing threats to these forests, and invasive species have the potential to increase in abundance in the assessment area under climate change. White-tailed deer populations are expected to increase with warmer winters, which may hinder regeneration of northern white-cedar in particular. Dutch elm disease will also likely limit the potential increase in American elm.
    - Dominant Species. The potential for emerald ash borer to spread throughout the assessment area presents a serious risk to black ash and green ash in Wet Forests. Considering the range of possible climate futures, the majority of dominant species that make up Wet Forests are expected to decline in suitable habitat and biomass across the assessment area, particularly under the GFDL A1FI scenario (black ash, northern white-cedar, balsam fir, balsam poplar, and black spruce). Model projections indicate that red maple may become a larger component of this system, and that minor species within Wet Forests like American elm and American basswood will also increase across the assessment area. Elm/ash/cottonwood forests could experience large potential productivity gains under a range of climate futures.

Appendix E
Native Plant Community Class Growth Stage and Composition

This appendix contains a series of tables that were used by the Planning Committee, in addition to other sources of information, to determine if the 100 year goals and strategies from the 2003 Plan should be maintained, amended, or eliminated. The revised goals appear in Section 7 of the North Central Landscape Forest Resources Plan. These tables were adapted from the Tree Suitability and NPC Silviculture Interpretation work developed by the MN DNR Division of Forestry, Ecological Land Classification Program. Readers should note that the MN DNR has not created these tables for all NPC Classes. This appendix contains data on NPC Classes for which: 1) the data was available; and 2) were modeled to appear in great enough abundance in the North Central Landscape to be relevant to the Planning Committee.

Table Interpretation

The following text provides information on interpreting the information displayed in this section of the plan; however, users of this plan are strongly encouraged to review the original documents and utilize the wealth of information within them.

Tree Suitability Tables (Left Side of NPC-Class Tables)

Each native plant community table includes a portion of the Minnesota DNR Tree Suitability Table – Version 2.2, 2013 (http://files.dnr.state.mn.us/forestry/ecssilviculture/treetables.pdf). These tables were developed by the Minnesota Department of Natural Resources, Division of Forestry, Ecological Land Classification Program. Please use the following information to interpret these tables:

- Numbers: rank in order of competitive ability; 1=most suited; -- indicates trace presence; blank cells are for species not include in the Suitability Table.
- Color: Ability to compete with all vascular plants within NPC class (**GREEN** = excellent, **BLUE** = good, **YELLOW** = fair, **TAN** = poor, **WHITE** = not suitable)
- Letters:
  w = tree species with a warmer synecological score than the community mean.
  d = tree species with a drier synecological score than the community mean.

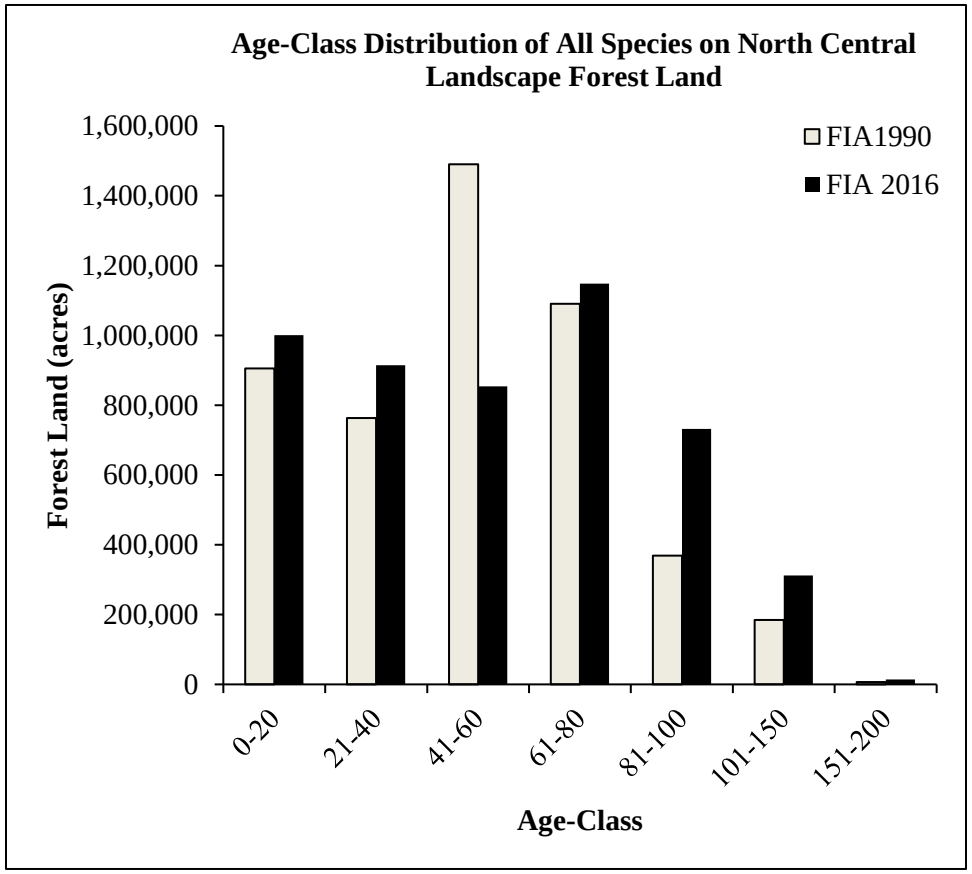
Public Land Survey vs Forest Inventory and Analysis Growth-stage Tables (Right Side of NPC-Class Tables)

The MN DNR Division of Forestry, Ecological Land Classification Program has developed Silviculture Interpretations for a number of NPC Classes (http://www.dnr.state.mn.us/forestry/ecs_silv/interpretations.html). In the development of these Silviculture Interpretations the MN DNR created tables comparing Public Land Survey (PLS; ca. 1846-1908 AD) and Forest Inventory and Analysis (FIA; ca. 1990 AD) growth-stage data. The 1990 FIA data is the most modern dataset that has been analyzed in this manner due to changes in how FIA collects its data. Changes have occurred in the region's forests between the FIA 1990 data and the development of this plan including a large decrease the 41-60 year age-class and an increase in the more mature age classes (see figure below). Please acknowledge these potential shortcomings when interpreting the following tables and realize these are the best estimates the Planning Committee had to work with when amending the 2003 North Central Landscape goals and strategies.

Please use the following information to interpret these tables:

- Table values are relative abundance (%) of trees at PLS corners (orange shading) and FIA subplots (blue shading) modeled to represent the NPC community and estimated to fall within the young, mature, and old growth-stages.
- Arrows indicate increase or decrease between growth-stages for common tree species.
- The bottom row allows for a comparison of the percent balance of growth-stages across the 'pre-settlement landscape' and the 'modern landscape.'

Note: This information is meant to give a rough idea of the change in species and growth stage over time and should be used to establish general context, and not targets that should or even could be achieved.



FDc23: Central Dry Pine Woodland

FDc23: Central Dry Pine Woodland											
Tree Suitability	**Tree Species**	**Young (0-55)**		**Transition (55-75)**		**Mature (75-155)**		**~155**		**Old (> 155)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1	Jack Pine	91%	5%	↓↓↓↓↓	↓	60%	3%	↓	↓	56%	0%
3w	Bur Oak	--	2%	↑	↑	2%	5%	↓	↓	1%	0%
4	Quaking Aspen	1%	81%	↑	-	2%	81%	↑	↓↓↓↓↓↓↓↓↓	3%	0%
5	Paper Birch	1%	5%	↓	↓	--	1%	↑	↓	2%	0%
6d	Red Pine	4%	2%	↑↑↑	↑	33%	4%	↓↓	↓	20%	0%
	White Pine [3]	--	0%	↑	-	1%	0%	↑	-	7%	0%
	Miscellaneous	3%	5%	↓	↑	2%	6%	↑	↓	11%	0%
2w	Northern Red Oak										
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 2,459 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 642 FIA (1990 AD) subplots that were modeled to be FDc23 sites. [3] Important historically, white pine is no longer a significant component of FDc23 forests and is not covered in the accounts of potential crop species.											
Percent of NPC Class in Growth Stage		**73%**	**56%**	**18%**	**32%**	**8%**	**12%**			**1%**	**0%**

FDc24: Central Rich Dry Pine Woodland

FDc24: Central Rich Dry Pine Woodland											
Tree Suitability	**Tree Species**	**Young (0-55)**		**Transition (55-75)**		**Mature (75-155)**		**Transition (155-195)**		**Old (> 195)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1d	Jack Pine	88%	1%	↓↓↓↓↓	↑	58%	7%	↓	↓	51%	3%
2d	Quaking Aspen	4%	87%	↓	↓	3%	81%	↑	↓	6%	76%
3d	Red Pine	4%	1%	↑↑↑	-	31%	1%	↓↓↓	↑	8%	5%
4wd	Bur Oak	--	2%	↑	↑	1%	3%	↑	↑	2%	6%
5d	Paper Birch	1%	2%	↑	↑	1%	3%	↓	↓	1%	1%
6wd	Northern Red Oak	1%	0%	↑	-	2%	0%	↓	-	0%	0%
	White Pine [3]	1%	0%	↑	-	2%	0%	↑↑↑	-	24%	0%
	Balsam Fir	--	1%	-	↑	--	2%	-	↑	0%	3%
	Red Maple	--	2%	-	↑	0%	3%	↓	↓	0%	0%
	Basswood	0%	1%	↓	↓	0%	0%	↑	↑	0%	3%
	Miscellaneous	2%	3%	↑	↓	4%	0%	↑	↑	8%	3%
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 2,805 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 456 FIA (1990 AD) subplots that were modeled to be FDc24 sites. [3] Important historically, white pine is no longer a significant component of FDc24 forests and is not covered in the accounts of potential crop species.											
Percent of NPC Class in Growth Stage		**71%**	**64%**	**18%**	**25%**	**10%**	**11%**	**1%**	**0%**		**0%**

FDc34: Central Dry-Mesic Pine-Hardwood Forest

FDc34: Central Dry-Mesic Pine-Hardwood Forest											
Tree Suitability	**Tree Species**	**Young (0-55)**		**Transition (55-95)**		**Mature (95-135)**		**Transition (135-175)**		**Old (> 175)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1d	Red Pine	25%	0%	↑↑↑	↑↑	50%	10%	↓↓↓↓	↓↓	15%	0%
2d	White Pine	14%	0%	↑	↑	22%	2%	↑↑↑↑	↓	54%	0%
3d (8wd)	Quaking (Big-toothed) Aspen [3]	31%	71%	↓↓↓	↓↓↓↓↓	5%	29%	↑	↓↓↓	7%	0%
4wd	Northern Red Oak	7%	2%	↓	↑↑	3%	12%	↑	↓↓	4%	0%
5d	Paper Birch	6%	10%	↓	↓	4%	7%	↑	↓	6%	0%
6wd	Red Maple	1%	8%	-	-	1%	8%	↑	↓	2%	0%
7wd	Bur Oak	1%	2%	-	↑↑↑	1%	25%	↑	↓↓↓	2%	0%
9d	Jack Pine	11%	1%	↓	-	9%	1%	↓	↓	1%	0%
	White Spruce [4]	1%	0%	↑	↑	3%	1%	↑	↓	3%	0%
	Miscellaneous	3%	6%	↓	↓	2%	5%	↑	↓	6%	0%
10wd	Basswood										
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.											
For Table Interpretation: See p. 7-2 and 7-3											
[1] 4,684 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).											
[2] 1,969 FIA (1990 AD) subplots that were modeled to be FDc34 sites.											
[3] Species could not be separated in the PLS data.											
[4] Important historically, white spruce is no longer a significant component of FDc34 forests and is not covered in the accounts of potential crop species.											
Percent of NPC Class in Growth Stage		**47%**	**58%**	**31%**	**40%**	**13%**	**2%**	**3%**	**0%**	**6%**	**0%**

FDn12: Northern Dry-Sand Pine Woodland

FDn12: Northern Dry-Sand Pine Woodland												
Tree Suitability	**Tree Species**	**Young (0-55)**		**Transition (55-75)**		**Mature (75-195)**		**~195**		**Old (> 195)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1	Jack Pine	71	36	↓↓↓↓↓	↓↓↓	22	16	-	↓↓	22	0
2d	Red Pine	16	5	↑↑↑↑	↓	50	4	↓↓↓	↓	24	0
3w	Quaking (Big-toothed) Aspen [3]	4	28	-	↓	4	22	-	↓↓↓	4	0
4	White Spruce	--	4	-	-	7	4	↑	↓	14	0
5	Balsam fir	1	16	-	↑	1	19	↑	↓↓	3	0
-	Paper Birch	3	6	↑	↑	6	15	↑	↓↓	9	0
-	White Pine [4]	3	0	↑	↑	5	3	↑↑	↓	15	0
	Bur Oak	--	2	-	↑	--	6	-	↓	0	0
	Red Oak	--	1	↑	↑	1	5	-	↓	1	0
	Miscellaneous	2	2	↑	↑	4	6	↑	↓	8	0
-	Black Spruce										
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.											
For Table Interpretation: See p. 7-2 and 7-3											
[1] 2,341 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).											
[2] 479 FIA (1990 AD) subplots that were modeled to be FDn12 sites.											
[3] Species could not be separated in the PLS data.											
[4] Important historically, white pine is no longer a significant component of FDn12 forests and not covered in the accounts of potential crop species.											
Percent of NPC Class in Growth Stage		**61%**	**59%**	**17%**	**24%**	**20%**	**17%**			**2%**	**0%**

FDn33: Northern Dry-Mesic Mixed Woodland

FDn33: Northern Dry-Mesic Mixed Woodland											
Tree Suitability	**Tree Species**	**Young (0-35)**		**Transition (35-55)**		**Mature (55-125)**		**~125**		**Old (> 125)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1d	Red Pine	17%	1%	↑↑	-	27%	1%	↓↓	-	16%	1%
2d	Paper Birch	16%	5%	↑	↑↑↑	19%	26%	↓	↓	14%	18%
3d	White Pine	--	0%	↑↑	↑	19%	1%	↑↑	↑↑	30%	19%
4d (7wd)	Quaking (Big-toothed) Aspen [3]	40%	79%	↓↓↓↓	↓↓↓↓	9%	48%	↓	↓↓	7%	37%
5d	Jack Pine	15%	--	↓	-	7%	--	↓	-	2%	--
6	Balsam Fir	1%	7%	↑	↑	4%	11%	↑	↑	5%	15%
8wd	Red Maple	--	4%	↑	↑	1%	9%	↑	↓	2%	0%
9 (10)	Black Spruce (White)[3]	--	1%	↑	-	5%	1%	↑	-	13%	1%
	White Cedar	--	0%	↑	↑	2%	1%	-	↑	2%	8%
	Miscellaneous	11%	3%	↓	↓	7%	2%	↑	↓	9%	1%
11wd	Northern Red Oak										
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 6,807 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 2,615FIA (1990 AD) subplots that were modeled to be FDn33 sites. [3] Species could not be separated in the PLS data.											
Percent of NPC Class in Growth Stage		**14%**	**30%**	**27%**	**30%**	**44%**	**39%**			**15%**	**1%**

FDn43: Northern Mesic Mixed Woodland

FDn43: Northern Mesic Mixed Forest											
Tree Suitability	**Tree Species**	**Young (0-35)**		**Transition (35-55)**		**Mature (55-95)**		**Transition (95-115)**		**Old (> 115)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1wd	Paper Birch	15%	5%	↑↑	↑↑	31%	20%	↓↓	↓	18%	18%
2wd	White Pine	2%	0%	↑↑↑	↑	24%	1%	↑	↑	28%	3%
3wd	Quaking Aspen	60%	76%	↓↓↓↓↓	↓↓↓	12%	52%	↓	↓↓↓	5%	23%
4d	Red Pine	3%	0%	↑	↑	9%	1%	↓	-	5%	1%
5	White Cedar	--	0%	↑	-	3%	0%	↓	↑↑	2%	14%
6	Balsam Fir	1%	7%	↑	↑	10%	13%	↑	↑↑	13%	25%
7	White Spruce	--	1%	↑	↑	4%	2%	↑↑↑	-	28%	2%
8wd	Red Maple	--	3%	↑	↑	1%	4%	↓	↓	--	1%
9	Black Spruce	0%	0%	-	↑	0%	1%	-	↑	0%	6%
10d	Jack Pine	19%	0%	↓↓	-	3%	0%	-	-	3%	0%
	Balsam Poplar	--	4%	-	↓	--	2%	-	-	--	2%
	Miscellaneous	0%	4%	↑	-	3%	4%	↓	↑	0%	5%
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 11,725 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 10,785 FIA (1990 AD) subplots that were modeled to be FDn43 sites.											
Percent of NPC Class in Growth Stage		**17%**	**20%**	**30%**	**26%**	**31%**	**48%**	**6%**	**3%**	**16%**	**2%**

MHc26: Central Dry-Mesic Oak-Aspen Forest

MHc26: Central Dry-Mesic Oak-Aspen Forest											
Tree Suitability	**Tree Species**	**Young (0-35)**		**Transition (35-55)**		**Mature (55-135)**		**~135**		**Old (> 135)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1wd	Northern Red Oak	4%	5%	↑	↑↑	12%	22%	↓	↑	11%	29%
2d **(8d)**	Quaking (Big-toothed) Aspen [3]	76%	50%	↓↓↓↓↓↓	↓↓↓↓	22%	19%	↑	↓↓	26%	1%
3d	Paper Birch	13%	4%	↑↑↑	↑	40%	11%	↓↓↓	↓	20%	2%
4d	Red Maple	1%	12%	↑	↓	5%	11%	↓	↓	2%	4%
5wd	Basswood	1%	6%	↑	↑	3%	10%	-	↓	3%	14%
6wd	Sugar Maple	0%	13%	-	↑	0%	14%	-	↑	0%	17%
7wd **(11wd)**	Bur (White) Oak [3]	--	1%	↑	↑	5%	4%	↓	↑↑	4%	14%
9d	White Pine	--	0%	↑	-	2%	0%	↑	-	10%	0%
12w	Green (Black) Ash	--	0%	↑	↑	1%	1%	↓	↑	0%	3%
13wd	Ironwood	--	6%	↑	↓	1%	5%	↑	↓	2%	4%
	White Spruce [4]	--	1%	↑	↓	2%	0%	↑↑	-	12%	0%
	Miscellaneous	5%	2%	↑	↑	7%	3%	↑	↑	10%	12%
10d	Red Pine										
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 3,649 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 2,525 FIA (1990 AD) subplots that were modeled to be MHc26 sites. [3] Species could not be separated in the PLS data. [4] Important historically, white spruce is no longer a significant component of MHc26 forests and is not covered in the accounts of potential crop species.											
Percent of NPC Class in Growth Stage		**21%**	**13%**	**31%**	**21%**	**45%**	**64%**			**3%**	**1%**

MHc36: Central Mesic Hardwood Forest (Eastern)

MHc36: Central Mesic Hardwood Forest (Eastern)								
Tree Suitability	**Tree Species**	**Young (0-35)**		**Transition (35-95)**		**Mature (> 95)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1wd	Sugar Maple	4%	30%	↑↑↑↑	↑	36%	33%
2wd	Northern Red Oak	50%	8%	↓↓↓↓↓	↑	9%	14%
3wd	Basswood	14%	10%	↑	↑↑	18%	20%
4wd / **(11wd)**	Bur (White) Oak [3]	--	1%	↑	↑	5%	6%
5d / **(9d)**	Quaking (Big-toothed) Aspen [3]	10%	18%	↓	↓↓	1%	3%
6w / **(13)** / **(12wd)**	Green (Black & White) Ash [3]	3%	4%	↑	↓	4%	3%
7d	Red Maple	--	3%	-	-	--	3%
8d	Paper Birch	5%	4%	↓	-	2%	4%
14wd	Ironwood	4%	12%	↑	↓	8%	7%
-	American Elm [4]	6%	5%	↑	↓	10%	3%
	White Pine [4]	1%	0%	↑	-	3%	0%
	Miscellaneous	3%	5%	↑	↓	4%	4%
10 w	Bitternut hickory						
-	Red Elm						
-	Butternut						

Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.

For Table Interpretation: See p. 7-2 and 7-3

[1] 5,368 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).

[2] 2,107 FIA (1990 AD) subplots that were modeled to be MHc36 sites.

[3] Species could not be separated in the PLS data.

[4] Important historically, American elm and white pine is no longer a significant component of MHc36 forests and not covered in the accounts of potential crop species.

Percent of NPC Class in Growth Stage	**7%**	**7%**	**75%**	**71%**	**18%**	**21%**

MHc47: Central Wet-Mesic Hardwood Forest

MHc47: Central Wet-Mesic Hardwood Forest											
Tree Suitability	**Tree Species**	**Young (0-55)**		**~55**		**Mature (55-155)**		**~155**		**Old (> 155)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1wd	Basswood	24%	11%	↓	↑	21%	12%	↑	↓↓	25%	0%
2 (7w)	Black (Green) Ash [3]	9%	1%	-	↑	9%	2%	↓	↓	3%	0%
3wd	Bur Oak	17%	8%	↑	↓	19%	5%	↑	↓	20%	0%
4wd (6d)	Sugar (Red) Maple [3]	10%	14%	↑	↑↑	15%	25%	↓	↓↓↓	12%	0%
5wd	Northern Red Oak	3%	8%	↓	↑↑	2%	18%	↓	↓↓	1%	0%
8d	Quaking Aspen	11%	39%	↓	↓↓↓	6%	18%	↓	↓↓	5%	0%
9d	Paper Birch	11%	5%	↓	↑	10%	6%	↓	↓	2%	0%
10w	American Elm	4%	4%	↑	-	5%	4%	↓	↓	3%	0%
	Ironwood	1%	5%	-	↑	1%	6%	-	↓	1%	0%
	White Pine [4]	6%	0%	↓	-	5%	0%	↑↑	-	20%	0%
	Miscellaneous	4%	5%	↑	↓	7%	4%	↓	↓	8%	0%
11w	Butternut										
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.											
For Table Interpretation: See p. 7-2 and 7-3											
[1] 895 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).											
[2] 1,301 FIA (1990 AD) subplots that were modeled to be MHc47 sites.											
[3] Species could not be separated in the PLS data.											
[4] Important historically, white pine is no longer a significant component of MHc47 forests and not covered in the accounts of potential crop species.											
Percent of NPC Class in Growth Stage		**23%**	**26%**			**73%**	**74%**			**4%**	**0%**

MHn35: Northern Mesic Hardwood Forest

MHn35: Northern Mesic Hardwood Forest											
Tree Suitability	**Tree Species**	**Young (0-55)**		**Transition (55-95)**		**Mature (95-205)**		**Transition (205-295)**		**Old (> 295)[3]**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1wd	Sugar Maple	11%	24%	↑	↑	14%	32%	↑↑	↑↑	29%	50%?
2wd	Basswood	6%	9%	↑	↑↑	9%	19%	↓	↓↓	6%	0%
3wd	Northern Red Oak	10%	6%	↓	↑	5%	11%	↓	↓↓	1%	0%
4d	Paper Birch	38%	9%	↓↓	↓	28%	7%	↓↓	↓	12%	0%
5d	Quaking Aspen	20%	22%	↓↓	↓↓	6%	4%	↓	↓	4%	0%
6wd	Red Maple	--	9%	-	↓	--	4%	-	↓	0%	0%
8wd	Ironwood	1%	7%	-	-	1%	7%	-	↓	1%	0%
9d	White Pine	1%	0%	↑	↑	7%	1%	↑↑↑	↓	31%	0%
10wd	Bur Oak	1%	1%	↑	↑	2%	3%	↓	↑↑↑↑↑	0%	50%?
12	Balsam Fir	5%	4%	↓	↓	3%	2%	↓	↓	1%	0%
-	White Spruce [4]	1%	1%	↑↑	↓	13%	0%	↓↓	-	--	0%
	American Elm	3%	2%	↓	↑	2%	3%	↓	↓	0%	0%
	Miscellaneous	3%	6%	↑	↑	10%	7%	↑	↓	15%	0%
7wd	Big-Toothed Aspen										
11w	Yellow Birch										

Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.

For Table Interpretation: See p. 7-2 and 7-3

[1] 5,887 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).

[2] 3,470 FIA (1990 AD) subplots that were modeled to be MHn35 sites.

[3] Just 4 FIA trees contributed to the old growth-stage and the results are unreliable.

[4] Important historically, white spruce is no longer a significant component of MHn35 forests and not covered in the accounts of potential crop species.

Percent of NPC Class in Growth Stage	**39%**	**29%**	**51%**	**52%**	**8%**	**18%**	**1%**	**1%**	**1%**	**0%**

MHn44: Northern Wet-Mesic Boreal Hardwood-Conifer Forest

MHn44: Northern Wet-Mesic Boreal Hardwood-Conifer Forest											
Tree Suitability	**Tree Species**	**Young (0-35)**		**Transition (35-95)**		**Mature (95-195)**		**~195**		**Old (> 195)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1d	Quaking Aspen	86%	78%	↓↓↓↓↓↓	↓↓↓↓	24%	40%	↑	↑	28%	43%
2	Balsam Fir	3%	5%	↑	↑↑	10%	17%	-	↓	10%	16%
3wd	Red Maple	1%	3%	-	↓	1%	2%	-	↓	1%	0%
4d	Paper Birch	5%	3%	↑↑	↑↑	18%	14%	↓	-	12%	14%
5wd	Basswood	--	1%	↑	-	1%	1%	-	↓	1%	0%
6	White Spruce	1%	0%	↑↑↑↑	↑	34%	1%	↓	↓	33%	0%
7	White Cedar	--	0%	↑	↑	1%	4%	-	↑↑	1%	18%
8d	Whine Pine	--	0%	↑	↑	1%	4%	↑	↓	4%	2%
9w	Black Ash	1%	2%	-	-	1%	2%	↓	↑	--	5%
10	Balsam Poplar	1%	6%	↓	↓	--	3%	↑	↓	1%	2%
11wd	Red Oak	--	0%	-	↑	--	1%	↑	↓	1%	0%
12wd	Bur Oak	1%	1%	-	↑	1%	2%	↑	↓	2%	0%
	Miscellaneous	2%	2%	↑	↑↑	9%	12%	-	↓↓	9%	0%
13wd	Sugar Maple										
14w	Green Ash										
15d	Red Pine										
-	American Elm										
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 4,074 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 10,595 FIA (1990 AD) subplots that were modeled to be MHn44 sites.											
Percent of NPC Class in Growth Stage		**24%**	**21%**	**60%**	**75%**	**14%**	**4%**			**2%**	**0%**

MHn45: Northern Mesic Hardwood (Cedar) Forest

MHn45: Northern Mesic Hardwood (Cedar) Forest											
Tree Suitability	**Tree Species**	**Young (0-75)**		**Transition (75-95)**		**Mature (95-155)**		**Transition (155-195)**		**Very Old (> 195)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1wd	Sugar Maple	33	17	↓↓↓	↑↑	12	34	↓	↑	11	38
2w	Yellow Birch	22	0	↓↓	↑	11	1	↑	↓	15	0
3d	Paper Birch	13	21	↓	↓	6	14	↓	↓	--	13
4	White Cedar	6	0	↑↑	↑	25	5	↓↓	↑↑↑	8	25
5wd	Basswood	2	4	-	↑	2	6	↓	↓	1	0
6	White Spruce	6	3	↑↑↑↑	↓	37	2	↑↑	↑↑	54	13
7	Balsam Fir	11	29	↓	↓↓	4	17	↓	↓↓	2	0
8wd	Red Maple [3]	--	3	-	↑	--	5	-	↓	--	0
9d	Quaking Aspen	2	19	↓	↓↓	--	7	-	↓	0	0
	Black Spruce [3]	--	0	-	↑	--	3	-	↓	--	0
	Miscellaneous	5	4	↓	↑	3	6	↑	↑	9	11
10d	White Pine										
-	Black Ash										

Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.

For Table Interpretation: See p. 7-2 and 7-3

[1] 4,074 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).

[2] 10,595 FIA (1990 AD) subplots that were modeled to be MHn45 sites.

[3] Red maple and black spruce could not be separated in the PLS notes and were included with sugar maple and white spruce respectively in the PLS percentages.

Percent of NPC Class in Growth Stage	**29%**	**64%**	**16%**	**20%**	**38%**	**15%**	**3%**	**0%**	**14%**	**0%**

MHn46: Northern Wet-Mesic Hardwood Forest

MHn46: Northern Wet-Mesic Hardwood Forest								
Tree Suitability		**Tree Species**	**Young (0-35)**		**Transition (35-95)**		**Mature (> 95)**	
			PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1	**(8)**	Black (Green) Ash [3]	2%	6%	↑	↑	4%	8%
2		Basswood	2%	9%	↑	↑↑↑	8%	31%
3	**(15)**	Quaking (Big-toothed) Aspen [3]	83%	44%	↓↓↓↓↓↓	↓↓↓↓	29%	5%
4		Bur Oak	1%	4%	↑	↑	3%	7%
5		Red Maple	1%	13%	-	↓	1%	5%
6		Sugar Maple	0%	10%	-	↑↑	0%	21%
7	**(13)**	Paper (Yellow) Birch [3]	5%	2%	↑	-	9%	2%
9		Northern Red Oak	--	3%	↑	↑	1%	7%
12		Balsam Fir	1%	2%	↑	↑	4%	3%
14		White Spruce	--	1%	↑↑↑	-	21%	1%
16		American Elm	3%	2%	↑	↑	10%	6%
		Ironwood	--	1%	↑	↑	1%	3%
		White Pine [4]	--	0%	↑	↑	6%	1%
		Miscellaneous	2%	3%	↑	↓	3%	0%
10		Balsam Poplar						
11		White Cedar						
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.								
For Table Interpretation: See p. 7-2 and 7-3								
[1] 3,219 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).								
[2] 685,647 FIA (1990 AD) subplots that were modeled to be MHn46 sites.								
[3] Species could not be separated in the PLS data.								
[4] Important historically, white pine is no longer a significant component of MHn46 forests and not covered in the accounts of potential crop species.								
Percent of NPC Class in Growth Stage			**20%**	**17%**	**67%**	**73%**	**3%**	**10%**

MHn47: Northern Rich Mesic Hardwood Forest

MHn47: Northern Rich Mesic Hardwood Forest											
Tree Suitability	**Tree Species**	**Young (0-55)**		**Transition (55-75)**		**Mature (75-195)**		**~195**		**Old (> 195)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1wd	Sugar Maple	38%	35%	↓	↓	35%	32%	↑	↓↓↓	43%	11%
2wd	Basswood	13%	20%	↓	↑	9%	26%	↓	↑↑↑	5%	47%
3	Yellow Birch	--	0%	↑↑	↑	15%	1%	↓	↓	9%	0%
4d	Paper Birch	21%	3%	↓	↑	13%	5%	↓	↑	5%	11%
5wd	Northern Red Oak	2%	3%	-	↑	2%	7%	↓	↓	0%	0%
6 (10w)	Black (Green) Ash [3]	1%	6%	-	↓	1%	3%	↑	↓	2%	0%
7wd	Ironwood	3%	10%	↓	↓	1%	8%	↑	↓	2%	0%
9d	Red Maple	0%	4%	-	↓	--	3%	-	↓	0%	0%
11d	Quaking Aspen	8%	8%	↓	↓	3%	4%	↓	↓	--	0%
-	Balsam Fir [4]	5%	1%	-	↑	5%	2%	↓	↑↑	2%	21%
	American Elm	3%	2%	↓	↑	2%	3%	↓	↓	0%	0%
	Bur Oak	--	1%	↑	↑	1%	2%	↓	↑	0%	10%
	White Pine [4]	1%	0%	↑	-	6%	0%	↑↑↑	-	32%	0%
	White Spruce [4]	1%	3%	↑	↓	3%	0%	↓	-	--	0%
	Miscellaneous	4%	4%	-	-	4%	4%	↓	↓	0%	0%
8	White Cedar										
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.											
For Table Interpretation: See p. 7-2 and 7-3											
[1] 1,579 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).											
[2] 1,206 FIA (1990 AD) subplots that were modeled to be MHn47 sites.											
[3] Species could not be separated in the PLS data.											
[4] Important historically, these species are no longer a significant component of MHn47 forests and not covered in the accounts of potential crop species.											
Percent of NPC Class in Growth Stage		**33%**	**19%**	**31%**	**25%**	**35%**	**56%**			**2%**	**0%**

APn80: Northern Spruce Bog

APn80: Northern Spruce Bog							
Tree Suitability	**Tree Species**	**Young (0-55)**		**~55**		**Mature (> 55)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1d	Black Spruce	28%	71%	↑↑↑	↑↑	51%	83%
2	Tamarack	54%	24%	↓↓	↓↓	35%	12%
	White Cedar[3]	2%	0%	↑	-	5%	0%
	Jack Pine[3]	5%	--	↓	-	3%	--
	Balsam Fir	2%	3%	↑	-	3%	3%
	Miscellaneous	9%	2%	↓	-	3%	2%
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 1,425 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 1,642 FIA (1990 AD) subplots that were modeled to be APn80 sites. [3] Important historically, white cedar and jack pine are no longer a significant component of APn80 forests and not covered in the accounts of potential crop species.							
Percent of NPC Class in Growth Stage		**30%**	**47%**			**70%**	**53%**

APn81: Northern Poor Conifer Swamp

APn81: Northern Poor Conifer Swamp							
Tree Suitability	**Tree Species**	**Young (0-55)**		**~55**		**Mature (> 55)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1d	Black Spruce	21%	59%	↑	↑	27%	66%
2	Tamarack	77%	29%	↓↓	↓	67%	24%
	Balsam Fir	--	5%	↑	↓	1%	3%
	White Cedar	--	2%	↑	↑	2%	3%
	Miscellaneous	2%	5%	↑	↓	3%	4%
3wd	White Pine						
-	Paper Birch						
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 3,818 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 4,961 FIA (1990 AD) subplots that were modeled to be APn80 sites.							
Percent of NPC Class in Growth Stage		**35%**	**41%**			**65%**	**59%**

FPn63: Northern Cedar Swamp

FPn63: Northern Cedar Swamp											
Tree Suitability	**Tree Species**	**Young (0-55)**		**~55**		**Mature (55-115)**		**~115**		**Old (> 115)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1	White Cedar	27%	12%	↑↑↑↑	↑	62%	18%	↓↓↓	↓	37%	17%
2	Black Spruce	6%	59%	↑	↓	11%	52%	↑	↓↓↓	15%	31%
3d	Balsam Fir	30%	17%	↓↓↓	↑	7%	20%	↑	↑↑	12%	39%
4	Tamarack	25%	7%	↓	-	16%	7%	↑↑	↑	34%	9%
5wd	Paper Birch	5%	3%	↓	-	2%	3%	↓	↑	1%	4%
	Miscellaneous	6%	2%	↓	↓	2%	0%	↓	-	1%	0%
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 922 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 901 FIA (1990 AD) subplots that were modeled to be FPn63 sites.											
Percent of NPC Class in Growth Stage		**11%**	**47%**			**36%**	**48%**			**53%**	**5%**

FPn71: Northern Rich Spruce Swamp (Water Track)

FPn71: Northern Rich Spruce Swamp (Water Track)							
Tree Suitability	**Tree Species**	**Young (0-55)**		**~55**		**Mature (> 55)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1d	Black Spruce	14%	47%	↑↑	↑↑	26%	66%
2	Tamarack	82%	41%	↓↓↓	↓↓	62%	19%
3d	White Cedar	1%	4%	↑	↑	9%	10%
	Balsam Fir	1%	6%	-	↓	1%	4%
	Miscellaneous	2%	2%	-	↓	2%	1%
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 3,003 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 567 FIA (1990 AD) subplots that were modeled to be FPn71 sites.							
Percent of NPC Class in Growth Stage		**27%**	**42%**			**73%**	**58%**

FPn81: Northern Tamarack Spruce Swamp (Water Track)

FPn81: Northern Rich Tamarack Swamp (Water Track)							
Tree Suitability	**Tree Species**	**Young (0-55)**		**~55**		**Mature (> 55)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1	Tamarack	87%	39%	↓↓	↓	68%	33%
2d	Black Spruce	10%	58%	↑↑	↑	24%	60%
	White Cedar	1%	1%	↑	↑	5%	5%
	Miscellaneous	2%	2%	↑	-	3%	2%
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] 3,481 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] 3,505 FIA (1990 AD) subplots that were modeled to be FPn81 sites.							
Percent of NPC Class in Growth Stage		**34%**	**59%**			**66%**	**41%**

WFn55: Northern Wet Ash Swamp

WFn55: Northern Wet Ash Swamp											
Tree Suitability	**Tree Species**	**Young (0-75)**		**~75**		**Mature (75-195)**		**~195**		**Old (> 195)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1w (5wd)	Black (Green) Ash [3]	53%	47%	-	↑	53%	48%	↓↓	-	40%	48%
2d	Quaking Aspen	3%	8%	↓	↓	1%	4%	↑	↓	2%	0%
3wd	Yellow Birch	6%	0%	↓	↑	5%	1%	↓	-	--	1%
4	White Cedar	3%	1%	↑	↑↑	9%	13%	↓	↑↑	4%	26%
7d	Balsam Poplar	1%	10%	↓	↓	--	4%	-	↓	0%	3%
8d	Paper Birch	6%	5%	↓	↓	4%	4%	↓	↑	3%	8%
9d	Balsam Fir	8%	16%	↓	↓	2%	11%	↑	↓	7%	7%
10wd	Basswood	1%	1%	↓	↑	--	2%	-	↑	0%	5%
11wd	American Elm	8%	5%	↓	↑	5%	6%	↑	↓	6%	2%
13 (15d)	Black (White) Spruce [3]	2%	1%	↑	-	9%	1%	↑	↓	15%	0%
-	Tamarack [4]	2%	0%	↑	↑	6%	1%	↑↑	↓	18%	0%
	Miscellaneous	7%	6%	↓	↓	6%	5%	↓	↓	5%	0%
6wd	Red Maple										
12d	White Pine										
14wd	Bur Oak										
-	Sugar maple										

Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program.

For Table Interpretation: See p. 7-2 and 7-3

[1] 1,317 Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD).

[2] 1,672 FIA (1990 AD) subplots that were modeled to be WFn55 sites.

[3] Species could not be separated in the PLS data.

[4] Important historically, tamarack is no longer a significant component of WFn55 forests and not covered in the accounts of potential crop species.

Percent of NPC Class in Growth Stage	**54%**	**49%**			**43%**	**50%**			**3%**	**1%**

WFn64: Northern Very Wet Ash Swamp

WFn64: Northern Very Wet Ash Swamp											
Tree Suitability	**Tree Species**	**Young (0-75)**		**~75**		**Mature (75-135)**		**~135**		**Old (> 135)**	
		PLS[1]	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**	**PLS[1]**	**FIA[2]**
1w	Black Ash	72%	55%	↓	↑	71%	56%	↓↓	↓↓↓	56%	36%
2	Tamarack	1%	0%	↑	-	2%	0%	↑↑	-	12%	0%
3d	Quaking Aspen	2%	6%	↓	↓	1%	4%	↓	↓	--	3%
4	White Cedar	1%	1%	↑	↑	8%	7%	↓	↑↑↑	4%	31%
5wd	Yellow Birch	1%	0%	-	↑	1%	1%	↓	-	--	1%
6wd	Red Maple	1%	1%	-	↓	1%	--	-	-	1%	0%
7d	Paper Birch	4%	4%	↓	↑	3%	5%	-	↓	3%	4%
8wd	American Elm	6%	6%	↓	↑	5%	7%	↑	↓	6%	4%
9d	Balsam Fir	6%	16%	↓	↓	1%	12%	↑	↑	2%	16%
-	White Spruce [3]	1%	1%	↑	-	5%	1%	↑	-	13%	1%
	Balsam Poplar	1%	8%	↓	↓	--	4%		↓	0%	1%
	Miscellaneous Red Elm	6%	3%	↓	↑	4%	4%	-	-	4%	4%
10wd											
Adapted from work done by MN DNR, Division of Forestry, Ecological Land Classification Program. For Table Interpretation: See p. 7-2 and 7-3 [1] Public Land Survey records for section and quarter-section corners (*ca.* 1846-1908 AD). [2] FIA (1990 AD) subplots that were modeled to be WFn64 sites. [3] Important historically, white spruce is no longer a significant component of WFn64 forests and not covered in the accounts of potential crop species.											
Percent of NPC Class in Growth Stage		**55%**	**51%**			**35%**	**40%**			**10%**	**9%**

Appendix F
Spatial Planning Categories

This appendix reports the number of acres by organizational planning category for several of the major public land owners in the North Central Landscape. These acre estimates are from the organization's Land Management Plan.

A. MFRC Landscape Program – 2003 North Central Landscape Plan

Upland Ecological Plant Communities in the North Central Landscape		
Ecological Plant Community	**Acres**	**% of Total**
Boreal Hardwood-Conifer	1,324,000	33.2%
Dry-Mesic Pine	654,000	16.4%
Mesic Northern Hardwoods	188,000	4.7%
Dry-Mesic Pine - Oak	1,582,000	39.6%
Dry Pine	245,000	6.1%
Total	**3,993,000**	**100%**
Adapted from 2003 North Central Landscape Plan (http://mn.gov/frc/north-central-committee.html)		

B. US Forest Service: Chippewa National Forest – Land & Resource Management Plan

Landscape Ecosystems on National Forest Land		
Landscape Ecosystem	**Acres**	**% of Total**
Dry Pine	12,500	2.3%
Dry-mesic Pine	91,000	16.4%
Dry-mesic Pine/Oak	182,400	33.0%
Boreal Hardwood/Conifer	133,200	24.1%
Mesic Northern Hardwoods and Rich Hardwoods	72,400	13.1%
White Cedar Swamp and Semi-terrestrial White Cedar	13,100	2.4%
Tamarack Swamp, Forested Bog, and Forested Poor Fen	48,600	8.8%
Total	**553,200**	**100%**
Adapted from 2004 US Forest Service: Chippewa National Forest – Land & Resource Management Plan (www.fs.usda.gov/main/chippewa/landmanagement/planning)		

C. Leech Lake Band of Ojibwe – Forest Management Plan

Cover Types on Reservation Lands (Tribal, Band, and Allotment)		
Cover Type	**Acres**	**% of Total**
Aspen	6,152	20.6%
Northern Hardwoods	5,095	17.0%
Marsh/Muskeg	3,408	11.4%
Lowland Brush	1,415	4.7%
Non-Productive (Includes housing)	1,409	4.7%
Red Pine	1,211	4.1%
Black Spruce	1,071	3.6%
Jack Pine	1,039	3.5%
Swamp Hardwoods	995	3.3%
Tamarack	858	2.9%
White Cedar	496	1.7%
Paper Birch	487	1.6%
White Pine	135	0.5%
Miscellaneous	1370	4.6%
Uninventoried Lands	4,751	15.9%
Total	**29,892**	**100%**
Adapted from 2002 Leech Lake Band of Ojibwe Forest Management Plan (http://www.llojibwe.com/)		

D. White Earth Nation – Forest Management Plan

Cover Types on Reservation Lands (Tribal, Band, Private, and Allotment)		
Cover Type	**Acres**	**% of Total**
Balsam Poplar	8	0.0%
Aspen-Northern Hardwoods	4,986	6.0%
Green Ash	17	0.0%
Trembling Aspen	18,574	22.4%
White Birch	345	0.4%
Balsam Fir	150	0.2%
Upland Fir-Spruce	195	0.2%
Lowland Brush	8,309	10.0%
Northern Hardwoods-Aspen	10,680	12.9%
Northern Hardwoods	12,532	15.1%
Red Oak	432	0.5%
White Oak	4	0.0%
Scrub Oak	391	0.5%
Jack Pine	403	0.5%
Mixed Pine	92	0.1%
Red Pine	2,380	2.9%
White Pine	82	0.1%
Black Spruce	15	0.0%
Swamp Conifers	305	0.4%
Swamp Hardwoods	1,937	2.3%
White Spruce	350	0.4%
Tamarack	700	0.8%
Bog	76	0.1%
Marsh/Muskeg	1,123	1.4%
Upland Brush	344	0.4%
Beaver Pond	8	0.0%
Lake	5,375	6.5%
Minor Lake	772	0.9%
River-Stream	71	0.1%

Minor Streams	40	0.0%
Farm	2,714	3.3%
Grass	1,545	1.9%
Housing	2,466	3.0%
Industrial	127	0.2%
Recreation	67	0.1%
Sand Dunes	6	0.0%
No Category	5,409	6.5%
Total	**83,033**	**100.0%**
Adapted from 2013 Forest Management Plan: White Earth Nation (https://whiteearth.com/programs/?program_id=8)		

E. Minnesota DNR Forestry – Chippewa Plains-Pine Moraines and Outwash Plains SFRMP

Forest Cover Types on Division of Forestry and Section of Wildlife Lands		
Cover Type	**Acres**	**% of Total**
Aspen/Balm of Gilead	183,353	44.8%
Paper Birch	9,946	2.4%
Ash/Lowland Hardwoods	16,856	4.1%
Northern Hardwoods	16,142	3.9%
Oak	16,056	3.9%
White Pine	2,001	0.5%
Red (Norway) Pine	35,144	8.6%
Jack Pine	14,419	3.5%
Black Spruce, lowland	27,677	6.8%
White Spruce	7,089	1.7%
Balsam Fir	7,749	1.9%
Tamarack	44,269	10.8%
White Cedar	12,579	3.1%
Stagnant Spruce	15,980	3.9%
Total	**409,260**	**100%**
Adapted from 2009 Chippewa Plains-Pine Moraines and Outwash Plains Subsections Forest Resource Management Plan (http://www.dnr.state.mn.us/forestry/subsection/cp_pmop/index.html)		

F. Minnesota DNR Forestry – Hardwood Hills SFRMP

Forest Cover Types on Division of Forestry and Section of Wildlife Lands		
Cover Type	**Acres**	**% of Total**
Ash/Lowland Hardwoods	457	1.7%
Aspen/Balm of Gilead	5,274	19.2%
Balsam Fir	57	0.2%
Black Spruce (upland and lowland)	21	0.1%
Brushland (upland and lowland)	5,912	21.5%
Jack Pine	52	0.2%
Northern Hardwoods	4,529	16.5%
Oak	4,732	17.2%
Openland (upland and lowland grass)	5,393	19.6%
Paper Birch	13	0.0%
Red Pine	154	0.6%
Tamarack	739	2.7%
White Pine	39	0.1%
White Spruce	131	0.5%
Total	**27,503**	**100%**
Adapted from 2012 Hardwood Hills Subsection Forest Resource Management Plan (http://www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html)		

G. Minnesota DNR Forestry – Mille Lacs Uplands SFRMP

Forest Cover Types on Division of Forestry and Section of Wildlife Lands		
Cover Type	**Acres**	**% of Total**
Ash and Lowland Hardwoods	18,537	8.0%
Aspen/Balm of Gilead	99,109	42.7%
Birch	9,934	4.3%
Northern Hardwoods	46,147	19.9%
Oaks and Central Hardwoods	21,101	9.1%
White Pine	551	0.2%
Red Pine	6,770	2.9%
Jack Pine	2,010	0.9%
Scots Pine	25	0.0%
White Spruce	2,705	1.2%
Balsam Fir	2,983	1.3%
Norway Spruce	5	0.0%
Lowland Black Spruce	11,375	4.9%
Tamarack	10,342	4.5%
White Cedar	235	0.1%
Upland Black Spruce	124	0.1%
Red Cedar	9	0.0%
Other species	393	0.2%
Total	**232,355**	**100%**
Adapted from 2008 Mille Lacs Uplands Subsection Forest Resource Management Plan (http://www.dnr.state.mn.us/forestry/subsection/millelacs/index.html)		

H. Minnesota DNR Forestry – St. Louis Moraines, Tamarack Lowlands, Nashwauk Uplands, and Littlefork-Vermilion Uplands SFRMP

Forest Cover Types on Division of Forestry and Section of Wildlife Lands		
Cover Type	**Acres**	**% of Total**
Ash/Lowland Hardwoods	52,319	7.3%
Aspen/Balm of Gilead	260,992	36.6%
Balsam Fir	16,033	2.3%
Birch	10,064	1.4%
Black Spruce, Upland	1,499	0.2%
Black Spruce, Lowland	179,474	25.2%
Tamarack	74,008	10.4%
Jack Pine	13,506	1.9%
Northern Hardwoods	22,706	3.2%
Red Pine	20,992	2.9%
Oak	5,074	0.7%
White Cedar	43,509	6.1%
White Pine	1,541	0.2%
White Spruce	10,695	1.5%
Subsection Total	**712,412**	**100%**

Adapted from 2010 St. Louis Moraines, Tamarack Lowlands, Nashwauk Uplands, and Littlefork-Vermilion Uplands Subsections Forest Resource Management Plan (http://www.dnr.state.mn.us/forestry/subsection/millelacs/index.html)

I. Aitkin County – Land Department Long Range Strategic Plan

Commercial Forest Cover Types		
Cover Type	**Acres**	**% of Total**
Ash	17,122	10.6%
Lowland Hardwoods	4,127	2.6%
Aspen	59,659	37.1%
Birch	2,804	1.7%
Balm of Gilead	110	0.1%
Northern Hardwoods	35,779	22.2%
Oak	9,820	6.1%
White Pine	366	0.2%
Red Pine	3,135	1.9%
Jack Pine	56	0.0%
White Spruce	1,946	1.2%
Balsam Fir	1,437	0.9%
Black Spruce, upland	133	0.1%
Tamarack	12,373	7.7%
White Cedar	2,662	1.7%
Black Spruce, lowland	9,324	5.8%
Total	**160,853**	**100%**

Forest Ecological Systems on Tax-Forfeited Land		
Forest Ecological System	**Acres**	**% of Total**
Dry-Mesic Hardwood-Conifer	22,940	10.3%
Dry-Mesic Conifer	5,798	2.6%
Mesic-Mixed Hardwood	37,289	16.8%
Mesic Northern Hardwood	24,524	11.0%
Wet-Mesic Boreal Hardwood-Conifer Forest	16,845	7.6%
Wet-Mesic Lowland Hardwood	3,287	1.5%
Wet Mesic Hardwood	13,606	6.1%
Organic Hardwood-Conifer	39,525	17.8%
Organic Lowland Conifer	58,727	26.4%

Total	**222,541**	**100%**

Adapted from 2011 Aitkin County Land Department Long Range Strategic Plan (https://www.co.aitkin.mn.us/departments/Land/landhome.html)

J. Becker County – Forest Plan

Commercial Forest Cover Types		
Cover Type	**Acres**	**% of Total**
Ash	541	0.9%
Aspen/Balm of Gilead	35,007	56.8%
Balsam Fir	972	1.6%
Black Spruce	568	0.9%
Jack Pine	2,331	3.8%
Lowland Hardwoods	890	1.4%
Northern Hardwoods	9,658	15.7%
Norway Pine	2,639	4.3%
Oak	5,088	8.3%
Tamarack	2,734	4.4%
Birch	924	1.5%
White Spruce	130	0.2%
White Pine	99	0.2%
Total	**61,581**	**100%**
Adapted from 2013 Becker County Forest Plan (http://www.co.becker.mn.us/dept/natural_resource/default.aspx)		

K. Beltrami County – Forest Management Plan

Commercial Forest Cover Types		
Cover Type	**Acres**	**% of Total**
Ash	2,705	2.6%
Lowland Hardwoods	3,160	3.1%
Aspen	51,281	49.6%
Birch	2,411	2.3%
Balm of Gilead	2,641	2.6%
Northern Hardwood	8,659	8.4%
Oak	1,040	1.0%
White Pine	421	0.4%
Red Pine	12,369	12.0%
Jack Pine	5,963	5.8%
White Spruce	997	1.0%
Balsam Fir	2,499	2.4%
Black Spruce	4,383	4.2%
Tamarack	4,893	4.7%
Total	**103,422**	**100%**

Cover Types on Tax-Forfeited Land		
Cover Type	**Acres**	**% of Total**
Ash	2,873	2.0%
Lowland Hardwoods	3,193	2.2%
Aspen	52,978	37.2%
Birch	2,560	1.8%
Balm of Gilead	2,663	1.9%
Northern Hardwoods	9,049	6.4%
Oak	1,040	0.7%
Central Hardwoods	7	0.0%
White Pine	436	0.3%
Jack Pine	6,069	4.3%
Norway Pine	12,697	8.9%

Scotch Pine	1	0.0%
White Spruce	997	0.7%
Balsam Fir	2,573	1.8%
Black Spruce (lowland)	4,440	3.1%
White Cedar	5,230	3.7%
Stagnant Spruce - SI 22 or less	121	0.1%
Stagnant Tamarack - SI 22 or less	53	0.0%
Stagnant Cedar	569	0.4%
Offsite Aspen - SI 34 or less	3	0.0%
Cutover area	3,523	2.5%
Lowland grass	3,761	2.6%
Upland grass	994	0.7%
Lowland brush	11,658	8.2%
Upland brush	207	0.1%
Agriculture	612	0.4%
Industrial development	250	0.2%
Recreation development	74	0.1%
Roads	224	0.2%
Rock outcrop	10	0.0%
Permanent water	1,513	1.1%
Non-permanent Water	5,945	4.2%
Marsh	5,702	4.0%
Muskeg	398	0.3%
Total	**142,423**	**100%**

Landscape Ecosystems on Tax-Forfeited Land		
Landscape Ecosystem	**Acres**	**% of Total**
Boreal Hardwood Conifer	35,034	37.8%
Dry Mesic Pine	12,829	13.8%
Dry Mesic Pine/Oak	28,203	30.4%
Dry Pine	9,951	10.7%
Mesic Northern Hardwoods	159	0.2%

White Cedar Swamp	6,495	7.0%
Total	**92,671**	**100%**
Adapted from 2007 Beltrami County Forest Management Plan (http://www.co.beltrami.mn.us/Departments/NRM/Forest_Mgmt.html)		

L. Cass County – Resource Management Plan

Cover Types on Tax-Forfeited Land		
Cover Type	**Acres**	**% of Total**
Ash	5,330	2.1%
Lowland Hardwoods	2,750	1.1%
Aspen	117,124	46.1%
Birch	9,516	3.7%
Balm of Gilead	948	0.4%
Northern Hardwoods	8,905	3.5%
Oak	10,341	4.1%
Central Hardwoods	2	0.0%
White Pine	369	0.1%
Red Pine	9,398	3.7%
Jack Pine	3,940	1.6%
White spruce	207	0.1%
Balsam Fir	2,592	1.0%
Black Spruce, lowland	3,077	1.2%
Tamarack	4,721	1.9%
White Cedar	3,704	1.5%
Stagnant Spruce	1,000	0.4%
Stagnant Tamarack	270	0.1%
Stagnant Cedar	1,845	0.7%
Cutover area	1,507	0.6%
Lowland grass	5,796	2.3%
Upland grass	1,864	0.7%
Lowland brush	20,572	8.1%
Upland brush	361	0.1%
Agricultural	281	0.1%
Industrial development	783	0.3%
Recreational development	10	0.0%
Roads	365	0.1%
Permanent water	5,600	2.2%

Non-permanent water	5,820	2.3%
Marsh	22,974	9.0%
Muskeg	1,909	0.8%
Other	157	0.1%
Total	**254,038**	**100%**

Commercial Forest Cover Types		
Cover Type	**Acres**	**% of Total**
Ash	5,324	2.9%
Lowland Hardwoods	2,742	1.5%
Aspen	116,689	63.4%
Birch	9,479	5.2%
Balm of Gilead	945	0.5%
Northern Hardwoods	8,888	4.8%
Oak	10,335	5.6%
White Pine	368	0.2%
Red Pine	9,396	5.1%
Jack Pine	3,931	2.1%
White Spruce	207	0.1%
Balsam Fir	2,589	1.4%
Black Spruce, lowland	3,077	1.7%
Tamarack	4,721	2.6%
White Cedar	3,704	2.0%
Other	1,562	0.8%
Total	**183,957**	**100%**

Commercial Forest Native Plant Communities		
Native Plant Community	**Acres**	**% of Total**
FDc24: Central Rich Dry Pine Woodland	7,071	4.4%
FDc34: Central Dry-Mesic Pine-Hardwood Forest	42,356	26.5%
FDn33: Northern Dry-Mesic Mixed Woodland	60,937	38.2%
MHc26: Central Dry-Mesic Oak-Aspen Forest	8,492	5.3%
MHc36: Central Mesic Hardwood Forest	8,632	5.4%

MHn35: Northern Mesic Hardwood Forest	3,489	2.2%
MHn44: Northern Wet-Mesic Boreal Hardwood-Conifer Forest	15,871	9.9%
FPn82: Northern Rich Tamarack Swamp	9,993	6.3%
WFn64: Northern Very Wet Ash Swamp	1,126	0.7%
WMn82: Northern Wet Meadow/Carr	1,677	1.1%
Total	**159,644**	**100%**
Adapted from 2010 Cass County Long Range Resource Management Plan (http://www.co.cass.mn.us/government/county_directory/land_department/index.php)		

M. Clearwater County – Resource Management Plan

Cover Types on Tax-Forfeited Land		
Cover Type	**Acres**	**% of Total**
Ash	996	1.1%
Aspen	42,066	46.4%
Balm of Gilead	473	0.5%
Balsam Fir	891	1.0%
Birch	4,093	4.5%
Black Spruce, lowland	931	1.0%
Black Spruce, upland	12	0.0%
Cotton Wood	87	0.1%
Jack Pine	1,533	1.7%
Lowland Hardwoods	694	0.8%
Northern Hardwoods	7,774	8.6%
Norway/Red Pine	5,230	5.8%
Oak	2,325	2.6%
Scotch Pine	3	0.0%
Stagnant Spruce	28	0.0%
Stagnant Tamarack	27	0.0%
Tamarack	1,530	1.7%
White Cedar	225	0.2%
White Pine	855	0.9%
White Spruce	1,078	1.2%
Non commercial	16,205	17.9%
Unknown	3,523	3.9%
Total	**90,579**	**100%**
Adapted from 2008 Clearwater County Resource Management Plan (http://www.co.clearwater.mn.us/index.asp?Type=B_LIST&SEC={DFAB31DE-47C5-434F-9AB7-05086E118B6E})		

N. Crow Wing County – Forest Resources Plan

Commercial Forest Cover Types		
Cover Type	**Acres**	**% of Total**
Ash	2,392	3.3%
Lowland Hardwoods	677	0.9%
Aspen	42,481	58.8%
Birch	1,371	1.9%
Northern Hardwoods	4,029	5.6%
Oak	13,282	18.4%
White Pine	158	0.2%
Red Pine	3,107	4.3%
Jack Pine	439	0.6%
White Spruce	418	0.6%
Balsam Fir	320	0.4%
Black Spruce, lowland	1,879	2.6%
Tamarack	1,631	2.3%
White Cedar	102	0.1%
Black Spruce, upland	11	0.0%
Total	**72,297**	**100%**

Native Plant Communities on Tax-Forfeited Lands		
Native Plant Community	**Acres**	**% of Total**
FDc23: Central Dry Pine Woodland	172	0.2%
FDc24: Central Rich Dry Pine Woodland	7,343	7.1%
FDc34: Central Dry-Mesic Pine-Hardwood Forest	7,027	6.8%
FDn33: Northern Dry-Mesic Mixed Woodland	906	0.9%
MHc26: Central Dry-Mesic Oak-Aspen Forest	34,111	33.0%
MHc36: Central Forest (Eastern)	7,379	7.1%
MHn35: Northern Forest	13,449	13.0%
MHn44: Northern Wet-Mesic Boreal Hardwood-Conifer Forest	1,949	1.9%
MHn46: Northern Wet-Mesic Hardwood Forest	2,980	2.9%
MHn47: Northern Rich Forest	189	0.2%

FPn72: Northern Rich Tamarack Swamp (Eastern Basin)	116	0.1%
FPn82: Northern Rich Tamarack Swamp (Western Basin)	1,409	1.4%
WFn55: Northern Wet Ash Swamp	1,844	1.8%
WFn64: Northern Very Wet Ash Swamp	11,213	10.8%
WMn82: Northern Wet Meadow/Carr	9,551	9.2%
APn80: Northern Spruce Bog	2,601	2.5%
APn81: Northern Poor Conifer Swamp	26	0.0%
Water	1,232	1.2%
Total	**103,497**	**100%**
Adapted from 2015 Forest Resources Plan for the Tax-Forfeited Lands of Crow Wing County (http://crowwing.us/261/Forest-Management)		

O. Hubbard County – Forest Resource Management Plan

Cover Types on Tax-Forfeited Lands		
Cover Type	**Acres**	**% of Total**
Ash	946	0.7%
Aspen	66,195	48.1%
Balm of Gilead	437	0.3%
Balsam Fir	3,186	2.3%
Birch	7,652	5.6%
Black Spruce, lowland	3,836	2.8%
Lowland Hardwoods	416	0.3%
Northern Hardwoods	3,080	2.2%
Jack Pine	16,193	11.8%
Red Pine	6,698	4.9%
White Pine	191	0.1%
Oak	3,926	2.9%
Tamarack	2,708	2.0%
White Cedar	291	0.2%
White Spruce	665	0.5%
Stagnant Cedar/Spruce/Tamarack	181	0.1%
Upland grass/brush	1,667	1.2%
Lowland grass/brush	10,123	7.4%
Offsite Aspen-Oak/cutover area	1,001	0.7%
Marsh/Muskeg	4,273	3.1%
Permanent water	2,518	1.8%
Non-permanent water	780	0.6%
Developed/Roads/Agricultural/Other	629	0.5%
Total	**137,592**	**100%**

Forest Ecological Systems on Tax-Forfeited Land		
Forest Ecological System	**Acres**	**% of Total**
Dry Pine/Oak Woodland	1,232	0.9%
Dry Poor Pine	23,837	17.7%

Dry Pine/Oak Woodland	8,212	6.1%
Dry Mesic Pine	48,781	36.2%
Dry Mesic Pine/Oak Forest	23,711	17.6%
Mesic Oak Forest	1,442	1.1%
Wet Mesic Lowland Mixed	2,505	1.9%
Organic Lowland Conifer	25,119	18.6%
Total	**134,839**	**100%**
Adapted from 2002 Hubbard County Tax-Forfeited Lands: Forest Resources Management Plan (http://www.co.hubbard.mn.us/Public%20Works/resourcemgmt.htm)		

P. Itasca County – Land Management Plan

Overstory Types on Tax-Forfeited Lands		
Overstory Type	**Acres**	**% of Total**
White Pine	388	0.1%
Red Pine	18,878	6.4%
Jack Pine	5,233	1.8%
Balsam Fir	2,913	1.0%
White Spruce	8,233	2.8%
Black Spruce	20,536	7.0%
Tamarack	10,485	3.6%
White Cedar	9,507	3.2%
Northern Hardwoods	7,817	2.7%
Red Oak	1,029	0.3%
Lowland Hardwoods	6,835	2.3%
Ash	9,958	3.4%
Balm of Gilead	2,790	0.9%
Aspen	111,404	37.8%
Birch	5,548	1.9%
Upland grass	1,184	0.4%
Duff	111	0.0%
Upland brush	514	0.2%
Offsite Aspen	62	0.0%
Lowland grass	5,062	1.7%
Lowland brush	30,319	10.3%
Beaver Pond	4,595	1.6%
Marsh	5,030	1.7%
Muskeg	8,642	2.9%
Permanent water	4,465	1.5%
Industrial/urban	3,556	1.2%
Stagnant Spruce	6,790	2.3%
Stagnant Tamarack	1,856	0.6%
Stagnant Cedar	370	0.1%

Stagnant (offsite) Ash	49	0.0%
Rock outcrop	208	0.1%
Total	**294,367**	**100%**

Ecological Forest and Non-Forest Types on Tax-Forfeited Lands		
Ecological Type	**Acres**	**% of Total**
Pine	24,486	8.4%
Spruce-Fir	12,228	4.2%
Northern Hardwoods	8,937	3.1%
Aspen/Birch	118,400	40.6%
Lowland Conifer	51,460	17.6%
Lowland Hardwoods	19,403	6.7%
Upland grass/brush	2,277	0.8%
Lowland brush	30,376	10.4%
Lowland grass	4,884	1.7%
Muskeg	8,834	3.0%
Marsh	5,332	1.8%
Open water	5,000	1.7%
Total	**291,617**	**100%**
Adapted from 2009 Itasca County Land Department: Land Management Plan (http://www.co.itasca.mn.us/Home/Departments/Land/Pages/default.aspx)		

Appendix G
Partner Modeling Tools, Maps, and Data

This section lists the models, maps, and data produced by partners to assist with the implementation of conservation projects. Many of these tools were used in the development of the Second Generation North Central Landscape Plan.

Study or Model Name	Description, Scale, Coverage, etc.	Contact Person	Agency
Inventory Mapping and Data			
Resource Atlas	76 inventory maps and tables which span ecological, economic and social topics	Jeff Reinhart	MFRC
Ecological Resource Data and Modeling			
Potential Native Plant Community Mapping Study	Laurentian Province – predicted native plant communities at system and class levels	George Host	NRRI
LANDIS II	Climate change forest landscape model	Kelly Barrett	US FS
Biodiversity Significance	Statewide (in progress) – sites ranked as "outstanding", "high", "moderate", or "below"	?	DNR Eco and Water Res.
High Conservation Value Forests	Statewide – DNR owned/managed lands	?	DNR Forestry
Old Growth Forests	Statewide – DNR owned/managed lands	?	DNR Forestry
Ecologically Important Lowland Conifers	Statewide – DNR owned/managed lands	?	DNR Forestry
WRAPs	Statewide – Major watershed level	?	MPCA
1 Watershed 1 Plan	Statewide – Priority major watersheds	Doug Thomas	BWSR
County Water Plans	County level mapping and data	Dan Steward	BWSR
Watershed Health Assessment Framework	Statewide	Ian Chisholm	DNR
Source Water Protection	Ranking of major watersheds for risk. *Forests, Water and People: Drinking water supply and forest lands*	?	US FS
TMDL Studies	Impaired waters	?	MPCA
Fish Habitat Conservation Framework	Statewide	Pete Jacobson Tim Cross	DNR Fisheries

Zonation Model - NCCR	Upper Mississippi River Basin Major watersheds	Todd Holman Paul Radomsky	TNC DNR
Deer Density Modeling		Erik Thorson	DNR Wildlife
Minnesota Forests for the Future Priority Forests	Statewide identification of priority private forest lands with high recreational, economic, and ecological values.	Andy Holdsworth Bart Richardson	DNR TNC
Economic Resource Data and Modeling			
North Central Minnesota Forestry Economic Impact Analysis 10-Year Projections	Analysis of the economic impacts of different scenarios on the forestry industry in the MFRC North Central region	Monica Haynes	UMD BBER
Social Resource Data and Modeling			
Parcelization Potential of Forest Lands	Itasca County forest land parcelization potential	George Host	NRRI
Forest Management			
Private Forest Mgmt Important Forest Resource Areas (IFRAs) and the Spatial Analysis Project (SAP) mapping	Statewide – prioritizes areas to focus private forest management efforts (high, medium, low priority)	Gary Michael John Carlson Jeff Reinhart	DNR Forestry
State Land Management Mgmt opportunity areas (MOAs)	NMOP SFRMP example • 18 Small Block Habitat Areas (RGMAs) • 8 Landscape Management Areas (Roseau River watershed management area) • 2 Large Block Management Areas (goshawk management areas) • 3 Winter Habitat Management Areas (deer yards) • 11 Patches (old / large) • Priority Open Landscapes identified • 11 +- OFMC Management Areas (inventory in progress)	Jon Drimel	DNR Forestry
School Trust Lands		Aaron Vande Linde	DNR Lands & Minerals
Strategic Land Asset Mgmt		Bob Tomlinson	DNR Lands & Minerals
Funding Development			
State Forest Action Plan (FAP)	• Four spatial models depict significant areas in Minnesota‘s Forests.	Helen Cozzetto	DNR Forestry

	• Threats and Risks map • Economic Impact map • Ecological Values map • Recreational Values map		
State Wildlife Action Plan (SWAP)	?	?	DNR Wildlife

25-Year LSOHC Forest Habitat Vision	• Statewide – priority forest habitat areas for LSOHC investment
	• Protect and restore forest cover in riparian areas
	  o Restore and enhance fish, game, and other wildlife habitat by Conducting habitat work in priority areas
	  o Conducting silvicultural and other forest habitat and land management work outside the scope of commercial forestry
	• Protect Minnesota forests and forest wildlife habitat via permanent conservation easements
	• Protect contiguous forest complexes
		Lindberg Ekola
		Jeff Reinhart
			MFRC
			MFRP

Appendix H
Committee Operations Guide

Preamble

The North Central Landscape Coordination (NC) Committee is a public forum for diverse interests to cooperatively promote sustainable forestry in the region as envisioned by the Sustainable Forest Resources Act and its landscape program. The Landscape Program is supported by the State General Fund. By bringing together representative interests from the region, the committee serves as a springboard for effective forest management activities that address specific needs and challenges in the region.

The NC Committee is the organizational structure of the Minnesota Forest Resources Council (MFRC) that ensures the ongoing and consistent coordination and implementation of the North Central Landscape Plan.

Statutory Mandate

The MFRC is a 17-member organization that promotes the long-term sustainable management of Minnesota's forests as directed by the Minnesota legislature in the Sustainable Forest Resources Act of 1995 (SFRA - Minnesota Statutes §89A). The MFRC is responsible for coordinating the implementation of the SFRA. They advise the Governor and federal, state, county, and local governments on sustainable forest resource policies and practices. The Council has four main purposes:

- Pursue the sustainable management, use, and protection of the state's forest resources to achieve the state's economic, environmental, and social goals.
- Encourage cooperation and collaboration between public and private sectors in the management of the state's forest resources.
- Recognize and consider forest resource issues, concerns, and impacts at the site and landscape levels.
- Recognize the broad array of perspectives regarding the management, use, and protection of the state's forest resources, and establish processes and mechanisms that seek these perspectives and incorporate them into planning and management.

The NC Committee is the primary component of the MFRC's administrative policy to promote sustainable forestry through its Landscape Program in the region. The NC Committee supports the MFRC's goal to increase transparency and public involvement through the consultation processes in connection with landscape management activities – planning, coordination, implementation and monitoring/evaluation.

Since the approval of the first generation North Central Landscape Plan in 2003, the NC Committee has met on a regular basis to guide implementation of the Plan and support coordination of land management activities. The NC Committee actively works to:

- Encourage consideration of the landscape-level context by all agencies, organizations, industry, and private landowners when developing their resource management plans and implementation projects.
- Coordinate and support projects by partnering organizations that promote sustainable forest management practices in the landscape region.
- Develop and implement committee projects that proactively address the goals and strategies outlined in the North Central Landscape Plan and other relevant plans and policies.
- Monitor activities and outcomes of projects implemented by the Committee, as well as those by partnering organizations and landowners across the landscape region.

Context

What are the challenges and opportunities facing the NC Committee in its promoting the implementation of the Plan and how it functions? Why is an operational guidance document needed?

- Inconsistent attendance and participation. At meetings over the last several years, there has been less than 25 percent of the original NC Committee members and relevant organizations (as established after the NC landscape plan was approved) represented or attending. The lack of attendance has diminished the Committee's capacity to promote the "all lands" coordination functions as envisioned by the SFRA.
- Committee continuity. While the number of persons attending meetings has remained high (15 to 20 people per meeting), different people are attending each meeting. This forces the Chair and staff to repeatedly describe or present committee organizational and operational matters. This wastes valuable committee time. It extends the length of meetings and prevents more productive things from getting accomplished. It has become a negative factor to a number of interested persons who might have contributed more time and resources to the Committee and relevant project but instead have decided to not get involved.
- Committee staff changes. Changes in staffing by committee members representing the partnering organizations through retirements, new jobs, etc. places impacts on the committee membership and vitality. It takes significant effort and staff time to maintain the committee membership. Committee members can support some membership recruitment efforts but generally do not have time to actively do this maintenance work.
- Limited involvement and inconsistent support. There has been limited involvement and inconsistent support of the Committee by "primary" agencies and organizations such as MN DNR Forestry, Chippewa NF, counties and industry, at meetings and on committee projects. Further, changes in staffing impacts internal communications and results in the leaders of these entities not being aware of the Committee's initiatives and projects. This minimizes the success of these projects and hampers the successful implementation of the landscape plan.
- Limited MFRC staff capacity. The MFRC Landscape Program has been underfunded for the past 9 plus years (1.0 FTE current staffing vs. 2.0 FTE previous staffing level). There often is not adequate time and resources to provide proper support to the Committee on operational and organizational matters (too short of lead times on meeting notices, late distribution of meeting materials, lack of meeting summaries, etc.). Under the current budget situation, there is not adequate staff time or resources to properly support Committee projects.
- The Constitutional Amendment and the funding opportunities over the next 20 years, creates great opportunities to implement the NC Landscape Plan. The Committee's work on the LSOHC 25-Year Implementation Vision, for example, resulted in increased interest in developing collaborative forest habitat projects. The Tullibee Lakeshed project utilizing Clean Water Funds illustrates another excellent collaboration example that can be more effectively replicated if the Committee was better organized and functioning more efficiently.
- Growing interest. There is a growing interest by individuals and organizations to get involved with the Committee. They bring very broad range of interests to the Committee but the lack of staff capacity to meet a meaningful level of their needs limits continued involvement.

- Successful federal funding. The recent success by the regional committees (MFRC Landscape Program and DNR Forestry) to secure federal funding through the US Forest Service S&P F Program has also gained greater attention by partners in the region. This is another great opportunity to significantly enhance implementation of the Landscape Plan, but under present operational procedures, we are not capitalizing on this opportunity.
- Limited seed funding. The current seed money available to the Committee (historically $5,000 per year) is too small to get the attention of committee members in developing projects. An increase in seed funding is needed to increase the success of securing federal and state funds.
- Roles. The SFRA and the MFRC provides limited direction on how the Committee should be organized, what are its roles in a time with exceptional funding opportunities through the Legacy Amendment, and how it should function to increase the implementation of the landscape plans. Over the past ten years, the Committee has incrementally developed its own set of informal set of operational approaches to enhance coordination and implementation efforts. This document is based on these approaches.

Goal

The goal of this operations guide is to help the NC Committee become more efficient and effective in its operations, enhance coordination amongst partners, and increase the implementation of the landscape plan. The guide is intended to help make better use of committee member's time and efforts.

Committee Structures

The NC Committee shall operate continuously. A separate planning committee will be created every 10 or so years to develop an update to the North Central landscape plan and be referred to as the NC Planning Committee. Members of the NC Planning Committee are encouraged to also serve on the NC Committee (see attached diagram – Organizing History).

Membership

The NC Committee will strive to be inclusive yet include a manageable number of people. To the extent possible and practical, the NC Committee shall be composed of a balanced yet diverse set of interests with respect to the management and use of the forest resources within the landscape region. A mix of public and private interests including land owners and managers should be involved in the region's landscape management program.

The NC Committee will consist of 30 members and 1 chair person. The members will represent the entities included on the attached list of partnering entities or interests (see attached list of partnering entities).

Members will be asked to attend meetings as regularly as possible, and not send alternates. This is important for group solidarity, trust and continuity. If an alternate does attend a meeting, they can participate in the committee discussions but are not eligible to vote, as practiced by the Council.

In the interest of maintaining the Committee's cohesive dynamics, members are asked to commit to an initial term of four years. Staggered terms will be used to distribute the member experience base but the length of the terms will be according to individual member's choice. Poor attendance without cause indicates a lack of interest. Members in this situation will be encouraged to resign from the Committee and be replaced by a more active member. A letter will be sent out from the Committee to a non-participating member notifying them that they are not meeting the attendance

standard and asked to either agree to meet the attendance requirement or resign. If the member does not respond within 30 calendar days, the member will be removed from the Committee and replaced by the Chair.

Nomination and Selection Process

- The chair will send out a letter every two years asking representative organizations or groups of stakeholders in the region to nominate individuals to serve on the committee.
- Each representative organization may have up to one person serving on the committee.
- The current committee will approve members to the committee at their last quarterly meeting every second year.

When a vacancy occurs, the Chair and staff will confer with the entity being represented to solicit names of potential persons interested in serving on the NC Committee. The representative entity will submit the name of the person they wish to serve on the Committee. The NC Committee will decide on the new member at the next meeting.

Roles and Expectations of Committee Members

- Individuals serving on the committee must:
- reside (including seasonally) within the landscape region for which the regional committee has responsibility for fostering landscape-based planning and coordinating activities.
- be committed to the goal of sustainable forest management and be interested in or affected by management of forest resources within the landscape region.
- be willing to work collaboratively with others, including those with different interests and values with respect to fostering landscape-based planning and coordination.
- be able to commit the time and energy required to further the landscape based planning and coordination goals of the regional committee.
- attend at least 50 percent of the meetings during their term.
- recognize the voluntary nature of the landscape-base planning and coordination program.
- support the development of the landscape level monitoring program.
- regularly communicate committee efforts and progress back to their home agencies and organizations.

Non Committee Members

- All interested people will have the opportunity to be involved in the process of landscape planning and coordination; those not serving on the NC Committee will have the opportunity to become part of a formal network that the committee will utilize for feedback and input, collaborative projects, ad-hoc working assignments, subcommittees, etc.

Leadership

The committee will maintain the following leadership positions. Leaders will be approved for 2 year terms and elected by the Committee.

- Chair – lead and facilitate committee meetings, set agendas with staff, sign letters on behalf of the committee, represent the committee at various functions and events such as the MFRC annual meeting and tour.
- Vice Chair – lead and facilitate committee meetings when chair is absent.
- Past chair – committee historian, back up to chair and vice chair as needed.
- Secretary – prepare meeting summaries.
- Outreach leaders – ombudsmen that supports outreach efforts in each county in the region. Distributes and shares information about the committee, the NC landscape plan, and the MFRC to entities in their home county on periodic basis.
- Fiscal Agent / Grant Support – serve supporting roles to committee and partners on project and funding development. Gives reports on current grants and emerging opportunities at each meeting.
- Education Liaison – represent the committee on SFEC, MLEP and Extension education committees and functions. Gives reports on upcoming education events and opportunities relevant to topics of interest to the Committee as well as completed events.
- MFRP Rep – represent the committee at MFRP meetings and functions.
- MFA Rep – represent the committee at MFA meetings and functions.
- MACF Rep – represent the committee at MACF meetings and functions.
- MASWCD Rep – represent the committee at MASCWD meetings and functions.

Management and Administration

NC Committee Functions

The NC Committee supports the coordination and implementation of a wide range of forest and related natural resource initiatives through a variety of approaches and methods. The NC Committee serves as a catalyst to initiate the development of projects, especially where the issues to be addressed are cross boundary in nature or in scope. The projects are designed to support the implementation of the MFRC landscape plans as well as partners' plans such as the MN DNR SFRMPs, Forest Action Plan, national forest plans, county forest management plans, tribal plans, forest stewardship plans, LSOHC habitat plans, etc. The following list summarizes the range of functions the NC Committee will likely take over the next ten years:

- Convening forums
- Partnerships – formation, development, support and maintenance
- Landscape vision
- Priority setting
- Policy recommendations
- Policy coordination and implementation
- Project development
- Funding development
- Letters of support
- Grant writing and grant administration
- Fiscal agents

- Project management
- Monitoring and evaluation

Meeting Processes

- The chair will preside over all committee meetings. The vice chair will serve as the first alternate if the chair is not able to attend, that past chair will serve as second alternate. If the chair, vice chair, and past chair are not able to attend, MFRC Landscape Program staff shall facilitate the meeting.
- The committee will use Robert's Rules of Order to guide meeting procedures. The chair has the prerogative to relax the use of the rules as he/she deems appropriate for running the meeting or portion thereof including work sessions incorporated into quarterly meetings (see attached diagram – Meeting Format).
- The Secretary will prepare meeting summaries including the recording of all Committee motions and voting results.
- Staff will work with the chair and/or vice chair to prepare agendas and materials for the committee meetings.
- All committee and subcommittee or work group meetings are open to the public.
- A public comment period will be provided at the beginning and end of all quarterly committee meetings. The chair may call on attending public to participate in the committee meeting dialogue.
- Information brought to and shared at regional committee meetings is considered public.

Decision Making / Voting

In general, a consensus based approach will be used for decision making. Roberts Rules of Order will be used to guide committee decision making. The chair may decide to relax the decision making process to help stimulate the development of concepts and projects. If a consensus cannot be reached on a matter, the committee will consider options as how to address the item. The following are the four options:

1. Decide. Make a decision on the matter at that given meeting.
2. Table. Move the item or matter to the next meeting so that the committee members and staff can do further research.
3. Subcommittee. Create a subcommittee to work on the item further and bring it back to the committee for further discussion.
4. Outside the Scope. Determine that the item or matter is outside the scope of the landscape planning, coordination or implementation process.

A simple majority vote of members attending the meeting will decide the option or approach to be taken. A final opportunity to resolve a stalled or controversial decision may be to refer the decision to the Council's Landscape Committee or the Council.

Ultimately, the Council is required to approve all landscape plans, policy recommendations, and other recommendations addressing significant forest resource issues that would have the effect of binding the Council.

This document may be amended by a two-thirds majority vote of the attending committee at quarterly committee meetings.

Speaker Guidelines

- Regional committees are encouraged to maintain a list of potential speakers and topics appropriate to their needs and concerns.
- Speakers are encouraged to provide copies of the presentation materials for distribution at the meeting. Speakers should be comfortable with sharing information and its availability to the public.
- Speakers are encouraged to share copies of their power point presentations for placing on the MFRC website.

Committee Operations

- The MFRC will cover committee member's out-of-pocket costs (e.g., mileage reimbursement, food, lodging) resulting from their participation in regional committee activities. Agency and organization members will be asked to cover their own expenses given limited program budgets.

Policy Recommendations and Priorities

Policy Recommendations

As established in the Minnesota Sustainable Forest Resources Act (SFRA), the regional landscape committees are to provide regional perspectives to the Minnesota Forest Resources Council (MFRC) on sustainable forestry matters. With this assigned responsibility, the regional committees play a critical advisory role in shaping and implementing forest policy in Minnesota. To carry out this mission, the NC Committee will:

- submit a letter of recommendations to the MFRC every 4 years as a part of the Council's strategic forest policy development program.
- provide periodic recommendations on forest policy matters as they arise or requested by the Council.

Priority Setting

Since 2005, each of the six MFRC regional landscape committees has been setting priorities on various policy documents in coordination with the implementation of the landscape plans. Input has been gathered through the regional committee meeting discussions and a series of worksheets (the yellow colored papers). The following list provides a brief overview of the priority setting efforts that the NC Committee has taken to date

1. Landscape plans. The NC Committee prioritized the desired future conditions, goals and strategies in their landscape plan.
2. Committee annual work programs and budgets. The NC Committee developed on an annual basis a work program and budget (guiding the $5,000 seed moneys per committee per year).
3. Committee projects. The NC Committee developed and prioritized a list of potential projects: 1) outreach and education, 2) research and development, 3) on the ground pilot or demonstration projects.
4. Policy priorities. The NC Committee has formally submitted letters outlining recommendations to the MFRC for their consideration in the Council's 2012 Forest Policy Development.
5. Research priorities. The NC Committee has provided recommendations on topical areas needing research to the MFRC and the Research Advisory Council (RAC).
6. MFRP Timber Productivity Process. The NC Committee has prioritized the list of action areas, strategies, action steps and tasks developed for this MFRP process. These regional priorities have been shared with the MFRC and the MFRP.

7. LSOHC 25-Year Forest Habitat Implementation Vision. The NC Committee identified key resource topics and geographic areas where LSOHC funds should be targeted within the landscape regions. This document has been accepted by the Minnesota State Legislature as a guide to LSOHC funds.
8. Minnesota State Forest Action Plan (FAP). The NC Committee commented on inventory and assessment, edited the implementation matrices, and prioritized the ten major issues listed in the FAP. The FAP is a requirement established of the US Congress to guide the use of federal funding from the US Forest Service S&P F Program for forestry in each state.
9. MFRC Parcelization Study Implementation. Prioritize the study's policy options and strategies in order to support their successful implementation.
10. Commissioner Landwehr's Request for Recommendations on Growing and Maintaining the Forest Products Industry. At the May 21, 2012 meeting, DNR Commissioner Tom Landwehr requested that the MFRC develop recommendations on actions to grow and maintain the forest products industry by September of 2012. The NC Committee reviewed and commented on the recommendations being submitted to the Commissioner.
11. Private Forest Land Study (HF 2164). The NC Committee provided input on report due to the legislature on January 15, 2013.

Other potential processes and documents that the NC Committee could help set priorities on include:

- Clean Water Legacy funding (similar to the LSOHC process).
- Parks and Trails legacy funding.
- MN DNR Forestry – US FS Competitive Allocation Request Process (CARP) – pending project proposals.
- MN DNR Forestry – Forests for the Future program priorities.
- MN DNR Forestry – private forest management focus areas.
- NRCS EQIP Forestry funding and other NRCS conservation programs.
- County water plans and watershed district plans – forestry projects.
- NRCS EQIP – Trees on the prairie – where and where not.
- BWSR/SWCD Lakeshed screening assessments (189 lakesheds) – forestry projects – lake protection strategy.
- MPCA Major watershed studies – forestry projects.
- TMDL studies – forestry projects.
- MN DNR Fisheries – Fish Habitat Plan implementation and Aquatic Management Areas (AMAs) – priorities for forestry projects.
- Local planning and zoning authorities for identifying critical forest resources that should be protected through local land use controls and incentives.

The committee will continue to set priorities for these types of documents in the future as a way to increase coordination and implementation.

Project and Funding Development

Since 2006, the NC Committee has been developing pilot or demonstration projects within the region to promote collaborative or cross boundary efforts which are intended to support the increased the implementation of the goals and strategies in the North Central Landscape Plan. The following

narrative provides an initial set of guidelines to help the NC Committee and partners in the region identify and select opportunity areas, pilots, and demonstration projects.

Collaborative Project Types

- Outreach and education.
- Research and development.
- On the ground, pilot or demonstration projects.

Collaborative Project Topics

- Forest management
- Recreation management
- Fish and wildlife management
- Water resource management
- Land management
- Forest based economic development
- General public awareness/education
- Coordinated public conservation policies/investments

Committee Involvement

Committee Led Projects: Projects where the NC Committee is taking the lead. Committee members lead in the development and implementation of the project. The Committee is always looking for partners to help support on these projects. Examples include:

- Education & Outreach – April 5, 2006 workshop - SFEC.
- Pine Regeneration/Deer Browse Study – USDA Forest Service NCRS.

Joint Projects: Projects where the NC Committee is a financial, technical and/or administrative partner, but not leading. Examples include:

- Education & Outreach - BSU CRI NRCEC monthly sessions and annual conferences.
- SFEC Sessions.

Supporting Projects: Projects where the NC Committee is supporting a project from direct to indirect approaches, but not leading. Possible roles include share information - GIS data and maps or sharing DFC, goals and strategies from the NC landscape plan. Examples include:

- US Forest Service Chippewa National Forest Land and Resource Management (LRM) Plan.
- MN DNR Section Forest Resource Management (SFRMP) plans.

Guidelines for Establishing Collaborative Opportunity Areas

The following guidelines are intended to provide the Committee with a relatively consistent approach to conceptualizing and developing committee led cross boundary projects:

1. Major Players – 2, 3 or more major landowners who want to work in given area or on a specific forest management or research topic.
2. Project Size – 10,000 to 200,000 acres. Opportunity area projects already in progress (Manitou, Leech Lake Pines, Four Corners, Wadena and Otter Tail, etc.) cover on average 100,000 acres.
3. Geographic Considerations – boundaries could be based on natural features – watersheds, LTAs, riparian corridors, etc.; or could be based on manmade boundaries – townships, portions of counties, major transportation corridors, or other geo-political jurisdictional areas.
4. Land Ownership Considerations – project areas can be defined or shaped by landownership patterns. For example, one approach could focus on areas dominated by public lands. The committee could design the boundaries of a project to minimize privately owned lands within a given area. For private land based projects, the focus could be directed on areas with larger tracts or parcels of private lands. A third approach could be to select a project area with mixed land ownership patterns. Boundaries would be jogged across ownerships for specific or intended purposes. A fourth option may focus on transitional areas of private lands that surround a major public site or facility such as Camp Ripley.
5. Ecological Significance – the project areas could have some ecological significance in the landscape. Sources to help identify may include: county biological surveys, Heritage database, National Forest Management Areas, existing SNAs, state parks, WMAs, etc.
6. Economic/Social Significance – the project area could be designed to focus on for areas with special economic and/or social significance (e.g. shoreland, industry lands, etc.)

Possible Project Strategies

1. Tree Species/Plant Communities – a project could focus on species of interest or concern, such as white pine, jack pine, cedar, aspen, etc.; but could also just be large working forests devoid of human developments.
2. Innovative Forest Management – could focus on new and innovative practices and approaches, prescribed burns or fire as a management tool, methods to minimize deer browse, etc.
3. Local Land Use Planning and Implementation – working with local officials in select locations to integrate sustainable forestry into local communities and their decision making processes on land use matters – zoning requests, subdivision plats, etc.
4. Targeting Private Landowners for Specific Programs – committees could select project areas to help encourage NIPF landowners within and/or adjacent to given areas to enroll in incentive programs such as SFIA program, the new 2 c tax law, conservation easements, state and federal cost share programs.
5. Strategic Land Asset Management – select project boundaries based on the desire to support more effective land trades and exchanges for the purpose of promoting better forest management. For example, a county could designate holdings within a project area as Memorial Forest (retained), or the state could focus exchanges with counties in project areas to preserve the natural character and discourage development.

Project Development and Application Process

Sustainable forestry projects where NC Committee coordination or funding support is desired may be initiated by any person or entity. All stakeholders in the region are encouraged to work with the NC Committee to seek increased collaborative opportunities with other partners in the

region especially on cross boundary types of forest management projects. Stakeholders are encouraged to refer to the NC Landscape Plan concurrently with the State Forest Action Plan as starting points for initiating new forestry projects. They are also encouraged to review the priorities set by the NC Committee (see narrative above). Partners are further encouraged to seek ways to integrate the goals of multiple plans with the implementation of the NC Landscape Plan.

Formal project ideas to be considered for NC Committee involvement and discussion at quarterly committee meetings need to be submitted to the Chair and the MFRC Landscape Program Manager three weeks prior to the meeting. An application form (see attached) shall be prepared for each project proposal. Preliminary project ideas can be brought up at the Committee meetings with no advance notice but formal action on the use of Committee funds will not occur until the project idea has been developed through this process.

A subcommittee of five members, as appointed by the Chair, will review the project proposals and provide a recommendation to the Committee. The subcommittee will determine the following: 1) if the application is complete, 2) a project score using the Project Evaluation Form, 3) a recommendation on the use of Committee funds. The NC Committee will review project proposals at the next available meeting and use the following criteria to determine their support with the use of seed moneys through the Council and grant funds. The NC Committee will also use the following criteria as general guidelines when evaluating potential join or supporting projects within the region when requested by partners:

1. Plan Implementation. The projects that support the implementation of the NC landscape plan and other relevant natural resource management plans in the region will receive the maximum points in this category.
2. Cost / Benefit. Those projects that demonstrate a lowest cost and maximum benefit will receive maximum points in this category.
3. Public Benefits. Each project will be evaluated based on the types and extent of public benefits from the project. Those projects benefiting the greatest public benefit will receive maximum points.
4. Deterrence of Future Problems. Those projects that will correct to a maximum degree, a foreseen problem including invasive species, forest health and productivity will receive maximum points under this category.
5. Collaboration. Each project will be evaluated based on the degree that long term collaborations can be developed to support future sustainable forestry projects. Those projects found to support ongoing collaboration receive maximum points from this category.

The NC Committee will review and decide on project proposals with one of the following: 1) approval to move ahead, 2) modify with suggested changes, 3) table decision for more information, or 4) not approve for the use of Committee funds.

The NC Committee will develop and maintain a Project Evaluation Form based on these criteria and apply it to proposed projects on an ongoing basis.

The NC Committee will typically incorporate a work session at each quarterly meeting where projects ideas can be initiated. The NC Committee will support work group or subcommittee meetings on approved projects with staff facilitation and coordination services as the budgets allow.

Letters of Support

The NC Committee will provide letters of support on approved partner proposals. All requests for letters of support need to be submitted to the Chair and the MFRC Landscape Program Manager three weeks prior to the meeting.

Letters of support can be prepared in between quarterly meetings through email communications or a conference call as determined by the Chair and/or staff.

Appendix I
Minor Watershed Methodology Manual

(Section in development)

Table of Contents

B. Private Forest Implementation Toolbox
C. Implementation Based on What the Forest Wants to Be
D. Development of Minor Watershed Atlases for Pilot Project
E. Parcel Based Approaches: Where to Start
F. Landowner Outreach
G. Moving the Needle

Section 6. Future Minor Watershed Efforts

A. Development of Local Government Workplan Document
B. Creation of Local Technical Teams
C. Coordination and Roles Definition

Section 7. Measuring and Communicating Success

A. Measuring Implementation
B. Mapping Accomplishments
C. Sharing the Story of Success
D. Long Term Data Collection, Management, and Integration

Section 8. Summary & Conclusion

A. Current and Future Uses of Minor Watershed Methodology
B. Compatibility with MFRC Landscape Planning Efforts
C. Summary: How Much is Enough?
D. Conclusion: Quality Forests + Quality Water = Quality of Life

Appendix J
Potential Landscape Stewardship Projects

(Section in development)

Table J-1. Major Watersheds in the North Central Landscape.

Major Watershed	Acres	% of Region
Big Fork River	642,164	7.1
Buffalo River	183,445	2.0
Clearwater River	618,573	6.8
Crow Wing River	989,280	10.9
Kettle River	68,160	0.8
Leech Lake River	857,971	9.5
Little Fork River	148,211	1.6
Mississippi River – Brainerd	750,329	8.3
Mississippi River - Grand Rapids	1,225,074	13.5
Mississippi River – Headwaters	1,228,889	13.5
Mississippi River – Sartell	23,785	0.3
Otter Tail River	356,141	3.9
Pine River	500,887	5.5
Red Lake River	57,348	0.6
Red River of the North - Sandhill River	97,857	1.1
Redeye River	28,454	0.3
Rum River	165,166	1.8
Snake River	130,118	1.4
St. Louis River	93,025	1.0
Upper/Lower Red Lake	292,268	3.2
Wild Rice River	612,570	6.8
Total North Central Region	**9,069,715**	**100.0**

Source: MN Geospatial Commons

Appendix K
FY2017-2018 Annual Work Plan

The following table provides an example of the template that the North Central Landscape Committee will utilize to create Annual Work Plans from the 10-Year Committee Work Plan. Annual Work Plans will prioritize objectives and action items from the 10-Year Committee Work Plan for a given fiscal year and will be used to identify leadership, partners, resource and staffing needs, and potential barriers to implementing action items and achieving objectives.

Ecological Goal 2: Maintain or increase the area of forest land in the North Central Landscape.

Objectives	Lead/ Partners	Resources Available / Resourced Needed	Potential Barriers	Estimated Cost	Staffing Needs
Objective 1: Landowner Education. Provide information to landowners on the value of forests to society, the economy, and the environment, and the importance of maintaining current acreage and parcel sizes to avoid the threats associated with fragmentation.					
Objective 2: Land Protection Tools. Utilize voluntary conservation easements, fee title acquisition, incentive payments, and tax programs to protect private forest land from conversion to non-forest uses.					
Objective 3: Establish Forests. Encourage reforestation of abandoned farm lands with tree and shrub species appropriate to the native plant community, to the extent possible.					

Appendix L
2003 – 2016 Accomplishments

(Section in development)

2003 DFC 1: There will be an increased component of red, white and jack pine, cedar, tamarack, spruce and fir.
2003 DFC 2: The forest will have a range of species, patch sizes, and age classes that more closely resemble natural patterns and functions within this landscape.

Table L-1. 2003 North Central Landscape Plan goals and Strategies for DFC 1 and 2; accomplishments to date (Jan 1, 2017).

Landscape Ecosystem	Goals	Strategies	Accomplishments
Boreal Hardwood-Conifer	• Increase >171 year growth stage. • Restore historic components of white pine, upland tamarack and cedar; include spruce/fir • Maintain a substantial amount in even-age aspen • Emphasize mixed stands of spruce, balsam fir, aspen, birch, red maple in the plant community.	• Underplant aspen with white pine, balsam fir, white spruce in the 21-40 year growth stage. • Examine aspen stands over 70 years of age for natural conifer regeneration, access difficulty, local soil and edaphic conditions and other evidence that suggests the stand should be advanced to later successional stages - those lacking these traits should be regenerated to aspen type. • Focus short-term management on 81+ old aspen (70-100). • Perform shelterwood harvests in old northern hardwood stands and underplant white spruce, pines and upland tamarack.	
Dry-Mesic Pine	• Increase red and white pine and tamarack • Increase >171+ year growth stages • Increase oak/hardwood composition	• Restore white pine in aspen stands in the 41-80 year growth stage • Introduce white pine in red pine 21-40 year growth stage	

Mesic-Northern Hardwoods	• Increase >171 year growth stage • Maintain some better quality aspen stands; use even-age management • Establish or maintain white pine, balsam fir and white spruce as stand components starting at the 21-40 growth stage. • Create a more natural composition of plant community starting at the 40-80 year growth stage.	• Manage rich basswood/maple to older growth stages • Manage on an uneven age system • Manage richer sites for yellow birch component. • Selectively harvest northern hardwoods stands as they age. • Perform shelterwood harvests in northern hardwoods and underplant with pine and spruce where site aspect and soils are appropriate. • Maintain aspen inclusions on good sites to provide age class and structural diversity.	
Dry-Mesic Pine-Oak	• Increase jack pine and oak in 1-20 and 21-40 year growth stages • Decrease aspen in 41-80 year growth stage and restore red, white and jack pine • Increase red/white pine in 81+ year growth stages • Increase 81+ year growth stages	• Manage pine and longer-lived hardwood by maintaining trees already present and/or underplanting • Manage pine and hardwood in mixed stand condition. • Underplant aspen with white spruce • Underplant red pine in 21-40 year growth stage with white pine • Focus short term harvest on regenerating 60-70 year old jack pine and aspen.	
Dry Pine	• Increase younger age classes of jack pine (0-40). • Increase older growth stages (81+) dominated by red and white pine.	• Concentrate harvests in the 41-80 year growth stage and regenerate to jack pine. • Where possible regenerate to a jack/red/white pine mixed stand; harvest jack pine and hold red and white pine for older growth stages on moister sites.	

2003 DFC 3: The amount of forest land and timberland will not decrease using FIA definitions for timberland and forest land. Large blocks of contiguous forest land that have minimal inclusion of conflicting land uses will be created and/or retained for natural resource and ecological benefits and to minimize land use conflicts (hereafter referred to as "natural resource emphasis areas").
2003 DFC 4: In large blocks of contiguous forest land retain critical natural shoreline on lakes for scenic, wildlife, water quality and other natural resource values

Table L-2. 2003 North Central Landscape Plan goals and Strategies for DFC 3 and 4; accomplishments to date (Jan 1, 2017).

Goals	Strategies	Accomplishments
Minimize the loss of forest land and timberland.	• Educate landowners on the value of forests to society, the economy, and the environment (including wildlife), and the importance of not reducing current acreage and tract sizes. o Encourage incentives for both forest retention and forest management. o Provide educational material on the positive benefits of larger parcel sizes on forest values and their management. • Strategy: Encourage use of conservation easements and similar conservation tools. • Where appropriate, encourage the establishment of forests in areas previously forested (ie. abandoned cropland) and retain natural openings, brushland, etc.	
Retain contiguous blocks of forest land.	• Encourage creation and/or retention of "natural resource emphasis areas" which encompass national forests, state forests, county memorial forests, and other large, contiguous blocks of forest land through mutual agreement. Manage "natural resource emphasis areas" in the following way: o Discourage development of properties within these areas to minimize conflicting land uses. o Encourage the retention of public lands within "natural resource emphasis areas", except small tracts needed to provide public services, or isolated tracts too small to manage effectively. o In cases where a government entity wants to dispose of lands within a "natural resource emphasis area" and those lands are desired by another public agency, encourage exchange of natural resource emphasis areas (NREA) lands for non-NREA lands held by the interested public entity. o Encourage the State to acquire in-holdings of private lands within "natural resource emphasis areas" as they become available in exchange for disposal of isolated parcels that are better suited for development or private ownership leading to no net loss of public land. o Encourage the exchange of federal, state, and county tax-forfeited lands lying outside of "natural resource emphasis areas" for private lands	

	lying within "natural resource emphasis areas" where both parties agree. o Minimize further fragmentation and loss of forest land within "natural resource emphasis areas" by: o Minimizing cross-country overhead lines. o Encouraging private landowners to keep their lands in forest use. o Encouraging interagency cooperation and coordination in road planning and design. o Encouraging road corridors to be the minimum size necessary to provide public service. o Manage roadsides within "natural resource emphasis areas" to retain natural beauty and to reflect the natural variation in forest age and composition. o Encourage the use of MN Forest Resource Council Site-Level Guidelines and Landscape-Level goals and strategies for forest management. • Minimize fragmentation of forests by encouraging innovative development that keep forest land intact. o Encourage residential and commercial development to occur in areas already fragmented by housing, urban uses and existing road corridors. o Encourage cluster development.	
Minimize the loss of publicly held shorelines.	• Discourage the sale and development of publicly held shorelines. • Exchange land for critical shoreline when available.	
Increase the natural benefits of developed shorelines.	• Educate lakeshore owners and lake associations on the environmental benefits of natural shorelines and available cost share programs to improve shorelines. • Encourage private shoreline owners to practice "lakescaping" (maintaining/ creating natural habitat along shoreline) or retain natural shoreline.	
Protect sensitive and/or undeveloped shoreline.	• Encourage local, grassroots government, and organizations (townships, lake associations, etc.) to identify and promote protection of these shorelines.	

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Appendix M
Monitoring Indicators Table

The following tables provides monitoring indicators and potential data sources for the North Central Committee to utilize during development, implementation, coordination, and monitoring of the 10-Year Committee Work Plan via Annual Work Plans.

Ecological Goals

Goals	Potential Monitoring Indicators	Potential Data Source
Goal 1: Enhance the ability of the forest ecosystems in the region to adapt and respond to current and future threats by fostering ecosystem resilience, resistance, and adaptability.	• Acres affected by natural disturbance events – fire, insects, windthrow, etc. • Within stand and landscape level diversity. • Number of rare species and acres of rare communities in the landscape. • Changes of species locations relative to topography, aspect, latitude. • Age structure diversity across the forest. • Wildlife species changes relative to habitat. • Acres of tree species anticipated to increase or decrease with climate change according to the USDA (2014) Forest Ecosystem Vulnerability and Assessment and Synthesis report.	• FIA • DNR Eco Resources • DNR Wildlife • DNR Forestry • TNC
Goal 2: Maintain or increase the area of forest land in the North Central Landscape.	• Forest acreage vs non-forest acreage overall. • Forest and timber land acreage overall.	• FIA • NLCD
Goal 3: Retain contiguous blocks of forest land.	• The number of acres protected from conflicting non-forest conversions by conservation easements, etc. • The number of forested blocks exceeding some threshold sizes (e.g. DNR Section Forest Resource Management Plan patch size definitions). • Changes in forest patch sizes and connectivity. • Changes in median and mean forest parcel size within the region.	• BWSR • SWCD • DNR PFM program • DNR Forestry • TNC
Goal 4: Protect and prevent the loss of sensitive and undeveloped lake and river shorelines. Restore	• Site-level monitoring program - spatial analyses of land use. • Changes in miles of impacted shoreline. • Water quality conditions of the lakes and rivers. • Downsteam water treatment costs or requirements.	• WRAPs reports • BWSR • MPCA • MHB • LLAWF

natural characteristics to developed shorelines. Manage stream ecosystems to maintain and protect their dimension, pattern, and profile to minimize erosion and support aquatic biota.		

Economic Goals

Goals	Potential Monitoring Indicators	Potential Data Source
Goal 1: Ensure a diverse and stable forested landscape that supports multiple sustainable economic benefits.	• Forest land cover data. • Forest cover diversity and age class distributions • Number of third party certified acres. • Good Neighbor Authority - number of projects, cords harvested, acres treated.	• FIA • NLCD • DNR Forestry • Chippewa National Forest
Goal 2: Support a diverse and stable forest products industry and infrastructure with a diverse forest land ownership.	• Growth in the logging industry and local wood products. • Facility expansion and diversity. • Cords harvested. • Treated acres across ownerships. • Number of bridge downgrades and reductions in speed limit impacting forest management operations. • Private forest land adjacent harvest/management on small acre parcels.	• DNR Forestry • MN DEED • UMD BBER • MN DOT • Mill surveys
Goal 3: Promote natural resource-based recreation and tourism. Increase statewide recognition of the broad economic and social value of North Central region's forests.	• Annual revenues generated in the region from tourism and recreation. • Use of the Chippewa National Forest, state forests, state parks, and wildlife management areas, number of visitor days. • Total value of state and federal grants being used to conserve forests and promote sustainable forest management in the region.	• DNR Parks and Trails • Chippewa National Forest • LSOHC
Goal 4: Stabilize and improve employment and incomes by sustainable use of landscape assets.	• Per capita income. • % poverty level. • % unemployed. • Median age of workers. • Increased number of forest related jobs.	• US Census Bureau • US Bureau of Labor Statistics • MN DEED

Social Goals

Goals	Potential Monitoring Indicators	Potential Data Source
Goal 1: Improve natural resource education to students and cultivate public awareness about the importance of forests and ecologically sound forest management.	• Enrollment in natural resource degree programs. • Number of active school forest programs. • Environmental learning center activities and visitor numbers. • Other natural resource workshops (Native Plan Communities, Sustainable Forests Education Cooperative).	• Minnesota State Colleges and Universities Systems • U of MN • UMN Extension • MN Forestry • MN Parks and Trails • Local environmental learning centers
Goal 2: Protect aquatic resources for clean and healthy water and improve the connection of forest and water quality.	• Lakes and stream water quality remains high in the forested regions of the state. • No new TMDL (Total Maximum Daily Load) listings and/or impaired waters.	• MPCA
Goal 3: Increase private forest management.	• Cords of timber from private lands. • % of private lands being actively managed. • Acres of conservation easements on private forested lands. • Number of registered stewardship plans. • Acres enrolled in 2C and SFIA.	• DNR PFM program • BWSR • SWCD
Goal 4: Promote high quality forest based experiences and the wellbeing of the people living and working in the North Central Landscape.	• Annual visitation estimates to parks and forests. • Availability of experiences – number of campgrounds and sites, number of public water landings, miles of trails, number of days parks are open.	• DNR Parks and Trails • Chippewa National Forest
Goal 5: Maintain the natural resource identity of the landscape and balance growth with resource protection.	• Miles of scenic byways. • Land cover trends. • Forestry elements in county and municipal comprehensive plans. • Forest protection provisions in local ordinances.	• MN DOT • NLCD • LGU partners