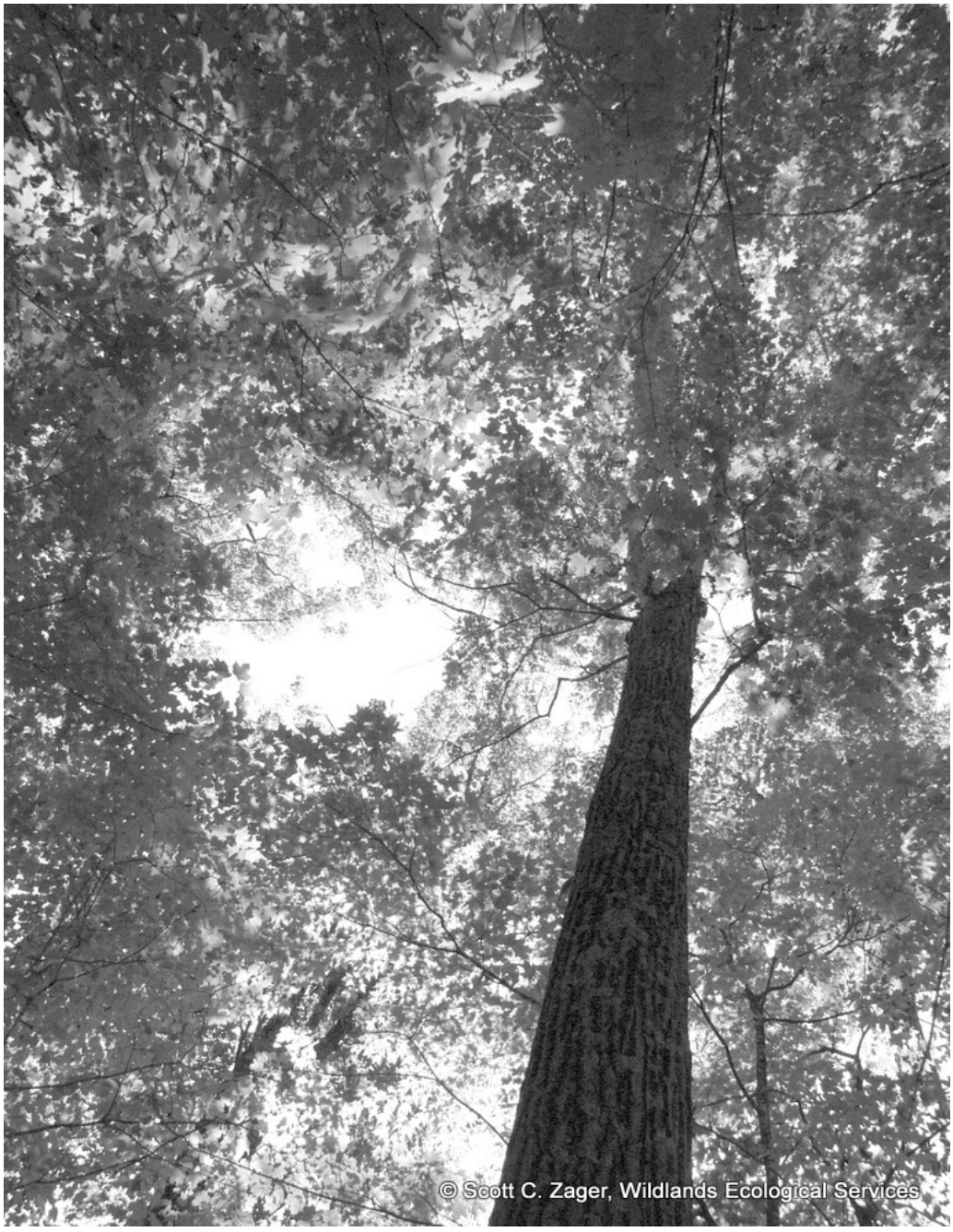
Ecological Evaluation and Assessment of the Lakeside Land Management Unit

Aitkin County Land Department, Minnesota



Scott C. Zager, Plant Ecologist
Wildlands Ecological Services

Wildlands Ecological Services

Ecological Evaluation and Assessment of the Lakeside Land Management Unit

Aitkin County Land Department, Minnesota

February 16, 2012

Aitkin County Land Department
209 2nd St. NW Room 206
Aitkin, Mn. 56431
218-927-7364
fax - 218-927-7249
email: acld@co.aitkin.mn.us

Submitted to:

Rich Courtemanche
Assistant Land Commissioner
Aitkin County Land Department

Submitted By:

Scott C. Zager, Plant Ecologist
Wildlands Ecological Services
2009 Maryknoll Avenue North
Maplewood, MN 55109-3645
ph: 651-261-2398
email: wildlands@comcast.net

WILDLANDS
ECOLOGICAL SERVICES

ACKNOWLEDGMENTS

I wish to thank the staff of the Aitkin County Land Department (ACLD), specifically Rich Courtemanche, Bob Kangas and Tom Parkin for their assistance and advice.

Aitkin County Land Department:
Mark Jacobs, Land Commissioner
Rich Courtemanche, Assistant Land Commissioner.
Bob Kangas & Tom Parkin: ACLD Foresters.
http://www.co.aitkin.mn.us/departments/land/landhome.html

I especially wish to thank the people of Aitkin County for their outstanding conservation ethic and strong heart-felt desire for sustainable resource management.

Mission Statement: The Aitkin County Land Department (ACLD) is responsible for managing the natural resources on approximately 222,000 acres of tax forfeited lands. ACLD strives to manage these lands so they contribute to the quality of life in terms of economic, ecological, and social benefits.

Through good forest management, ACLD strives to conserve the natural environment, develop unique recreational experiences, preserve historical and scenic values, enhance essential habitat, protect rare and endangered species and plant communities, as well as forest soil and water quality. ACLD is able to maintain and enhance timber quality and productivity of our forests and provide a sustainable yield of renewable resources for area industries and for our citizens.

To demonstrate the commitment to good forestry ACLD has been certified by the Forest Stewardship Council™, since 1997. ACLD has two citizen committees that advise the Aitkin County Board of Commissioners on issues related to natural resources (Forest Advisory Committee and Park Commission).

TABLE OF CONTENTS

TABLE OF CONTENTS

APPENDIX 2 - TABLES

APPENDIX 3 - FIGURES

SUMMARY

The Aitkin County Land Department (ACLD) contracted Scott Zager, Plant Ecologist for Wildlands Ecological Services, to survey vegetation and soils on the Lakeside Management Unit. This report, maps and supporting database are the result of that study conducted during the field season of 2011. The report analyzes USDA soil types and compares them with vegetation data and soil data collected for this study. This report also reviews ACLD management prescriptions for the Lakeside Management Unit and comments upon their ecological appropriateness to upland forests described in this survey.

The results described in this report demonstrate that the area surveyed within the Lakeside Unit has high-scoring ecological attributes that meet, or exceed, Forest Stewardship Council criteria for designation as a High Conservation Value Forest.

INTRODUCTION

Ecological land classifications, such as Minnesota's Ecological Classification System (ECS), are used to identify, describe and map progressively smaller areas of land. As these hierarchical units diminish in scale, their ecological attributes become increasingly more uniform and easier to describe. Consequently, ECS will make forestry more efficient while simultaneously, ECS will help maintain valuable biological legacies of a natural forest ecosystem. ECS uses associations of biotic and environmental factors including climate, geology, topography, soils, hydrology and vegetation. These are the same characteristics resource managers must consider for managing forests and other types vegetation.

The primary function of this assessment is to provide ACLD managers an effective tool for resource management. In Minnesota, ecological silviculturalists begin management prescriptions by assessing the ecological attributes of a specific forest stand, and then applying them to the pre-existing framework defined by Minnesota's Ecological Classification System. Forest managers will benefit from using this widely accepted land classification, because they will have access to an ever-increasing library of silvicultural knowledge derived from on-going research and management prescriptions that will have direct and practical application to their lands.

The Aitkin County Land Department (ACLD) manages the natural resources on approximately 222,000 acres of Aitkin County tax forfeited lands. ACLD does this in a variety of ways by managing the timber, the recreational opportunities, and access roads for the various uses of the lands. In Aitkin County, there are three "zones" of differing landscape objectives that apply to broad-scale ecological goals. Current conservation science encourages a combined coarse- and fine-filter approach for managing ecosystems across the landscape. Fine-filter management focuses on specific rare, threatened, endangered (RTE) species as well as other sensitive plant and animal species. Coarse-filter management is distinct from fine-filter in that it does not use a species-by-species approach, but focuses on habitats and species associations across the landscape.

The ACLD Forest Management Plan defines a set of ecological objectives across the various landscapes, which prescribes a "coarse-filter" ecological approach across a range of forest types on ACLD land (while specific site management directives by area foresters apply a "fine-filter" approach to individual stands supporting RTE species on a case-by-case basis). Since 1997, ACLD has been in process of recognizing, delineating and managing forests with high conservation values.

High Conservation Value Forest (HCVF) is a forest management designation by the Forest Stewardship Council (FSC) used to describe forests who meet specific criteria addressing economic, social, and environmental concerns. The FSC was created to change the dialogue about and the practice of sustainable forestry worldwide. The FSC - United States Chapter is located in Minneapolis, MN. It's purpose is to coordinate the development of forest management standards throughout different U.S. biogeographic regions, to provide public information about FSC certification, and to work with certification organizations to promote FSC certification. FSC has developed a set of Principles and Criteria for forest management that are applicable to all FSC certified forests throughout the world. The FSC standards represent the world's strongest system for guiding forest management toward sustainable outcomes. There are

10 Principles and 57 Criteria that address legal issues, indigenous rights, labor rights, multiple benefits, and environmental impacts surrounding forest management. In general, a HCVF possesses one or more of the following attributes:

(a) forest areas containing globally, regionally or nationally significant: concentrations of biodiversity values (e.g. endemism, endangered species, refugia); and/or large landscape-level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.

(b) forest areas that are in or contain rare, threatened or endangered ecosystems.

(c) forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).

(d) forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health) and/or critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

On October 30, 1997, Aitkin County became one of the first counties in the United States to have its publicly managed forests become "green certified" by SmartWood, a non-profit forest certification organization located in Vermont. Aitkin County sought certification as a means to better position its forest resources for the global market with particular attention being given to creating a market premium for hardwood resources. ACLD forest lands have been certified as "well-managed" by SmartWood in accordance with the standards of the Forest Stewardship Council (FSC)[1]. Forest products harvested from ACLD forests can carry the FSC label, ensuring consumers that the product is the result of environmentally, economically and socially responsible forest management.

ACLD completed a process for determining HCVF areas occurring on ACLD managed lands. This included an initial query of Rare, Threatened and Endangered (RTE) species and other ecological values that produced a "first cut" of potential HCVF areas. These preliminary HCVF selections were reviewed by ACLD staff; and then by an independent consulting firm. Finally, there was a public review of the remaining proposed HCVF areas.

The initial query for HCVFs began with areas previously delineated by ACLD as Habitat Management Zones. HMZs are delineated as a four-square mile section within Public Land Survey Townships. Every township has 36 sections which are grouped into 9 Habitat Management Zones (HMZ) with each HMZ covering four square sections (about 2,500 ac). HMZs are comprised of public and private land of varying amounts: ACLD managed lands, state, federal land and private lands. HMZ areas were numerically scored for their potential as HCVF areas (Table 6, Appendix 2).

The Minnesota County Biological Survey (MCBS)
MCBS systematically collects, interprets, and delivers baseline data on the distribution and ecology of rare plants, rare animals, native plant communities, and functional landscapes needed to guide decision making. In 1996-1997, MCBS botanists made several collections of rare, threatened and endangered (RTE) species within the Lakeside Unit and vicinity (Table 7, Appendix 2).

MCBS has yet to publish data about the Native Plant Communities within Aitkin County. However, this report specifically addresses these natural communities and their relationship to the landscape.

Ecological Classification System
As part of the forest certification process, ACLD Land managers were interested in an Ecological Classification System (ECS) that integrated vegetation, and the animals that inhabit them, with geophysical features such as landformations, topography, soils, etc. These landscape features, and the ecological habitats they support, are themselves the result of pervasive conditions of both past and present climates. A visual

[1] 2008-2010 Tactical Forest Plan Aitkin County Land Department

representation of these ecological variables on a computer-generated ECS map (Fig. 7, Appendix 3) increases the land manager's ability to determine the quantity and quality of available habitat for a particular species or species association, such as a forest type. An ECS assessment of forests would help managers prescribe silvicultural goals, monitor climatic changes and better predict potential outcomes to decisions. ECS mapping will help managers conceptualize a single small local unit of vegetation, (i.e., forest stand) within the context of larger ecological patterns in the surrounding region.

The U.S. Forest Service (USFS) and the Minnesota Department of Natural Resources (MN DNR) has adopted an ecosystem approach, which seeks to manage any individual animal, plant, or habitat as part of the landscape. An ecosystem approach to forest conservation means protecting or restoring the function, structure and species composition of an ecosystem while providing for its sustainable socioeconomic use. Recently, the MN DNR and the USFS, have established an ECS protocol for land classification and ecological mapping for Minnesota based upon a national hierarchy of nested units (i.e., Provinces, Sections, Subsections, Land Type Associations, etc.) (Almendinger et. al. 2000; ECOMAP 1993; Cleland et. al. 1997; Albert 1995).

In addition, MN DNR (2003-2005) has completed a classification of Native Plant Communities (NPC) for Minnesota based primarily on vegetation composition from data collected within forests, prairies, wetlands and other habitats. Likewise, the NPC classification is hierarchical, with units describing broad landscapes to local native plant communities. An important consideration in the new NPC classification is the inclusion of ecological processes as an organizing principle known as NPC Systems (e.g., Fire-dependent System, Mesic Hardwood System, Wetland Prairie System, etc). Both ECS and NPC classifications are needed to identify, describe and map progressively smaller areas of land with increasingly uniform ecological features. The integration of vegetation with abiotic environmental factors provides a direct tie between the plant community classification and the national ecological mapping protocol. At its lowest levels, the NPC classification relates to the U.S. National Vegetation Classification (Grossman et al. 1998). The NPC classification was developed to provide a common language for the professional disciplines involved in using, restoring, or conserving native vegetation in Minnesota (MN DNR 2003).

For the last two decades, Geographic Information Systems (GIS) have become widely used by various disciplines of land managers and researchers. This has resulted in the widespread availability of various GIS cover themes that depict important characteristics of the land. However, often lacking for a particular management unit or even an entire region is an accurate vegetation inventory at specified locations (i.e., GPS Waypoints). These sample points are important benchmarks for interpreting aerial photography, satellite images and other forms of remote sensing used to produce an ecological map or GIS theme. By associating vegetation with soil and topographic characteristics, it is easier to understand how native plant communities (NPC) are distributed across the landscape within the Lakeside Unit area. Understanding these relationships, facilitates the delineation of NPC map units over vegetation patterns visible on the air photographs while using NRCS soil map units and USGS topographic contour lines.

Principal Investigator

Wildlands Ecological Services (WILDLANDS) is a small company that surveys vegetation and constructs ecological maps using a combination of techniques including Geographic Information System (GIS) software, remote sensing (air photo interpretation), and field investigation. Clients include federal, tribal, state and county agencies – as well as private engineering firms – requiring vegetation surveys and GIS maps of parks, wildlife management areas, ecologically-managed commercial forests, etc. WILDLANDS also conducts not-for-profit research in habitat conservation, plant taxonomy and floristics. Products include databases, electronic maps, ecological analysis and interpretive reports. As the name implies, WILDLANDS focuses on large natural areas often in remote wilderness settings. Our mission is to provide affordable data useful toward sustainable management of important ecosystems.

Scott Zager is the sole proprietor of WILDLANDS.

Since receiving his master's degree in botany at the University of Northern Iowa, he has been a professional botanist and plant ecologist for over twenty-six years since beginning floristic studies as an Assistant Park Ranger for Iowa State Parks. Later as a natural resource technician for Black Hawk County, IA; he restored prairies, planted trees and managed natural areas on public and private lands. As a research assistant at the University of Northern Iowa, he researched native plant establishment and erosion control. For nearly twelve years he worked as a plant ecologist of for the Minnesota County Biological Survey (MCBS), where he mapped vegetation and searched for rare plants in nearly every type of plant community within the eastern half of Minnesota from border to border. As a private consultant for Wildlands Ecological Services, he has expanded his geographic range to include much of the Midwest. He was the principal ecologist in plant and vegetation surveys of the Red Lake Peatlands - the largest peatland complex in the contiguous United States. He mapped vegetation for Lake Itasca State Park and St. Croix State Park (Minnesota's largest state parks). He as also mapped vegetation in U.S. National Wildlife Refuges (Tamarac & Agassiz National Wildlife Refuges). Other projects have been completed in Iowa and Wisconsin. He has taught Plant Taxonomy at the University of Minnesota - Crookston. His academic research is focused on plant taxonomy and systematics. His graduate studies investigated a very difficult taxonomic group of sedges in the genus *Carex*. He is currently working with Dr. William Norris on an illustrated monograph of the genus *Carex* in Iowa.

Study Area

The Aitkin County Land Department (ACLD) is responsible for managing the natural resources on the approximately 222,000 acres of Aitkin County tax forfeited lands including the management units of Lakeside, Rice Lake, Blind Lake, Libby Lowlands and Wagner Management Units. These areas were surveyed and mapped by Scott Zager, Plant Ecologist, Wildlands Ecological Area (Fig. 1, Appendix 3).

ACLD has proposed three model forests as areas having unique biodiversity features including rare ferns, salamanders, and birds or generally having high value as wildlife habitat. These Model Forests qualify as High Conservation Value Forests (HCVF) under FSC® criteria (HCV1: forests with high biodiversity values). Lakeside Unit located east of Mille Lacs Lake is one of these HCVF. The Habitat Management Zone (HMZ) designation for the Lakeside Unit is Mosaic (see Table 6, Appendix 2); conservation values include rare plants and rare biodiversity features in an area with high development pressure (eastern Mille Lacs Lake). Lakeside qualifies for the fine-scale management approach, where ACLD staff account for and considers rare, threatened, and endangered species on a case-by-case basis along with forest type objectives and appropriate harvest intensity when planning timber sales. This is similar to how ACLD approaches all its lands but with an extra special awareness of the unique values present at Lakeside Unit.

WILDLANDS was contracted by ACLD to conduct an ECS survey and map vegetation in parcels within the Lakeside Management Unit. The Lakeside Unit is managed by ACLD. The unit encompasses 634.9 total acres total owned by Aitkin County. The overall management goal is to maintain and expand large forest patches with a focus on shade-tolerant, long-lived species. In general, forested lands will be managed within the broader landscape and in a manner consistent with the site's forest ecological system (type). The principle objectives are: 1) increase the size of the Core Zone forest patches within the management unit and consolidate the Clustered Zone patches into larger sizes, 2) increase the extent of northern hardwood forest type through selective harvesting (uneven age) and manipulation of other upland forest types, 3) enhance wildlife habitat characteristics for species that prefer mature/old, closed-canopy, upland deciduous forests, in large contiguous areas, 4) produce high quality, large diameter hardwood saw timber for high value forest products, 5) maintain or increase native tree species that are "rare" in the Lakeside Management Unit (e.g., butternut walnut, yellow birch, white pine, etc.).

Geologic Landformations

Figure 3 (Appendix 3) shows the location of the Lakeside Management Unit on ground moraine originated from the Superior Lobe of the Wisconsin Glacier (see descriptions for Figures 1 & 3 (Appendix 3). The area is defined as a region of non-calcareous till deposited by glacial ice that advanced southward from the Lake Superior Basin. Most of this till is deposited

in level to undulating ground moraines. These landforms have coarse-textured soils in the lower soil horizons but can have clayey hardpan layers in the "B" horizon. Lakeside Unit has as a thin layer of silty loess deposited over the moraine that originated from the calcareous outwash of the St. Louis Sublobe of the Des Moines Glaciation. The areas of coarser drift are occupied by forests dominated by northern red oak, while areas of clayey till have forests of sugar maple, aspen, and birch.

Modern Climate
The present climate for Aitkin County is characterized by warm summers and long, cold winters. Lakeside township (Aitkin county), MN, gets 27 inches of rain per year. Snowfall is 42 inches. The number of days with any measurable precipitation is 82. On average, there are 187 sunny days per year in Lakeside township (Aitkin county), MN. The July high is around 79 degrees. The January low is -4. Temperatures range from minus 50 degrees Fahrenheit to 107 degrees Fahrenheit (-45.5° to 41.6° C) . Most climatic models predict that this area will warm by 4 degrees to 5 degrees Celsius within the next 50 years. There is a chance of frost during any month of the year; although June, July and August are usually frost-free. The annual average growing season is 115 days.

Expected Climate Change[2]
The following paragraphs are excerpts from the 2000 report: Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change, produced by the National Assessment Synthesis Team, an advisory committee chartered under the Federal Advisory Committee Act to help the US Global Change Research Program fulfill its mandate under the Global Change Research Act of 1990. These excerpts are from the section of the report focused upon the eight-state Midwest Region (USDA 2010).

Observed Climate Trends[2]
Over the 20th century, the northern portion of the Midwest, including the upper Great Lakes, has warmed by almost 4 degrees Fahrenheit (2 degrees Celsius), while the southern portion, along the Ohio River valley, has cooled by about 1 degree Fahrenheit (0.5 degrees Celsius). Annual precipitation has increased, with many of the changes quite substantial, including as much as 10 to 20 percent increases over the 20th century. Much of the precipitation has resulted from an increased rise in the number of days with heavy and very heavy precipitation events. There have been moderate to very large increases in the number of days with excessive moisture in the eastern portion of the Great Lakes basin.

Scenarios of Future Climate[2]
During the 21st century, models project that temperatures will increase throughout the Midwest, and at a greater rate than has been observed in the 20th century. Even over the northern portion of the region, where warming has been the largest, an accelerated warming trend is projected for the 21st century, with temperatures increasing by 5 to 10 degrees Fahrenheit (3 to 6 degrees Celsius). The average minimum temperature is likely to increase as much as 1 to 2 degrees Fahrenheit (0.5 to 1 degree Celsius) more than the maximum temperature (i.e., winters less severely cold). Precipitation is likely to continue its upward trend, at a slightly accelerated rate; 10 to 30 percent increases are projected across much of the region. Despite the increases in precipitation, increases in temperature and other meteorological factors are likely to lead to a substantial increase in evaporation, causing a soil moisture deficit, reduction in lake and river levels, and more drought-like conditions in much of the region. In addition, increases in the proportion of precipitation coming from heavy and extreme precipitation are very likely.

METHODS

The procedure used by Wildlands Ecological Services for producing an ECS map begins with the collection of vegetation data with species composition and cover abundances at prescribed sample points (GPS waypoints), often with soil data observed from pits dug within the plot. The vegetation and soils data collected at the waypoints are entered into a MS ACCESS 2002/2003/2007 database (mdb files) along with

[2] Taken verbatim from: National Assessment Synthesis Team. 2001. Climate Change Impacts on the United States: The potential consequences of climate variability and change. Report for the US Global Change Research Program, Cambridge University Press, Cambridge UK, 620pp.

hyperlinks to digital photos taken at the sample site. An ARCVIEW shapefile is then created from the GPS sample points, which enables a quick reference to the data while mapping. These waypoints serve as bench marks for photo-interpreting signatures on high-resolution, color-infrared (CIR) and black and white (B&W) air photographs taken at relatively low altitudes. The best air photos were taken with footprints approximating the scale 1:15,840 or roughly 4 inches to the mile, but other scales (1:40,000) have been used effectively depending upon the complexity of the terrain and the diversity of the vegetation. Ideally, CIR's are taken during peak fall colors, when distinctions between tree species are maximized. Additional photos are very helpful in distinguishing wetlands or high-quality prairies when taken in the Spring before trees leaf out. The more photos available, especially those taken at different seasons, the better the NPC interpretation and may become the only alternative when some photos are obscured by clouds or poor photo processing. Light exposed photographs, held in hand, have the highest visible resolution and are best for photo interpretation. However, scanned images on computer screens have been effective. GIS themes of satellite images are helpful in depicting large landscape patterns such as glacial moraines, peatland complexes or even extensive areas of conifers.

Maps are drawn when NPC polygons are delineated around signatures of vegetation or landscape features visible on the photographs. This is best accomplished over an ARC GIS photo mosaic of scanned air photos that have been rectified with the most accurate map available, and then combined into one theme, such as a Mr. Sid image, that portrays the entire area to be mapped. Other ARCVIEW themes that facilitate NPC mapping include: 1) accurate boundaries of the unit or study area to be mapped, 2) scanned USGS 7.5 minute topographic maps, 3) USGS soil maps with text descriptions of units, 4) previous vegetation data from precisely known locations including heritage data of rare plant and animal occurrences, 5) geomorphic landform cover themes with descriptions (e.g., surficial and or bedrock geology), 6) Land Type Association polygons and descriptions. Other data sources are extremely helpful while interpreting photos. Examples include any GIS theme and/or report concerning past landuse, natural history, pre-settlement vegetation, geologic surveys, etc. The more data available the more accurate the resulting NPC map will be and the less time it will take to produce.

The final products include 1) shapefiles of NPC polygons, 2) shapefiles of sample locations, 3) a database containing waypoint records with general observations, vegetation structure, soil observations and species lists with abundance values, and 4) a report summarizing NPC map units and comments.

RESULTS

Collected Data

Field survey was conducted by Scott Zager, Plant ecologist for Wildlands Ecological Services. A total of 20 days were budgeted for collecting data. Survey days were allocated during several intervals during the months of July, August and September of 2011. During the survey, I spent a day in the field with the Lakeside Unit area forester, Bob Kangas for the Aitkin County Land Department (ACLD). Rich Courtemanche, ACLD Assistant Land Commissioner, was project manager for the study. Data were collected at a total of 168 waypoint locations (Lakeside had 34) within the various Native Plant Community (NPC) map units present (Fig. 4, Appendix 3). Many communities were sampled repeatedly in order to capture the perceived range of variation. The locations of sample waypoints are overlain on both NPC and Soil Moisture Maps.

The recorded data were entered into an MS ACCESS 2002/2003/2007 database as "mdb" files. Waypoint locations were recorded with GPS and uploaded as a shapefile into ARCVIEW v3.3/9.3. A list of NPC types observed at each waypoint is provided in Table 3 (Appendix II), along with observed conditions of the landscape and soils. Vegetation data were recorded using the relevé method with Braun-Blanquet values (Mueller-Dombois & Ellenberg 1974). The methodology is compatible with the relevé method used by the MN DNR (2007, 2005 p 4).

Soils and NPC distributions

ACLD Land Management Units combined include 78 different soil map units and complexes delineated as soil polygons by the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (Table 5 Appendix 2). The soils map for the

Lakeside Unit Area is a subset of NRCS soils surveys from Aitkin County (NRCS 2011). ARCGIS shapefiles of the Aitkin county soil survey were clipped according to the Lakeside Unit boundary and combined into one cover. Table 4 (Appendix II) is an index to NRCS soil map units within Lakeside Unit. It shows soil unit names, map number, soil properties, soil drainage and soil taxonomic hierarchy.

ARCGIS polygons of native vegetation for the Lakeside Unit were delineated and classified according to their respective map units of Native Plant Community (NPC) classes and types (e.g., MHc36, MHn35b, etc.). GIS polygons of each NPC type were overlain upon the GIS soil cover. Soil map units were "clipped" according to polygons of Native Plant Community (NPC) types and classes. For each NPC map unit, soil units were arranged in Table 3 according a soil unit's total acreage occurring under each NPC unit. The relative importance of a soil unit for each NPC unit is presented as a percentage of the total area of each soil unit mapped within each NPC unit. This created an ARCGIS shapefile of soil polygons found underlying each NPC class. Sliver polygons of soil units were discarded because these represented only marginal occurrences of the NPC class. Major soil map units were determined when acreage values were added to each soil polygon. To determine the relative importance of a particular NRCS soil map unit for individual NPC classes and types, each soil unit is given as a percentage of the total area covered by each NPC type [e.g., Mora fine sandy loam, 1 to 4 percent slopes are beneath 27.55% (37.6 acres) of MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)]. Table 3 shows the results of this analysis sorted by NPC code (i.e., MHc36b, MHn35b, etc.) referenced to the full name of the NPC class in Table 1. Table 3 and its accompanying soils maps (Fig. 5, Appendix 3) should be an invaluable tool in predicting potential outcomes to prescribed management practices (Figs 9 & 10, Appendix 3).

Each NRCS soil map unit – delineated on a soil map or as polygons within an ARC GIS shapefile – represents an area dominated by one major kind of soil or by a defined “complex” of two or three kinds of soil. While conducting vegetation surveys within Lakeside Unit lands, soil characteristics were observed in the field and compared with NRCS soil map units. Later, after native plant community (NPC) map polygons were delineated, each NPC map unit (class or type) was analyzed spatially to determine what soil units occurred beneath the vegetation categories (Table 5 Appendix II). No exclusive relationships were perceived between any one NRCS soil map unit and any particular NPC class or type observed on Lakeside Unit lands. Therefore, it was concluded that NRCS map units do not represent distinct ecological units useful for distinguishing and mapping vegetation. However, the soil properties that define higher levels of soil taxonomy do explain plant patterns observed on the landscape.

Based upon direct observations in the field, it was determined that the most important soil characteristics influencing plant occurrence – and their respected NPC distributions across the landscape – were the organic content in the rooting zone, presence of an “E” horizon, drainage, soil texture and the soil moisture regime. Organic content was recorded in terms of depth, texture and color of the humus layer (“O” horizon) and the top soil (“A” horizon). The “E” horizon marks a zone where mineral and organic substances are leached by percolating water through the horizon. The presence and quality of an “E” horizon usually indicates the influence of woody vegetation (i.e., oaks, pines, etc.) and the duration of their dominance.

Several soil characteristics influence a substrate’s ability to retain moisture or perch standing water above the prevailing water table. These soil characteristics were combined into larger, more-meaningful ecological categories that were useful fo explaining plant occurrence. These soil properties are described in higher soil taxonomic levels for NRCS units, especially the categories of Order, Suborder and Great Group (see Table 4, 5 Appendix II). For example, the soil order "mollisol" describes mineral soils formed under upland grasses and sedges that created deep organic, surface horizons. The suborder of "aquoll" describes soils saturated with water for periods long enough to limit their use for most crops other than pasture unless artificially drained. The prefixes for Great Group, describes other soil properties (e.g., “endo” - wet from below; “epi” - wet, perched; or “arg” – clay subhorizons, which can impede soil permeability).

By combining 78 separate soil units into 10 categories based upon soil moisture regime, we make a complex, obtusely-abstract relationship more discernable between soil types and native plant types. Arranging plant communities (ordination) along a soil-moisture gradation (continuum) is a fundamental principle of plant ecology (Curtis 1959). Nonetheless, while species associations are recognizable on the landscape, each species of the guild has an individualistic pattern of distribution that varies slightly differently than its associate species across the continuum. Consequently, key species useful for distinguishing between plant communities, may overlap causing boundaries between plant communities to be indistinct. Or one or more species that generally co-occur together are absent in any particular location. Similarly, plants are distributed across the landscape according to preferred properties of the soils. Yet these properties, while distinct in the middle of a soil unit, tend to blend together at the margins. By combining soil units into larger groups with similar properties, we are able to accentuate those soil characteristics most responsible for observed plant distributions.

General Descriptions of Soil Moisture Types
The mineral soil in much of the Lakeside Unit is calcareous deposited by the St. Louis Sublobe of the Des Moines Lobe; however, some areas are slightly acidic, these areas are attributed to the Superior Lobe (both of the Wisconsin Glacier). Soil properties vary in moisture retention, soil drainage (porosity) and texture. Based upon their soil properties, ARCGIS polygons of soil map units were labeled according to ten ecological categories describing soil moisture regime (Table 4, 5 Appendix II). It was found that by combining NRCS soil map units into these ten categories, a generalized map of soil moisture regimes ands soil texture could be made. This soil moisture map illustrates NRCS soil polygons in a manner more useful for recognizing and delineating boundaries of native plant communities. These moisture regime categories include: 1 = Dry Sand, 2 = Dry-Mesic Sand, 3 = Dry-Mesic Loam or Silt, 4 = Mesic Sand, 5 = Mesic Loam or Silt, 6 = Wet-Mesic Sand, 7 = Wet-Mesic Loam or Silt, 8 = Wet Sand, 9 = Wet Loam or Silt, 10 = Peat and "w" = Water.

The category "water" describes soils that had standing water or pools throughout the year. Wet soils have saturated root zones throughout the year. Wet-mesic soils have a high water table in Spring – sometimes with shallow water – but the water table drops below the upper root zone later in Summer. Mesic soils are often part of a complex landscape with a wide-range of moisture regimes, but usually they are moderately drained to somewhat poorly drained. In general, mesic soils remain moist throughout the year either due to high-seasonal water tables near the rooting zone and/or with a high content of fine soil particles (silt) that tend to retain moisture. Dry-mesic soils are moderately to well drained, being moist in Spring but tending to dry later in Summer (such soils tend to be droughty at least 2 of 5 years). Dry soils are excessively well-drained or well drained and experience water stress seasonally; these soils are usually found on the crests of the highest beach ridges.

NRCS general soil descriptions that best characterize the soil moisture categories for the Lakeside Unit were compiled in Appendix IV and summarized within the most relevant NPC descriptions.

Species Lists of Native Plant Communities
During the ECS survey and subsequent data entry, the taxonomic nomenclature was essentially Ownbey and Morley (1993) as adapted by MN DNR. However, the floristic lists (Table 4, Appendix 2) have been converted to the most recent synonymy for Minnesota, (Cholewa 2011). However, many of the taxa listed in Table 4 are psuedospecies used for analysis. For example sugar maple is treated as a separate psuedospecies when it occurs in the canopy, subcanopy, shrub/sapling and seedling layers.

Species observed within NPC types are provided in Table 4 (Appendix 2). NPC floras are arranged by NPC Code, Physiognomic Structure (i.e., Canopy, Subcanopy, etc.), Abundance Code and Species Scientific Name. Psuedospecies names are listed for each height stratum (sugar maple in canopy, subcanopy, etc.). Abundance values are provided from plot data. The values presented here represent the highest abundance that each psuedospecies was observed during the study for that particular NPC cover type (i.e., not all observed abundances are given).

Wildlands Mn Taxa, Draft Version 2011-07-15 © was compiled by Scott C. Zager in these formats from floras created by Dr. Anita Cholewa (2011), Bell Museum Herbarium, MNDNR's MN Taxa v. (v. July 2011), Milburn et. al. (2007), Kartez & Meacham (1999), FNA (1993+) and USDA-NRCS 2010.

Waypoint Sample Locations.
A total of 34 waypoints were sampled in the Lakeside Unit for vegetation; in addition, soil pits were dug to record soil data in 17 plots (Fig. 4, Appendix 3). It was important to collect data throughout the Lakeside Unit in order to capture the range of variation expressed by each NPC cover type. Soil samples were collected from pits dug to 1.5 m depth. Soil properties were entered into an ACCESS database along with general observations, floristic lists and species' cover abundance. Waypoint samples were uploaded as a GIS shapefile and served as reference points for photo-interpreting, rectified air photos. Vegetation data included species lists with cover abundance values. By associating vegetation with soil and topographic characteristics, it is easier to understand how native plant communities (NPC) are distributed across the landscape within the study area. Understanding these relationships, facilitates the delineation of NPC map units over vegetation patterns visible on the air photographs while using NRCS soil map units and USGS topographic contour lines.

Existing Vegetation Map
A cover map of existing vegetation was created using ARCVIEW v9.3 for Lakeside Unit (Fig. 7, Appendix 3 and Table 1, Appendix 2). Polygons of native plant community (NPC) types were delineated over patterns visible on rectified images of air photo mosaics. GPS locations of 34 sample waypoints were uploaded into ARCVIEW and used as bench marks during air photo interpretation of the vegetation cover. Map units of native vegetation were classified according to Native Plant Community (NPC) types developed by the Minnesota Department of Natural Resources (MN DNR 2003, 2005a, 2005b). Non-natural and other natural cover types, such as roads, utility corridors and various categories of open water, were developed by MN DNR Parks. NPC types for Lakeside Unit were determined from analysis and evaluation by Scott Zager of vegetation data collected at waypoint sample locations (MS ACCESS Database: Aitkin County Land Department - 2011 ECS Waypoint Data; Table 5, Appendix 2). These data helped interpret vegetation patterns seen on air photos. Vegetation patterns were also compared with GIS digitized soil map units classified according their soil moisture regime (Fig. 5, Appendix 3) and by using contour lines of digitized USGS 7.5 minute topographical maps. NPC polygons were delineated on the basis of multiple factors: dominant plant cover, soil type, topographic slope position and aspect, and recorded vegetation data. The recorded vegetation data associated with GIS points were derived from standardized vegetation plots (relevés), species lists and other ecological observations. Each NPC polygon attempts to circumscribe a homogeneous unit of vegetation with a well-defined set of landscape features. Recognizable differences of the vegetation structure (canopy age and size, canopy species composition, percent cover, etc.) were mapped separately for each stand. It is hoped that the splitting of NPC polygons into these finer categories based upon vegetation structure and composition, will facilitate planning for habitat improvements.

The existing vegetation cover map (Figs. 7, Appendix 3) for Lakeside Unit is comprised of 152 polygons classified according to 11 different NPC types and 4 other non-natural cover types, including old fields, roads and various categories of open water. Tables 1 (Appendix 2) provides statistics for each NPC map unit. For example, Lakeside Unit contains 22 separate polygons classified as MHc36b (Red Oak - Basswood Forest) for a total of 112 acres covering about 17.65% of the unit. Black ash swamps (WFn64b) were the most abundant natural cover type in Lakeside Unit, covering 200.6 acres or about 31.59% of the unit. The combined total of all mature mesic hardwood forest (MH) is 206.3 acres (32.5%). The combined total of all wetlands is 405 acres (63.8%). There were 77.7 acres of cut forests of all types, which includes 21.7 (3.42%) of managed mesic hardwood forests and 56 acres (8.8%) of cut and recovering black ash swamps.

ARCVIEW GIS shapefiles of the NPC cover for Lakeside Unit are available from ACLD staff (see address on inside cover). Also, NPC data of vegetation and soils collected in 2011 are available in MS ACCESS 2007. Data are linked with specific GPS

waypoints and associated with digital photographs taken from the NPC plots (metadata describing files and fields are provided in the Table of Contents).

Potential Vegetation Map

In order to illustrate potential outcomes of management decisions (Desired Future Conditions) polygons of the existing vegetation map were re-labeled by their potential NPC Class codes within the GIS attribute table. For example, ACLD desires to promote red oak. The Potential Vegetation Map in Figures 9 & 10 (Appendix 3) depict this priority. For example, Existing Vegetation Maps can show areas currently in a non-natural state, or with native vegetation in an undesirable seral stage, such as young deciduous forest (2.6a). In contrast, the Potential Vegetation Map shows that these same areas could be managed for Red Oak - Basswood Forests (MHc36) because they have the prerequisite soils and geomorphic land formation (see Figs. 5 & 9, Appendix 3). Furthermore, NPC polygons were also labeled in the GIS attribute table by an area's "Potential ECS System". Non-natural vegetation types were identified by the ECS system that best expresses the prevailing ecological processes governing vegetation. The areas in Figure 10 (Appendix 3), depict NPC polygons that would be best managed as "Mesic Hardwood" communities. These are areas that also show potential for red oak management. These examples demonstrate how management outcomes described in Aitkin County's Strategic Plan can be illustrated using NPC polygons produced from this study.

The potential vegetation map can also be used to identify habitats for plants and animals. For example, the state threatened plant, False Mermaid (*Floerkea proserpinacoides*) inhabits wet hardwood forests perched on upland moraines (see Table 7, Appendix 2). Three NPC types are considered prime potential habitats (MHn46a, MHn46b & WFn55b). Combined, these NPC potential classes provide over 63 acres (10%) of the unit as potential habitat for this rare species.

General Recommendations for the Lakeside Unit Area High Conservation Value Forest

The general goal for managing High Conservation Value Forests (HCVF) is to balance commercial forestry with the goals of maintaining biological legacies. Metaphorically, this is accomplished by a process of "Life Boating" critical ecological components of a site from their pre-disturbance condition, through a period of recovery following management, to -- ideally -- an eventual, complete recovery to their previous ecological state. Conceptionally, it is thought that silvicultural practices that maintain -- or even increase -- biological legacies must be based upon natural disturbance regimes and stand development processes. In practice, silviculture intended to mimic natural phenomena forms the basis for an Ecological Forestry Approach (Franklin et al, 2007). Biological legacies are defined as the organisms, organic matter (standing snags, downed logs, humus, top soil, etc.) and ecological patterns.

Ecosystem stability is an important consideration in maintaining biological legacies. Three levels of stability are recognized: 1) species stability referring to the maintenance of viable populations of individual species; 2) structural stability referring to the stability of various aspects of ecosystem structure (e.g., food-web organization, species numbers, soils); and 3) process stability referring to the stability of processes such as productivity and nutrient cycling. Stability is understood as the maintenance of change within certain bounds. Two aspects of stability are: (1) resistance, the ability of a system to absorb small disturbances and prevent them from amplifying into large disturbances; and (2) resilience or recovery, the capacity to return to some given system state. An example of resilience is succession. Although a forest state to which a stable system recovers is unlikely to exactly replicate the forest which had been there before, it will possess the same core elements and support the same vital processes. A critical feature of recovery is the ability to rapidly stabilize the soil ecosystem, including nutrients, physical structure, and food webs (Perry and Amaranthus 1997).

Existing Biological Legacies for Lakeside Unit on Upland Forests

1) Variation in forest structure and species diversity at each forest strata.

   a) In old forest canopies, there are four or five codominant tree species in abundance and ten

or more tree species in total. This diversity may exist in select stands of high-quality reserves; or across the managed area among several stands. Both conditions are preferred.

b) Large trees in the canopy, also, decadent trees, snags and downed trunks.

c) Multi-aged cohort of trees, with representatives from every age class.

d) Abundant shrub and subshrubs with high wildlife value, comprised of a diverse array of fruit-producing species (juneberries, dogwoods, viburnums, etc.) in contrast to an abundance of sugar maple saplings/seedlings and hazel.

e) Several stands with low abundance of undesirable trees (sugar maple, ironwood) in the understory with a higher proportional abundance of developing trees of oaks, basswood, white pine, big-toothed aspen, yellow and paper birch.

2) A moderate solar light regime without extreme (dark) shade or intense full-spectrum light for extended photo-periods.

a) Allows a combination of partial shading (subdued, reduced spectrum light) with mottled patches of intense, full-spectrum light that shift across the forest floor with the circadian movement of the sun (e.g. shelterwood). And/or

b) Permits intense, full-spectrum light for only some portion of the day (4 hours?) followed by partial shading for the remaining daylight (e.g., small clear-cuts on slope positions that allow intense sun – during the summer solstice – between 10:00 AM to 2:00 Pm; or to reduce moisture loss, between either 8:00 AM to Noon, or 4:00 PM to 8:00).

3) Natural hydrologic regime and drainage with reduced desiccation during seasonal and periodically intense droughts.

4) Natural soil profiles with abundant amounts of organic material in the leaf litter, humus and top soil.

5) Representative stands of high-quality, biologically diverse forests with outstanding examples of existing structure, species diversity, etc.

6) Absence of destructive, non-native, invasive species (earthworms, European buckthorn, garlic mustard, honeysuckle cultivars, etc.).

7) A reduced population of white-tail deer with a low Relative Deer Density (RDD) of <20% of carrying capacity (deCalestra and Stout 1997) – throughout the hardwood forests of Lakeside Unit. At such levels there is some browsing of preferred plant species, but standing crop and productivity is controlled by the ecosystem. The deer population is maintained at its biological potential resulting in sustainable hunting yields with low impact to the ecosystem.

A Suggested Goal for Incorporating Ecological Silviculture Techniques.

One potential management goal for the Lakeside Unit Area would be to promote marketable products from Lakeside Unit favoring large, mature trees capable producing economically valuable high-grade lumber and veneer products. Such marketable products can be sustainably harvested from a particular hardwood in short, 20-25 year cycles (i.e., large trees tend to have lower rates of mortality, i.e., greater probability of survival). For example, research has shown that red oaks can reliably reproduce under silvicultural techniques that use either small, linear gaps or dense shelterwood cuts (70% canopy). This is based upon research that shows red oaks in the sapling stage or older can endure partial shading for extended periods until canopy release (i.e., it is the seedling stage before root mass development that most restricts red oak recruitment). I suggest a creative combination of two techniques using a modified, Variable Density Thinning practice that follows the contours of the landscape. I suggest a stratified implementation whereby dense shelterwood cuts are practiced on drier MHn35 locations and small, clear cuts in moist swales, ravines, lower slopes and upper slopes with east-to-north aspects (MHc36b). This serves the function of minimizing soil moisture loss while reducing potential erosive activities on steep slopes. An exception could be made on level to undulating moraine crests, where small gaps could be created to promote big-tooth aspen clones or white pine stands. Another difficult compromise must be struck in ecological management that maintains well-developed organic soil layers while promoting seed-to-soil contact

that favors germination success (usually brought about by soil scarification).

This type of management is best described by ACLD as a Type VI: Select Cut – Uneven Age. This methodology will promote the desired stand structure and composition, by harvesting marked trees, to promote high saw-timber quality and quantity. Trees are to be removed based on risk, defect, vigor or crown competition with crop trees, Marking is done in all size classes to achieve the desired size/age class balance. The Residual Basal Area (RBA) target range is 75-90 sq. ft. This strategy will provide for an uneven aged forest stand of 4 or more size/age classes that may be perpetuated. Future harvesting occurs on a 10-15 year entry cycle. Canopy gaps are created by the removal of large individual or small groups of trees will promote regeneration of shade intolerant or mid tolerant tree species. Retaining snags, den trees, mast-producing trees, the multi-layered canopy and the perpetual mature forest condition are important wildlife habitat characteristics. Applied Best Management Practices (BMP) should protect water resources potentially impacted by harvest operations. The stand will be re-examined in 10 years to evaluate forest regeneration, Timber Stand Improvement (TSI) needs and determine future harvests (ACLD 2011).

Suggested Examples of
Ecological Silviculture Objectives.

1) Reduce abundance or eliminate enclosing canopies of climax species (i.e., sugar maple).

2) Reduce abundance or eliminate densely shading species in the subcanopy and shrub layers (i.e., immature sugar maple, ironwood, hazel, etc.).

3) Maintain an overall canopy of 25-75% cover, with a modified Variable Density Thinning practice that incorporates select areas with dense shelterwood (70% cover) with small clear-cuts (i.e., eliminate the practice of large-scale clear-cuts that allow intense, full spectrum light for greater than a 6-8? hour photo-period).

4) Create un-even-aged (multi-cohort) structure of red oaks, birch, white pine, basswood, etc.

5) Maintain the best ecologically representative stands as forest reserves, preferring wet-mesic to wet forest NPC classes (MHn46, WFn55 and WFn64), which are inclusions within MHn47 and MHn35 polygons (e.g., MHn46 has many biological components of upland forests and can potentially serve as refugia for species, a bank for old decadent trees, etc.

6) Soil management prescriptions specifically designed to reduce soil compaction of fine-textured soils (silt, loam), eliminate erosion of top soil layers (litter, humus, A horizon), prevent equipment rutting, and reduce the area covered by haul roads and skid trails. Specifically allow only winter harvest on frozen ground.

7) Frequent, periodic monitoring for invasive species (earthworms, European buckthorn, etc.); especially along haul roads and trails. Specifically ban or reduce ATV and other off-road vehicle use that are potential vectors transporting invasive propagules. At a minimum, encourage a through cleaning of equipment and recreational vehicles prior to use within the Lakeside Unit Area.

8) Manage deer population levels occurring within Lakeside Unit to minimize browse on seedlings and herbaceous plants. Use techniques, such as special deer hunts prescribed to limit or reduce population size.

   a) A suggested level would be determined using the Relative Deer Density (RDD) at <20%, which is the percentage of the deer density as a percentage of the carrying capacity "K" (deCalesta and Stout, 1997; Johnson 1996).

Management for Climate Change

I have read several research studies on historic climate and vegetation for the Upper Midwest (see References). Based upon historic precedence of warm and dry paleo-climates and computer models of potential regional climate by prominent ecologists, I conclude that there will be a shift in climate to weather patterns that have milder winters, warmer summers and radically intense precipitation events. While yearly amounts of rainfall and snow will likely be maintained at current levels, precipitation will be more erratic and extreme with

unreliable precipitation events producing long, intense periods of seasonal drought. Intense storms following a period of drought would increase the likelihood of severe erosion on steep slopes.

The above suggestions for ecological silviculture were designed to promote plant community resilience, protect moisture-retaining soil attributes and otherwise keep water on the landscape (i.e. , not promote runoff, drainage, etc.). Such forests as documented presently in the Lakeside Unit Area, have always been on the North American continent since glaciation. Historically these species, and the forests they comprise, have migrated repeatedly as glaciers advanced and declined across the Upper Midwest...and/or as the prevailing climate patterns shifted across the mid-continent during the Holocene (i.e., Hypsithermal). Despite some projected scenarios to the contrary, I conclude that NPC types described in this report will very likely persist in the Lakeside Unit Area – perhaps with shifting relative abundances among associate species.

Finally, projected climate changes will likely favor migration of invasive species from the south. These potentially destructive species are capable of reducing ecological stability and forest production. Invasive species, such as European buckthorn, have the potential to radically reduce ecological resilience and reduce biodiversity. Frequent periodic monitoring will be necessary to arrest these invasions in the early stages of colonization or else more costly remediations will be required to sustain the forest. It has been estimated by the U.S. Department of the Interior, that the current environmental, economic, and health-related costs of invasive species could exceed $138 billion per year in the U.S. (USGS 2004).

NPC Description and Commentary
This section is the legend for the NPC vegetation cover map prepared for the Lakeside Unit. The following map unit descriptions were written primarily from data collected within Lakeside Unit using the MN DNR (2003) classification as a template. The NPC descriptions given in this report relies only on data collected within Lakeside Unit. Summaries of the most important soil types for each NPC units are part of the NPC descriptions (see Table 5, Appendix II with full NRCS soil series profiles compiled in Appendix IV).

MHc36b **NPC System Code: MH**

MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)

Acres of NPC Unit: **112.0** acres.
Percent Total Acres: **1.13%**

Polygon Count: **22**

General Description:
Mesic to temporarily wet-mesic, hardwood forests dominated by mixed hardwoods. Most of the MHc36b polygons within the Lakeside Unit were formerly dominated by red oak. At present, sugar maple and basswood are the most abundant with several associate species frequently occurring, including bitternut hickory (yellow-bud hickory, pignut). The Lakeside Unit's flora is comprised of several species with a distribution range characteristic of central and southern forests in Minnesota. These "Central" species occur in all forest strata (canopy, subcanopy, etc.); hence the classification of MHc36 instead of MHn47. Central indicator species are highlighted below in bold.

MHc36b occurs on silty or loamy soils on slightly convex to slightly concave slopes of moraines. MHc36b was mapped on middle to lower slopes, often in slight depressions. These areas are generally mesic to wet-mesic, and moderately to somewhat poorly drained with standing water in micro-depressions following recent rains. Soil mostly silt over clay hardpan with seasonal hydric indicators suggesting perched spring water. Clay and clay loam layers were common in the "Bt" horizon. Some plots had a deep organic layer and the "A" horizon nearly absent. The "E" horizon is a silty cap over silty clay and clayey coarse sand. Another plot had dark, organic silt to 15 cm deep over bands of clay and clayey silt above a "C" horizon of coarse red-brown sand. The silt cap appears to have originated from wind-blown loess from the Des Moines Lobe. This may account for the abundance of calciophilic herbs (calcium loving) in the flora that would not otherwise inhabit non-calcareous till of the Superior Lobe Moraine (see MN DNR 2003 comparisons between MHc36a and MHc36b). Earthworms were a problem in some stands. The worst infestations were adjacent to a former sanitary land fill.

Interior stands are unaffected with deep moder/mor organic layers.

Canopy Layer is interrupted to closed (cover 50-75% to 100%). The canopy openings are attributed to forestry practices designed to promote oak regeneration. One plot was in a small area of closed canopy surrounded by trails and partial cuts. Throughout MHc36b forests, mature trees have crown heights 20-25 (30) m tall; Mode DBH 25-35 cm (10-14"), infrequent Max DBH 35-60 cm (15-24"). Most polygons were dominated by basswood, sugar maple with an occasional large paper birch (DBH <40 cm). One red maple was recorded with a DBH of 53 cm. An example of a managed shelterwood stand (wypt 22) included immature to maturing bur oak and red oak [Canopy 15-20 m tall, DBH 15-25 cm (6-10") with some trees to 29 cm. Cover 85% allowing patchy, mottled light to substrate; basal area 50 ft^2/acre]. Canopy trees, in descending order of abundance recorded for at least one plot, include Sugar maple, Bur oak, Basswood, Green ash, **Bitternut hickory**, Big-toothed aspen, Northern red oak, Red maple, Black ash, and Paper birch.

Recorded Basal Area measurements with a 10x gauge were 100-180 ft^2/acre (50 ft^2/acre within a shelterwood stand). Coarse Woody Debris (CWD) varied considerably. At most locations, CWD = 1-5% cover, comprised of very decayed branches and trunks; contemporary tipups were occassional to infrequent; and snags were common. Some cut areas have CWD = 1-5% with local brush piles. Occasionally, CWD = 10-20% cover, comprised of selectively-logged tree-tops, large down paper birch and small to medium-sized trees with all stages of decay; ancient tipup mounds were occassional with micro-relief of 1-3 feet; contemporary tipups were absent; and snags were rare to occassional.

Subcanopy Layer is patchy to interrupted, infrequently closed (cover 25-75% (100%); crowns heights vary from 2-20 m tall; DBH 5-20 cm). The subcanopy is usually comprised of several distinct layers dominated by sugar maple and ironwood. Subcanopy trees, in descending order of abundance recorded for at least one plot, include Sugar maple, **Blue beech**, Ironwood, Black ash, Bur oak, Basswood, and Slippery elm.

Shrub - Sapling Layer is sparse to mostly, patchy and occasionally closed (cover 5-25% to 25-50%). Shrub and sapling species, in descending order of abundance recorded for at least one plot, include Sugar maple, Beaked hazelnut, **Blue beech**, Leatherwood, Ironwood, Basswood, Juneberry, **Bitternut hickory**, Bush honeysuckle, Black ash, Green ash, Fly honeysuckle, Hairy honeysuckle, Prickly gooseberry, Currant; Gooseberry, Swamp red currant, Wild black currant, Swamp gooseberry, Western Poison ivy, Yellow birch, American hazelnut, **Butternut**, and mountain fly honeysuckle.

Subshrub - Seedling Layer is sparse to patchy (cover 1-5% to 25-50%). Yellow-bud (bitternut) hickory seedlings infrequent. Subshrubs, vines and seedling species, in descending order of abundance recorded for at least one plot, include Virginia creeper, Red raspberry, Sugar maple, **Blue beech**, Beaked hazelnut, **Bitternut hickory**, Leatherwood, Green ash, Ironwood, Chokecherry, Red maple, Pagoda dogwood, Black ash, Big-toothed aspen, Bur oak, Northern red oak, Basswood, Paper-birch, Nannyberry, Downy arrow-wood, and Yellow birch.

Herb Layer is partial to interrupted (cover 5-25 to 50-75%). Infrequent, bare ground is 50-75% cover (attributed to earthworm infestation). There is often an abundant fern flora dominated by lady fern, maidenhair fern, and ostrich fern. The diverse fern and forb flora is attributed to a calcareous silt cap that is mostly mesic with wet-mesic inclusions. Small depressions frequently have sensitive fern. Most species occur frequently to locally common. Forb and fern species, in descending order of abundance recorded for at least one plot, include northern lady fern, big-leaf aster, Interrupted fern, **Maidenhair fern**, Wild leek, **Hog-peanut or falcata**, round-lobed hepatica, Wild sarsaparilla, Jack-in-the-pulpit, Wild ginger, **Canada enchanter's nightshade**, **Pointed-leaved tick-trefoil**, Common strawberry, Three-flowered bedstraw, **Wild geranium**, **Virginia waterleaf**, Pale vetchling, Canada mayflower, Clayton's sweet cicely, Common pyrola, Dwarf raspberry, Bloodroot, Zig-zag goldenrod, rosy twisted stalk, calico aster, Early meadow-rue, Nodding trillium, Yellow bellwort, Pale bellwort, Rugulose violet, Violet species, Red baneberry, Wood-anemone, Spreading dogbane, American spikenard, Rattlesnake fern, Blue cohosh, Bluebead lily, **Honewort**, greater

yellow lady's-slipper var. pubescens, parasol whitetop, Spinulose shield-fern, Field horsetail, Meadow horsetail, Wood horsetail, Rough bedstraw, Yellow avens, **White avens**, Common oak-fern, Veiny pea, starflower, Fringed loosestrife, feathery false lily-of-the-valley, Ostrich-fern, Indian pipe, Sensitive fern, Palmate sweet coltsfoot, **Lopseed**, Hairy Solomon's-seal, **Gregarious black snakeroot**, Maryland black snakeroot, white panicled aster, Common dandelion, American vetch, Crested fern, **Downy rattlesnake-plantain**, Michigan lily, giant Solomon's-seal, White rattlesnake-root, and **Hairy-nerved carrion-flower**.

Grass - Sedge Layer is frequently sparse to infrequently patchy (cover 1-5% to 25-50%).
Graminoid species, in descending order of abundance recorded for at least one plot, include Long-stalked sedge, Pennsylvania sedge, Bearded shorthusk, Drooping wood-sedge, Bladder sedge, Stellate sedge, Nodding fescue, Mountain rice-grass, Dewey's sedge, Hop-sedge, Bottlebrush grass, Pointed wood-rush, Woodland millet grass, Fowl blue grass, Fringed brome, False melic grass, and Graceful sedge.

Moss Layer is sparse (cover 1-5%). Usually on tree trunks and coarse woody debris.

Soil Description:
Within the boundaries of the ACLD Lakeside Management Unit, the most prominent soils underlying **MHc36b** polygons are provided in Table 3, Appendix 2. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series are also provided in Table 8, Appendix 2.

The most characteristic USDA soil series for **MHc36b** are Brennyville Series, Freer Series, Twig Series, and Giese Series. Other soil series are associated with **MHc36b** communities, however, these appear to be a function of the GIS analysis and tend to be marginal to the NPC polygons, while the most characteristic soil series tend to be centered within NPC polygons.

The Brennyville series consists of very deep, somewhat poorly drained soils that formed in a silty mantle of loess or lacustrine deposits and dense loamy glacial till on ground and end moraines. A densic contact occurs at depths of 40 to 60 inches. Slopes range from 0 to 6 percent. These soils are on nearly level to gently sloping ground and end moraines. Brennyville soils formed in loess or silty lacustrine deposits and the underlying dense loamy glacial till of the Late Wisconsinan Age. Somewhat poorly drained. Surface runoff is medium or low. A perched zone of saturation occurs as high as 0.5 foot during the months of April to May in years of normal rainfall.

The Freer series consists of poorly drained soils that formed in a silty mantle of loess or lacustrine deposits and dense loamy glacial till on drumlins or moraines. These soils are moderately deep or deep to dense till. These soils have moderate permeability in the silty mantle and very slow permeability in the dense till. These soils have moderate permeability in the silty mantle and very slow permeability in the dense till. These soils have plane or slightly concave slopes and are on drumlins or moraines. Freer soils formed in silty sediments of eolian or lacustrine sediments and noncalcareous dense loamy glacial till of Late Wisconsinan Age. Poorly drained. Runoff is slow. Permeability is moderate in the upper part and very slow in the dense till. Depth to a perched seasonal high water table is as high as 1 to 2.5 feet at some time from November to June in most years.

The Twig series consists of very deep, very poorly drained soils on moraines and drumlins. It formed in a mantle of organic material and underlying loamy material and underlying till that becomes very firm.

The Giese series consists of very deep, very poorly drained soils in low lying areas on moraines. This soil formed in a loamy mantle over very firm dense glacial till.

MHn35b NPC System Code: **MH**

MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest

Acres of NPC Unit: **55.9** acres.
Percent Total Acres: **17.65%**

Polygon Count: **21**

General Description: Dry-mesic to mesic mixed hardwoods dominated by red oak, basswood and sugar maple within an open canopy from periodic wind events. The overall MHn35b canopy is heterogeneous with scattered groves of big-toothed aspen with small local clusters of paper birch. Ironwood dominates knolls beneath large trees. Otherwise sugar maple dominates the subcanopy. The Shrub and seedling layers are often open. MHn35b forests occur on excessively well-drained to well drained soils comprised of a thin-layer of fine silt with cobbles and boulders over a weakly cemented hardpan of fine sandy, clayey loam and rock. Boulders at the surface occur infrequently. Most subsoils are characteristic of the Superior Lobe comprised of coarse sandy loam with greenstone and granite. "B" horizon are weakly mottles (iron oxide; 1-5%); and is weakly cemented clay nodules within a matrix of loamy, very fine sand. C-horizon densely compacted coarse red sand. MHn35b occurs on knolls and narrow, interfluvial ridges. High silt content and deep organic horizons help promote a species richness that approaches MHc36 except with better drainage.

Canopy Layer is patchy to nearly closed (cover 25-50% to <95%; crowns (15) 20-30 m tall; Bimodal DBH 20-20 cm & 35-50 cm; occassional Max DBH 50-65 cm). Unmanaged stands are comprised of relic red oak (DBH 40-50 cm) with younger sugar maple and basswood that are replacing paper birch and aspen (managed forest stands have been selectively logged of old oaks with stumps up to 85 cm diameter). Many older trees have an open-grown habit with spreading crowns or crooked trunks with epicormic branches. Frequent gaps are attributed to wind-damaged oaks, paper birch and aspens. Canopy trees, in descending order of abundance recorded for at least one plot, include Sugar maple, Big-toothed aspen, Northern red oak, Basswood, Paper birch, Bitternut hickory, and Green ash.

Basal Area with a 10x gauge ranges from 120-150 ft^2/acre. Coarse Woody Debris (CWD) is occasionally 1-5% cover, comprised of trunks and stumps with all stages of decay; ancient tipup mounds are common with 1-3' relief; no contemporary tipups; snags occassional. Commonly CWD is 5-10% cover, comprised of broken tops and limbs, small trees with all stages of decay; ancient tipup mounds are infrequent to locally abundant with 1-3' relief; contemporary tipups absent; and snags were common. Within infrequently occurring areas, recently affected by wind, CWD is 10-25% cover, comprised primarily of either contemporary tipups of small and large trees or recently cut areas comprised of tree-tops, broken limbs and old decayed trunks; snags were occasional to infrequent; ancient tipup mounds were infrequent, common to frequent with relief of 1-4'. This data suggests that MHn35 occupies landscape positions and aspects commonly affected by wind damage. Tipups at all stages of decay including very large ancient mounds suggesting former pine canopy. Recent demise of paper birch canopy and several open grown large trees suggest woodland origins of some MHn35b stands.

Subcanopy Layer is occasionally patchy to mostly closed (cover 25-50% to 75-100%; crowns 2-15 m tall). The understory varies considerably, most stands have several layers of sugar maple with a combined cover that is nearly closed but yet allows filtered, mottled light to the substrate. Other areas are dominated by ironwood with only a sparse coverage of maples. Subcanopy trees, in descending order of abundance recorded for at least one plot, include Sugar maple, Ironwood, Basswood, and Bitternut hickory.

Shrub - Sapling Layer is mostly sparse to patchy, sometimes closed locally (cover 1-5% to 25-50% [100%]). Local areas are dense with maple and ironwood saplings within canopy gaps. Otherwise, shrubs are thinly dispersed beneath oaks. These areas have a sparse cover (1-5%) with sugar maple, ironwood, yellow birch and beaked hazel. Blue beech or musclewood (*Carpinus caroliniana*) is rare to infrequent. Shrub and tree saplings, in descending order of abundance recorded for at least one plot,

include Sugar maple, Ironwood, Blue beech, Beaked hazelnut, Fly honeysuckle, Hairy honeysuckle., Basswood, Yellow birch, Bitternut hickory, Leatherwood, Green ash, Big-toothed aspen, Prickly gooseberry, Swamp red currant, Bush honeysuckle, and Chokecherry.

Subshrub - Seedling Layer is occasionally sparse to partial (cover 1-5% to 5-25%). Maple seedlings are locally patchy. Otherwise the layer is sparse with few blue beech, ironwood and sugar maple. Most seedlings are thinly dispersed. Subshrubs, vines and seedlings, in descending order of abundance recorded for at least one plot, include Red raspberry, Virginia creeper, Sugar maple, Bitternut hickory, Ironwood, Basswood, Yellow birch, Blue beech, Pagoda dogwood, Beaked hazelnut, Leatherwood, Green ash, Big-toothed aspen, Chokecherry, and Northern red oak.

Herb Layer is partial to occasionally patchy (cover 5-25% to 50%). The diverse number of forbs are attributed to thin cap-layer of calcareous silt (wind-blown Des Moines lobe or loess). However, most herb species are infrequent, with low numbers that are poorly dispersed except in small localities. The heterogeneous distribution of forbs are found amid a nearly closed carpet of Pennsylvania sedge. The most frequent species are ubiquitous dry-mesic herbs with mesic species less occurring infrequently in small local depressions and tipup hollows. Several central species are present but there are some northern plants as well. Forb and fern species, in descending order of abundance recorded for at least one plot, include Wild sarsaparilla, big-leaf aster, Giant goldenrod, Hog-peanut or falcata, round-lobed hepatica, Wood-anemone, American spikenard, northern lady fern, Rattlesnake fern, Pointed-leaved tick-trefoil, Pale vetchling, Canada mayflower, Bloodroot, Early meadow-rue, Nodding trillium, Stinging nettle, Pale bellwort, Rugulose violet, Yellow violet, Red baneberry, Wild leek, Spreading dogbane, Jack-in-the-pulpit, Wild ginger, Common milkweed, Blue cohosh, Canada enchanter's nightshade, Honewort, climbing false buckwheat, Common strawberry, Rough bedstraw, Three-flowered bedstraw, Wild geranium, Virginia waterleaf, Veiny pea, starflower, feathery false lily-of-the-valley, Clayton's sweet cicely, Interrupted fern, Lopseed, Bracken fern, Maryland black snakeroot, Zig-zag goldenrod, rosy twisted stalk, white panicled aster;, calico aster, purple-stem aster, Common dandelion, Yellow bellwort, American vetch, Violet, Maidenhair fern, Blue giant-hyssop, Canada thistle, and Common burdock

Grass - Sedge Layer is patchy to closed (cover 25-100%). Pennsylvania sedge often forms carpets. Graminoid species, in descending order of abundance recorded for at least one plot, include Pennsylvania sedge, Sedge, Dewey's sedge, Mountain rice-grass, Wool-grass, Bearded shorthusk, Graceful sedge, Long-stalked sedge, Projecting sedge, Drooping woodreed, Nodding fescue, Pointed wood-rush, Woodland millet grass, and False melic grass.

Moss Layer is nearly absent to sparse (cover <1 to 5%).

Soil Description:
Within the boundaries of the ACLD Lakeside Management Unit, the most prominent soils underlying **MHn35b** polygons are provided in Table 3, Appendix 2. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series are also provided in Table 8, Appendix 2.

The most characteristic USDA soil series for **MHn35b** are Mora Series and Milaca Series. Other soil series are associated with **MHn35b** communities, however, these appear to be a function of the GIS analysis and tend to be marginal to the NPC polygons, while the most characteristic soil series tend to be centered within NPC polygons.

The Mora series consists of very deep, somewhat poorly drained soils that formed in loamy till on drumlins and moraines. These soils have a densic contact at 40 to 60 inches. These soils are on nearly level to gently sloping drumlins or moraines. Slope ranges from 0 to 6 percent. Mora soils formed in noncalcareous, Superior lobe dense loamy till of Late Wisconsinan Age. Somewhat poorly drained. Surface runoff is negligible to medium. This soil has perched season high saturation at depths as high as 0.5 foot during April through May in years of normal precipitation.

The Milaca series consists of very deep, moderately well drained soils that formed in loamy till on drumlins and moraines. These soils have a densic contact at 40 to

60 inches. Slopes ranges from 2 to 45 percent. These soils are on drumlins and moraines. Slope ranges from 2 to 45 percent. Milaca soils formed in noncalcareous, Superior lobe dense loamy till of Late Wisconsinan Age. Moderately well drained. Surface runoff is low to high. This soil has perched season high saturation at depths as high as 1.5 feet during April to June in normal years.

MHn46a NPC System Code: **MH**
MHn46a = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Aspen - Ash Forest

Acres of NPC Unit: **6.0** acres.
Percent Total Acres: **0.95%**
Polygon Count: **8**

General Description:
Wet-mesic hardwood forests dominated by quaking aspen on somewhat poorly drained swales; edges of oval-linear depressions on moraine ridges; small inclusions within depressions on midslope, terrace treads; and on level to undulating moraine crests with perched wetlands/swamps and flowing rivulets or intermittent streams. While no data was collected in MHn46a forests in the Lakeside Unit, these areas are considered to be early successional seres of more diverse MHn46b forests.

Please see MHn46b for a complete description.

MHn46b NPC System Code: **MH**
MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest

Acres of NPC Unit: **32.3** acres.
Percent Total Acres: **5.09%**
Polygon Count: **31**

General Description:
Wet mesic deciduous forest dominated by black ash with basswood, red maple, sugar maple and green ash. Within Lakeside Unit, MHn46 wet-mesic forests usually occur as inclusions within MHn36b forests or as a broad MHn46 borders around margins of seasonally wet WFn55 swamps. Landform positions include wet-mesic, somewhat poorly drained swales; edges of oval-linear depressions on moraine ridges; small inclusions within depressions on midslope, terrace treads; and on level to undulating moraine crests with perched wetlands/swamps and flowing rivulets or intermittent streams. Such areas usually have highly variable microrelief with low swales and rises (1-2 ft). Many areas have standing water following recent rains. However, these areas drain late in the season leaving mud flats with no standing water. Soils are poorly drained, sapric peat over gleyed clay with iron deposits (oxidized); or sapric humus over clayey silt, silt and red-mottled "B" horizon at 47 cm deep. In one plot with no standing water on surface, the depth to water was 36 cm. Boulders 0.25 - 3.5 m diameter at surface covered less than 1% surface area.

Canopy Layer is closed (cover 75-100%; crowns 20-25 m tall; Mode DBH 20-40 cm (8-16"); common Max DBH to 65 cm). Canopy trees, in descending order of abundance recorded for at least one plot, include Black ash, Red maple, Green ash, Basswood, Sugar maple, Paper birch, and Bitternut hickory.

Basal area as measured by a 10x gauge is 120 ft^2/acre. Coarse Woody Debris (CWD) is sparse to partial (cover 5-20%) comprised of very decayed trunks, contemporary tipups and old stumps; no snags observed.

Subcanopy Layer is patchy to closed (cover 50-100%; crowns 5-15 m tall; DBH 5-15 cm). Subcanopy dominated by sugar maple and red maple. Subcanopy trees, in descending order of abundance recorded for at least one plot, include Red maple, Sugar maple, Black ash, Basswood, American elm, Slippery elm, Ironwood, Blue beech, and Bitternut hickory.

Shrub - Sapling Layer is sparse to partial (cover 1-5% to 5-25%). These are poorly dispersed to patchy thick. Shrub, vines and sapling species, in descending order of abundance recorded for at least one plot, include Winterberry, Prickly gooseberry, Western Poison ivy, Beaked hazelnut, Black ash, Green ash, Wild black currant, Swamp red currant, Basswood, American elm, Nannyberry, Chokecherry , Sugar maple, Speckled alder, Paper-birch, Blue beech, Fly honeysuckle, Alder-leaved buckthorn, and Slippery elm.

Subshrub - Seedling Layer is sparse to patchy (cover 1-5% to 25-50%). Subshrubs and seedling species, in descending order of abundance recorded for at least one plot, include Sugar maple, Yellow birch, Bitternut hickory, Black ash, Green ash, Winterberry, Balm-of-Gilead SE, Basswood, American elm, Nannyberry, Red maple, Round-leaved dogwood, Chokecherry, Bur oak, Downy arrow-wood, Blue beech, Pagoda dogwood, Slippery elm, Virginia creeper, and Red raspberry.

Herb Layer is patchy to nearly closed locally (cover 25-50% to ~85%). bare ground is partial (cover 5-25%). Forb layer dominated by wet-mesic ferns and sedges, adapted to low-light and seasonal high water table. Herb layer lush, very diverse, all species nearly frequent throughout except swamp species, which are at margin of black ash swamp and in small wet swales/depressions. Fern species of ostrich and lady fern dominate large patches within a heterogeneous mosaic. Many diverse forbs in patches between ferns . Wood nettle abundant throughout (thinly dispersed in plot but dominating other MHn46 areas). Patterns suggest perched water in spring causing disturbances promoting annuals and weedy ferns. Fern and forb species, in descending order of abundance recorded for at least one plot, include northern lady fern, Wood-nettle, Ostrich-fern, Jack-in-the-pulpit, Wild ginger, Canada enchanter's nightshade, Honewort, Spinulose shield-fern, big-leaf aster, Three-flowered bedstraw, Virginia waterleaf, Spotted touch-me-not, Sensitive fern, Interrupted fern, Lopseed, Dwarf raspberry, Bloodroot, Maryland black snakeroot, Common blue violet, Violet, Maidenhair fern, Stickweed, Wild leek, Hog-peanut, falcata, Wild sarsaparilla, American spikenard, Rattlesnake fern, Swamp marsh-marigold, Blue cohosh, Spotted water-hemlock, Swamp thistle, Bluebead lily, Pointed-leaved tick-trefoil, Crested fern, Wood horsetail, Common strawberry, Wild geranium, White avens, Common oak-fern, Canada mayflower, Naked miterwort, Clayton's sweet cicely, Palmate sweet coltsfoot, Hairy Solomon's-seal, White rattlesnake-root, Hooked crowfoot, Mad-dog skullcap, Zig-zag goldenrod, Giant goldenrod, rosy twisted stalk, calico aster, Nodding trillium, Stinging nettle, Rugulose violet, etc.

Grass - Sedge Layer is sparse to patchy (cover 5-50%). Graminoid species, in descending order of abundance recorded for at least one plot, include Sedge (unknown Carex sp.), Bladder sedge, Long-stalked sedge, Projecting sedge, Drooping woodreed, Bottlebrush grass, Nodding fescue, Bearded shorthusk, Stellate sedge, Stout woodreed, Woodland millet grass, Unknown grass, Bluejoint grass, Lake-sedge, Tall manna-grass, Fowl manna-grass, and Pointed wood-rush.

Moss layer is sparse to partial (cover 1-10%).

Soil Description:
Within the boundaries of the ACLD Lakeside Management Unit, the most prominent soils underlying **MHn46b** polygons are provided in Table 3, Appendix 2. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series are also provided in Table 8, Appendix 2.

The most characteristic USDA soil series for **MHn46b** are Mora Series, Freer Series, Twig Series, Giese Series, and Ronneby Series. Other soil series are associated with **MHn46b** communities, however, these appear to be a function of the GIS analysis and tend to be marginal to the NPC polygons, while the most characteristic soil series tend to be centered within NPC polygons.

The Mora series consists of very deep, somewhat poorly drained soils that formed in loamy till on drumlins and moraines. These soils have a densic contact at 40 to 60 inches. These soils are on nearly level to gently sloping drumlins or moraines. Slope ranges from 0 to 6 percent. Mora soils formed in noncalcareous, Superior lobe dense loamy till of Late Wisconsinan Age. Somewhat poorly drained. Surface runoff is negligible to medium. This soil has perched season high saturation at depths as high as 0.5 foot during April through May in years of normal precipitation.

The Freer series consists of poorly drained soils that formed in a silty mantle of loess or lacustrine deposits and dense loamy glacial till on drumlins or moraines. These soils are moderately deep or deep to dense till. These soils have moderate permeability in the silty mantle and very slow permeability in the dense till.

These soils have moderate permeability in the silty mantle and very slow permeability in the dense till. These soils have plane or slightly concave slopes and are on drumlins or moraines. Freer soils formed in silty sediments of eolian or lacustrine sediments and noncalcareous dense loamy glacial till of Late Wisconsinan Age. Poorly drained. Runoff is slow. Permeability is moderate in the upper part and very slow in the dense till. Depth to a perched seasonal high water table is as high as 1 to 2.5 feet at some time from November to June in most years.

The Twig series consists of very deep, very poorly drained soils on moraines and drumlins. It formed in a mantle of organic material and underlying loamy material and underlying till that becomes very firm.

The Giese series consists of very deep, very poorly drained soils in low lying areas on moraines. This soil formed in a loamy mantle over very firm dense glacial till.

WFn55b NPC System Code: **WF**
WFn55b = Wet Forest System / Northern Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Basswood Swamp (Eastcentral)

Acres of NPC Unit: **25.1** acres.
Percent Total Acres: **8.82%**

Polygon Count: **16**

General Description:
While no data was recorded within wet forests of the Lakeside Management Unit, WFn55b represent a significant component of the landscape. WFn55b are wet hardwood forests on mucky mineral soils in shallow basins and along ground-water seepage area or on low, level terrain near wetlands. Typically with standing water in the spring that drains by late summer.

Soil Description:
Within the boundaries of the ACLD Lakeside Management Unit, the most prominent soils underlying **WFn55b** polygons are provided in Table 3, Appendix 2. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series are also provided in Table 8, Appendix 2.

The most characteristic USDA soil series for **WFn55b** are Lupton Series, Twig Series and Giese Series. Other soil series are associated with **WFn55b** communities, however, these appear to be a function of the GIS analysis and tend to be marginal to the NPC polygons, while the most characteristic soil series tend to be centered within NPC polygons.

The Lupton series consists of very deep, very poorly drained soils formed in organic deposits more than 51 inches thick within depressions on lake plains, moraines and outwash plains. Permeability of these soils is moderately slow to moderately rapid. Slopes typically are from 0 to 2 percent, but may range to 15 percent. Lupton soils are in depressions within lake plains, till plains, outwash plains, and moraines. These depressions vary from small enclosed ones to those of several thousand acres in extent. Lupton soils have normally been influenced by ground water passing through surrounding mineral soil materials that are high in minerals. Minor deposits above 2 percent are on foot slopes as the upland soils break sharply into depressional or flood plain areas. These minor deposits are typically associated with groundwater discharge or seep areas. Very poorly drained. The representative depth to wet soil moisture status is at the surface to 1 foot below the surface at some time throughout the year. The representative depth of ponding is from .2 to 1.0 foot at some time throughout the year. Surface runoff is negligible to high, dependent on slope. Permeability is moderately slow to moderately rapid.

WFn64b NPC System Code: **WF**
WFn64b = Wet Forest System / Northern Very Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Alder Swamp (Eastcentral)

Acres of NPC Unit: **200.6** acres.
Percent Total Acres: **31.59%**

Polygon Count: **8**

General Description:
While no data was recorded within wet forests of the Lakeside Management Unit, WFn64b swamps represent a significant component of the landscape. WFn64b are wet hardwood swamps on peaty soils in small closed depressions or within large peatland basins. Typically

with standing water present throughout spring and summer. These very wet forests are dominated by black ash with yellow birch, red maple and paper birch.

Soil Description:
Within the boundaries of the ACLD Lakeside Management Unit, the most prominent soils underlying **WFn64b** polygons are provided in Table 3, Appendix 2. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series are also provided in Table 8, Appendix 2.

The most characteristic USDA soil series for **WFn64b** is the Lupton Series. Other soil series are associated with **WFn64b** communities, however, these appear to be a function of the GIS analysis and tend to be marginal to the NPC polygons, while the most characteristic soil series tend to be centered within NPC polygons.

The Lupton series consists of very deep, very poorly drained soils formed in organic deposits more than 51 inches thick within depressions on lake plains, moraines and outwash plains. Permeability of these soils is moderately slow to moderately rapid. Slopes typically are from 0 to 2 percent, but may range to 15 percent. Lupton soils are in depressions within lake plains, till plains, outwash plains, and moraines. These depressions vary from small enclosed ones to those of several thousand acres in extent. Lupton soils have normally been influenced by ground water passing through surrounding mineral soil materials that are high in minerals. Minor deposits above 2 percent are on foot slopes as the upland soils break sharply into depressional or flood plain areas. These minor deposits are typically associated with groundwater discharge or seep areas. Very poorly drained. The representative depth to wet soil moisture status is at the surface to 1 foot below the surface at some time throughout the year. The representative depth of ponding is from .2 to 1.0 foot at some time throughout the year. Surface runoff is negligible to high, dependent on slope. Permeability is moderately slow to moderately rapid.

BIBLIOGRAPHY

Aber, J., N Christensen, I. Fernandez, J Franklin, L. Hidinger, M. Hunter, J. MacMahon, D. Mladenoff, J. Pastor, D. Perry, R. Slangen, and H. van Miegroet. 2000. Applying Ecological Principles to Management of U.S. National Forests. Ecological Society of America - Issues in Ecology 6: 1-18.

Abrams, M.D. 1992. Fire and development of oak forests. Bioscience 42(5):346-353.

Agee, J. K. 1996. Achieving conservation biology objectives with fire in the Pacific Northwest. Weed Technology 10: 417-421.

Aitkin County Land Department (ACLD). 2001. Strategic Management Plan: Aitkin County Tax Forfeited Land Management Plan. Adopted: September 4, 2001. Prepared by Klaers, Powers and Associates; Pro-West & Associates, Inc.; and Northern Software & Consulting. Downloaded 6/5/2010: http://www.co.aitkin.mn.us/departments/land/forestmgmt.html

Aitkin County Land Department (ACLD). 2010. Tactical Forest Plan 2008-2010. Downloaded 6/5/2010: http://www.co.aitkin.mn.us/departments/land/PDF/TacticalNarrative8-10.pdf

Albert, D.A. 1994. Regional landscape ecosystems of Michigan, Minnesota, and Wisconsin: a working map and classification (fourth revision: July 1994). Upper Great Lakes Biodiversity Committee, North Central Forest Experiment Station, Forest Service, United States Department of Agriculture, St Paul, MN, 250 p.

Alleya, R.B., and A.M. Ágústsdóttira. 2005. The 8k event: cause and consequences of a major Holocene abrupt climate change. Quaternary Science Reviews 24: 1123-1149.

Almendinger, J. C. 1996. Minnesota's bearing tree database. Minnesota Natural Heritage System, Section of Ecological Services, Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul. 23 pp.

Almendinger, J. C., and D. S. Hanson. 1998. Ecological land classification handbook for the Northern Minnesota Drift and Lake Plains and the Chippewa National Forest: identification, description, and ecology of forested, native plant communities. Ecological Land Classification Program, Division of Forestry, Minnesota Department of Natural Resources, Grand Rapids, Minnesota. Version: June 1998.

Almendinger, J. C. 1987. A handbook for collecting releve data in Minnesota. Unpublished report, Section of Wildlife, Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul. 23 pp.

Almendinger, J. C. 1992. The late Holocene history of prairie, brush-prairie, and jack pine (Pinus banksiana) forest on outwash plains, north-central Minnesota, USA. Holocene 2(1): 37-50.

Almendinger, J. C., Hanson, D. S., and Jordon, J. K. 2000. Landtype Associations of the Lake States. Lake States LTA Coordinating Committee. Minnesota Department of Natural Resources, St. Paul, MN

Anderson, A. 2000. Guidelines for managing and restoring native plant communities along trails and waterways. Trails and Waterways Unit, Minnesota Department of Natural Resources, St. Paul, Minnesota. Version: August 2000.

Ashworth, A.C., and Cvancara, A.M., 1983, Paleoecology of the southern part of the Lake Agassiz basin, in Teller, J.T., and Clayton, L., eds., Glacial Lake Agassiz, Geological Association of Canada, Dept. of Geology, Memorial University of Newfoundland, St. John's, Newfoundland, p.133-156.

Augustine, D. J., and L. E. Frelich. 1998. Effects of white-tailed deer on populations of an understory forb in fragmented deciduous forests. Conservation Biology 12(5): 995-1004.

Axelrod, D.I. 1985. Rise of the grassland biome, central North America. Botanical Review 163-201.

Bailey, R.G., and C.T. Cushwa. 1981. Ecoregions of North America. Washington, D.C.: United States Geological Survey. 1 map (1:12,000,000).

Baker, R. G., E. A. Bettis III, D. P. Schwert, D. G. Horton, C. A. Chumbley, L. A. Gonzalez, and M. K. Reagan. 1996. Holocene paleoenvironments of Northeast Iowa. Ecological Monographs 66(2): 203-234.

Baker, R. G., C. A. Chumbley, P. M. Witinok and H. K. Kim. 1990. Holocene vegetational changes in Eastern Iowa. Journal of the Iowa Academy of Science 97(4): 167-177.

Baker, R. T., K. L. Van Zant and J. J. Dulian. 1980. Three late glacial pollen and plant micro-fossil assemblages from Iowa. Palynology 4: 197-203.

Baker, R.G., L.J. Maher, C.A. Chumbley and K.L. Van Zant. 1992. Patterns of holocene environmental change in the midwestern United States. Quarternary Research 37:379-389.

Baker. R. G. 1979. Late Wisconsinian and Holocene biotic history in Iowa (Abstract). Palynology 3: 278.

Barber, D.C., A. Dyke, C. Hillaire-Marcel, A.E. Jennings, J.T. Andress, M.W. Kerwin, G. Bilodeau, R. McNeely, J. Southon, M.D. Morehead, and J.M., Gagnon. 1999. Forcing the cold event of 8,200 years ago by catastrophic drainage of Laurentide Lakes. Nature 400: 344-348.

Bartlein, P.J., T. Webb III, and E. Fleri. 1984. Holocene climatic change in the northern Midwest: pollen-derived estimates. Quaternary Research 22, 361-374.

Bluemle, J. P., 1974. Early history of Lake Agassiz in Southwest North Dakota. Geological Society of America Bulletin 85: 811-814.

Bluemle, J. P., 2000, The Face of North Dakota, 3 rd Edition: North Dakota Geological Survey Educational Series 26, p. 70 - 75.

Bluemle, J.P. 2008. Glacial rebound, warped beaches and the thickness of the glaciers in North Dakota. https://www.dmr.nd.gov/ndgs/ndnotes/Rebound/Glacial%20Rebound.htm [downloaded 4/22/2008].

Braun, E. L. 1950. Deciduous forests of eastern North America. Blakiston Co., Philadelphia.

Braun, E. L. 1951. Plant distribution in relation to the glacial boundary. Ohio Journal of Science 51(3):139-146.

Bray, E.C. 1977. Billions of years in Minnesota: the geological story of the state. Science Museum of Minnesota, St. Paul.

Brevik, E. C. and Reid, J. R., 1994, Ice-thickness in the Lake Agassiz Basin during the Wisconsinan: Proceedings of the North Dakota Academy of Science, v. 48, p. 80.

Brevik, E. C., 1994, Isostatic rebound in the Lake Agassiz Basin since the late Wisconsinan: MS Thesis, University of North Dakota, 127 p.

Brooks, G.R., L.H. Thorleifson, and C.F.M. Lewis. 2005. Influence of loss of gradient from postglacial uplift on the Red River flood hazard, Manitoba, Canada. The Holocene 15: 347-352.

Brouillet, L., and R.D. Whetstone. 1993. Climate and physiography, pp 15-47. In Flora of North America: north of Mexico. Volume 1: Introduction. Flora of North America Editorial Committee (eds). Oxford University Press, New York. 372 pp.

Buckley, D.S., T.R. Crow, E.A. Nauertz, and K.E. Shulz. 2001. Influence of skid trails and haul roads on understory plant richness and composition in managed forest landscapes in Upper Michigan, USA. Forest Ecology and Management 175: 509-520.

Buell, M.F., H.F. Buell, and J.A. Small. 1954. Fire in the history of Mettler's Woods. Bulletin Torrey Botanical Club 81: 253-255.

Burns, R.M., and B.H. Honkala. 1990. Silvics of North America: vol. 1, conifers, 675 pp; vol. 2, hardwoods, 877 pp. USDA Forest Service, Washington, DC. Agriculture handbook No. 654.

Cahayla-Wynne, R. and D.C. Glenn-Lewin. 1978. The forest vegetation of the driftless area, northeast Iowa. American Midland Naturalist 100(2):307-19.

Cholewa, Anita F. 2010b. Collections Database of Vascular Specimens of the Herbarium, Bell Museum of Natural History. version 2010, copyright January 2010, University of Minnesota Herbarium, Bell Museum of Natural History. http://www.bellmuseum.org/plants/index.htm

Cholewa, Anita F. 2010a. Comprehensively Annotated Checklist of the Flora of Minnesota, version 2010, copyright January 2010, University of Minnesota, Herbarium, Bell Museum of Natural History. http://www.bellmuseum.org/plants/check_list.htm

Christiansen, P., H. Hadow and E. Hinman. 1980. Natural resource inventory of Pikes Peak/Point Ann State Park, Clayton County, Iowa. Final report to the Iowa Conservation Commission, Des Moines. 170 pp.

Christy, J.A., and T.A. Meyer. 1991. Bryophytes of algific talus slopes in Wisconsin=s driftless area. Rhodora 93(875):242-247.

Chumbley, C. A., R. G. Baker, and E. A. Bettis III. 1990. Midwestern Holocene paleoenvironments revealed by floodplain deposits in Northeastern Iowa. Science 249: 272-274.

Clark, G. K. C., D. W. Leverington, J. T. Teller and A.S. Dyke. 2003. Superlakes, megafloods, and abrupt climate change. Science 301: 922-923.

Clark, G. K. C., and D. W. Leverington, J. T. Teller and A.S. Dyke. 2005. Paleohydraulics of the last outburst flood from glacial Lake Agassiz and the 200 cold event. Quaternary Science Reviews 24:1533-1541.

Clayton, L., S. R. Moran, and J. P. Bluemle. 1965. Intersecting minor lineations on Lake Agassiz Plain. Journal of Geology. 73: 652-656.

Cleland, D.T.; Avers, P.E.; McNab, W. H.; Jensen, M. E.; Bailey, R. G., King, T.; Russell, W. E. 1997. National Hierarchical Framework of Ecological Units. Published in, Boyce, M. S.; Haney, A., ed. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp. 181-200.

Climatology Working Group. 1998. Website summarizing Minnesota weather data from 1960 to 1990. URL:http://www.soils.agri.umn.edu/research/climatology. Last modified June 11, 1998.

Coffin, B. and L. Pfannmuller, eds. 1988. Minnesota's Endangered Flora and Fauna. Natural Heritage and Nongame Wildlife Programs, Division of Fish and Wildlife, Minnesota Department of Natural Resources. University of Minnesota Press, Minneapolis, 473 pp.

COHMAP. 1988. Climatic changes of the last 18,000 years: observations and model simulations. Science 241: 1043-1052.

Collins, S. L. 1992. Fire frequency and community heterogeneity in tallgrass prairie vegetation. Ecology 73(6): 2001-2006.

Corace, R.G. III, L.M. Shartell, L. A. Schulte, W.L. Brininger Jr., M.K.D. McDowell, and D.M. Kashian. 2012. An ecoregional context for forest management on National Wildlife Refuges of the Upper Midwest, USA. Environmental Management 49:359-371.

Cottam, G. 1949. The phytosociology of an oak woods in southwestern Wisconsin. Ecology 30(3): 271-287.

Crow, T.R. 1988. Reproductive mode and mechanisms for self-replacement of northern red oak (Quercus rubra) B a review. Forest Science, vol 34 (1): 19-44.

Crum, H. 1988. A focus on peatlands and peat mosses. University of Michigan Press, Ann Arbor, 306 pp.

Cubasch, U. G.A. Meehl, C.J. Boer, R.J. Souffer, M. Dix, et al. 2001. Projections of future climate change. In: Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. Van Der Linden, X. Dai, K. Maskel, and C.A. Johsnon, (eds.) 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom, pp 526-582.

Curtis, J.T. 1959. The vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison. 657 pp.

Cushing, E.J. 1965. Problems in the Quarternary phytogeography of the great lakes region. In H.E. Wright and D.J. Frey (eds). The Quaternary of the United States. Princeton University Press, NJ. pp 403-416.

Cushing, E.J., 1967. Late-Wisconsin pollen stratigraphy and the glacial sequence in Minnesota. In: Cushing, E.J., H.E. Wright Jr., (Eds). Quaternary Paleoecology. Yale University Press, New Haven, pp 59-88.

Dean, W.E., T.S. Ahlbrandt, R.Y. Anderson, and J.P. Bradbury. 1996. Regional aridity in North America during the middle Holocene. The Holocene, Vol. 6, No. 2, 145-155.

Dean, W.E., T.S. Ahlbrandt, R. Y. Anderson, J.P. Bradbury. 1996. Regional aridity in North America during the middle Holocene. The Holocene 6: 145-155.

DeCalestra, D.S., and S.L. Stout. 1997. Relative deer density and sustainability: a conceptual framework for integrating deer management with ecosystem management. Wildlife Society Bulletin 1997, 25(2): 252-258.

Deevey, E. S., and R. F. Flint. 1957. Postglacial Hypsithermal Interval. Science 125: 182-184.

Delcourt, P.A., and H.R. Delcourt. 1993. Paleoclimates, paleovegetation and paleofloras during the late Quarternary, pp 71-94. In Flora of North America Editorial Committee (eds); Flora of North America: north of Mexico. Volume 1: Introduction.. Oxford University Press, New York. 372 pp.

Dinsmore, J.J. 1994. A country so full of game: the story of wildlife in Iowa. University of Iowa Press, Iowa City. 249 pp.

ECOMAP. 1993. National hierarchical framework of ecological units. Unpublished administrative paper. Washington, DC: U.S. Department of Agriculture, Forest Service.

Faber-Langendoen, D., and M. A. Davis. 1995. Effects of fire frequency on tree canopy cover at Allison Savana, Eastcentral Minnesota, U.S.A. Natural Areas Journal 15(4): 319-328.

Fisher, T. G. and D. G. Smith. 1994. Glacial Lake Agassiz: its northwest maximum extent and outlet in Saskatchewan (Emerson Phase). Quaternary Science Reviews 13(9-10): 845-858.

Fisher, T. G. 2003. Chronology of glacial Lake Agassiz meltwater routed to the Gulf of Mexico. Quaternary Research v59 (2): 271-276.

Fisher, T.G. 2004. River Warren boulders, Minnesota, USA: catastrophic paleoflow indicators in the southern spillway of glacial Lake Agassiz. Boreas 33: 349-358.

Flashingbauer, B.A. 1965. The elk in Minnesota, pp 99-132. In J.R. Moyle (ed), Big game in Minnesota. Technical bulletin 9, Minnesota Department of Conservation, St. Paul.

Fralish, J.S. 1988. Predicting potential stand composition from site characteristics in the Shawnee Hills of Illinois. American Midland Naturalist 120:79-101.

Fralish, J.S., F.B. Crooks, J.L. Chambers, and F.M. Harty. 1991. Comparison of presettlement, second-growth and old-growth forest on six site types in the Illinois Shawnee Hills . American Midland Naturalist 125:294-309.

Franklin, J.F., R.J. Mitchell and B.J. Palik. 2007. Natural disturbance and stand development principles for ecological forestry. United States Department of Agriculture, Forest Service, Northern Research Station, General Technical Report NRS-19. 44p.

Frelich, L. E. 1998. Natural disturbance and variability of forested ecosystems in northern Minnesota. Unpublished manuscript, Department of Forest Resources, University of Minnesota. 15 pp with figures.

Frelich, L. E., and P. B. Reich. 1995. Neighborhood effects, disturbance, and succession in forests of the western Great Lakes Region. Ecoscience 2(2): 148-159.

Frelich, L.E., and Reich, P.B. 2009. Wilderness Conservation in an era of global warming and invasive species: a case study from Minnesota's Boundary Waters Canoe Wilderness. Natural Areas Journal Vol. 29 (4): 385-394.

Frelich. L.E., and P.B. Reich. 2009. Wilderness Conservation in an era of global warming and invasive species: a case study from Minnesota's Boundary Waters Canoe Area Wilderness. Natural Areas Journal 29(4): 385-393.

Galatowitsch, S., Frelich, L.E., and Phillips-Mao, L. 2009. Regional climate change adaptation strategies for biodiversity conservation in a midcontinental region of North America. Biological Conservation 142 (2009) 2012–2022.

Galatowitsch, S., L. Frelich, and L. Phillips-Mao. 2009. Regional climate change adaption strategies for biodiversity conservation in a midcontinental region of North Americ a. Biological Conservation (in press).

Gleason, H. A. 1913. The relation of forest distribution and prairie fires in the Middle West. Torreya 13: 173-83

Gleason, H. A. 1922. The Vegetational History of the Middle West. Annals of the Association of American Geographers. Vol. 12: 39-85.

Gore, A. 2006. An inconvenient truth. Rodale Press, New York.

Gorham, E., C. Lehman, A. Dyke, J. Janssens, and L. Dyke. 2007. Temporal and spatial aspects of peatland initiation following deglaciation in North America. Quaternary Science Reviews 26: 300-311.

Gorham, E., J. A. Janssens, and P. H. Glaser. 2003. Canadian Journal of Botany 81: 429-438.

Green, J. C. 1995. Birds and forests: a management and conservation guide. Minnesota Department of Natural Resources, St. Paul, Minnesota. 182 pp.

Griffin, K. O. 1975. Vegetation studies and modern pollen spectra from the Red Lake Peatland, Northern Minnesota. Ecology 56: 531-546.

Griffin, K. O. 1977. Paleoecological aspects of the Red Lake Peatland, northern Minnesota. Canadian Journal of Botany, 55: 172-192.

Grimm, E.C. 1983. Cronology and dynamics of vegetation change in the prairie-woodland region of southern Minnesota, USA. New Phytologist 93:311-350

Grimm, E.C. 1984. Fire and other factors controlling the big woods vegetation of Minnesota in the mid-nineteenth century. Ecological Monographs 54(3):291-311.

Grimm, E.C. 1985. Vegetation history along the prairie-forest border in Minnesota. In J. Spector and E. Johnson (eds). Archeology, ecology, and etnology of the prarie-forest border zone of Minnesota and Manitoba. Reprints in Anthropology, vol 31. J & L Reprint Company, 410 Wedgewood Drive, Lincoln, NE 68510. pp 9-30.

Grossman, D. H., Faber-Langendoen, D., Weakley, A.S., Anderson, M., Bourgeron, P. Crawford, R., Goodin. K., Landaal, S., Metzler, K., Patterson, K.D., Pyne, M., Reid. M., and Sneddon, L. 1988. The National Vegetation Classification System: Development, status and applications. Vol. 1 International classification of ecological commuities; Terrestial vegetation of the United States. Arlingon, VA: The Nature Conservancy.

Grossman, D.H., K.L. Goodin and C.L. Reuss. 1994. Rare plant communities of the conterminous United States: an initial survey containing the national overview and midwest region. The Nature Conservancy, Arlinton, VA, 304 p.

Hallberg, G.R., Betttis III, E.A. and Prior, J.C. 1984. Geologic overview of the Paleozoic Plateau region in northeastern Iowa. Proceedings Iowa Academy Science 91(1):5-11.

Hargrave, B. 1996. Upper three levels of ECS [Ecological Classification System] for Minnesota. Compiled by: Minnesota Department of Natural Resources, University of Minnesota and the USDA Forest Service. ECS Specialist, Division of Forestry, Resource Assessment Program, Minnesota Department of Natural Resources, Grand Rapids. Poster with back notes.

Harris, A.G., McMurray, S.C., Uhlig, P.W.C., Jeglum, J.K., Foster, R.F., and Racey, G.D. 1996. Field guide to the wetland ecosystem classification for Northwestern Ontario. Field Guide FG-01. Thunder Bay: Ontario Ministry of Natural Resources, Northwest Science & Technology.

Higgins, K.F. 1986. Interpretation and compendium of historical fire accounts in the northern great plains. United States Department of the Interior, Fish and Wildlife Service. Resource Publication 161, Washington D.C. 39 pp.

Hobbs, H. C., 1983. Drainage relationship of Glacial Lake Aitkin and Upham and early Lake Agassiz in northeastern Minnesota. In: Teller, J. T. and Clayton, L. Eds., Glacial Lake Agassiz, pp. 245-259, Geological Association of Canada Special Paper 26

http://www.lib.ndsu.nodak.edu/govdocs/text/lakeagassiz/chapter6.html#304

http://www.lib.ndsu.nodak.edu/govdocs/text/lakeagassiz/chapter9.html

Hupy, C.M., and C.H. Yansa. 2009. Late Holocene vegetation history of the forest tension zone in Central Lower Michigan, USA. Physical Geography 30 (3): 205-235.

Jacobs, R. D. and R. D. Wray. 1992. Managing oak in the driftless area. Minnesota Extension Service, University of Minnesota, Natural Resouces, No. NR-BU-5900-S. 32 pp.

Jacobson Jr., G. L. 1979. The paleoecology of white pine (Pinus strobus) in Minnesota. Journal of Ecology 67: 697-726.

Janssen, C. R. 1968. Myrtle Lake: a late and post-glacial pollen diagram from Northern Minnesota. Canadian Journal Botany 46: 1397-1408.

Janssen, C. R. 1967. Stevens Pond: a postglacial pollen diagram from a small Typha swamp in Northwestern Minnesota. Journal of Ecology 67: 697-726.

Janssen, R.J. 1987. Birds in Minnesota. University of Minnesota Press, Minneapolis, 352 pp.

Janssens, J. A., and P. H. Glaser. 1986. The bryophyte flora and major peat-forming mosses at Red Lake Peatland, Minnesota. Canadian Journal of Botany 64: 427-442.

Janssens, J. A. 1983. A quantitative method for stratigraphic analysis of bryophytes in Holocene peat. Journal of Ecology 71: 189-196.

Janssens, J. A., B. C. S. Hansen, P. H. Glaser, and C. Whitlock. 1992. Development of a raised-bog complex. In: Wright, H. E., B. A. Coffin and N. E. Aaseng, [eds]. The patterned peatlands of Minnesota. University of Minnesota Press, Minneapolis, pp 189-203.

Johnson, D.H. 1996. Population Analysis. In: T.A. Bookhout. Research and management techniques for wildlife and habitats. Wildlife Society. Allen Press, Lawrence, KS. pp 419-444.

Johnson, R. 2007. The beach ridges of the Glacial Ridge Area. Unpublished Manuscript made available from the author.

Kotar, J., and Burger, T.L. 1996 Field guide to foest communities and habitat types of central and southern Wisconsin. Madison: Department of Forestry, University of Wisconsin-Madison.

Kotar, J., and Burger, T.L. 2000. Field guide to forest habitat type classification for north-central Minnesota. Madison, WI: Terra Silva Consultants.

Kuchler, A. W. 1964. The potential natural vegetation of the conterminous United States. Special Publication 36. New York, NY: American Geographic Society. 154p. & map.

Ladd, D. 1991. Reexamination of the role of fire in Missouri Oak woodlands. Proceedings of the Oak Woods Management Workshop. Eastern Illinois University, IL. pp 67-80.

Lammers, T.G. 1983. The vascular flora of Des Moines County, Iowa. Proceedings Iowa Academy Science 90(2):55-71.

Leverington, D. W., J. T. Teller, and J. D. Jason. 2001. Bathymetry, Volume, and Dynamics of Glacial Lake Agassiz 11,000 to 7,700 YBP. Paper No. 133-0. GSA Annual Meeting, November 5-8, 2001. Quaternary Geology/Geomorphology (Posters) I. Abstract downloaded (January 2008). http://gsa.confex.com/gsa/2001AM/finalprogram/abstract_24785.htm

Lockner, W., 2008. Personal communication by email with Gretchen Mehmel. January 23, 2008.

Lorimer, C. G. 1989. The oak regeneration problem: new evidence on causes and possible solutions. Seventeenth Annual Symposium of the The Hardwood Research Council, Merrimac, Wisconsin, May 7-10, 1989. pp 23-39.

Lorimer, C.G. 1983. Eighty year development of northern red oak after partial cutting in a mixed-species Wisconsin forest. Forest Science 29(2): 371-383.

Lusardi, B.A. 1997. Minnesota at a glance: Quaternary Glacial Geology, revised. Minnesota Geological Survey, University of Minnesota, St. Paul. [PDF]

Mann, J. D., D. W. Leverington, J. Rayburn, and J. T. Teller. 1999. The volume and paleobathymetry of glacial Lake Agassiz. Journal of Paleolimnology 22(1) 71-80.

Marschner, F. J. 1930 ex. Heinselman, M. L. 1974. Original Vegetation of Minnesota. USDA Forest Service, North Central Forest Experiment Station, St. Paul (Reproduction).

Marschner, F. J. 1974. The original vegetation of Minnesota (map, scale 1:2,500,000). Forest Service, U. S. Department of Agriculture, North Central Forest Experiment Station, St. Paul, MN (redraft of the original 1930 edition by M. L. Heinselman).

Mason, J.A. 1992. Loess distribution and soil landscape evolution, southeast Minnesota. M.S. Thesis, University of Minnesota, St. Paul, MN. 407 p.

McAndrews, J. H. 1966. Postglacial history of prairie, savana, and forest in Northwestern Minnesota. Memoirs of the Torrey Botanical Club 22: 1-72.

McAndrews, J. H. 1996. Martin Pond pollen record. In E.C. Grimm et al., editors, North American Pollen Database. IGBP PAGES/World Data Center for Paleoclimatology. NOAA/NCDC Paleoclimatology Program, Boulder, Colorado, USA.

McAndrews, J.H. 1966. Postglacial history of prairie, savanna, and forest in northwestern Minnesota. Memoirs Torrey Botanical Club. 22(1):1-72.

McCartney, W.H. 1990. An examination of northern red oak stands in Houston County, Minnesota. M.S. Thesis - Plan B, University of Minnesota, St. Paul. 29 pp.

McCune, B., and G. Cottam. 1985. The successional status of a southern Wisconsin oak woods. Ecology 66(4):1270-1278.

Minnesota Forest Resource Council. 1999. Sustaining Minnesota Forest Resources: voluntary site-level forest management guidelines for landowners. Minnesota Forest Recourse Council, St. Paul, Minnesota.

MN DNR (Minnesota Department of Natural Resources). 1981. Minnesota Peat Program Final Report.

MN DNR (Minnesota Department of Natural Resources). 1993. Forest stewardship plan for Minnesota forest landowners - Division of Forestry, Minnesota Department of Natural Resources, St. Paul, Minnesota. Edition 3.1, September 1993.

MN DNR (Minnesota Department of Natural Resources). 1983. Forest survey manual: Phase II intensive inventory. Revised 11/83. Forest Resource Assessment Program, Division of Forestry, Minnesota Department of Natural Resources. 72 pp with appendices.

MN DNR (Minnesota Department of Natural Resources). 1982a. Peat Resources: an area of Beltrami and Lake of the Woods Counties, Minnesota. Map. Peat Inventory Project, MN DNR Division of Minerals, St. Paul (Rectified JPG image)

http://www.lmic.state.mn.us/chouse/metadata/peatmaps.html

MN DNR (Minnesota Department of Natural Resources). 2007. GIS Data Attribute Report for: Minnesota Releve Site Data. Minnesota Department of Natural Resources. (http://jmaps.dnr.state.mn.us/mdreporter/cl_attributes.jsp?clid=723&lname=Minnesota%20Releve%20Site%20Data)

MN DNR (Minnesota Department of Natural Resources). 2007. A handbook for collecting vegetation plot data in Minnesota: The relevé method. Minnesota County Biological Survey, Minnesota Natural Heritage and Nongame Research Program, and Ecological Land Classification Program. Biological Report 92. St. Paul: Minnesota Department of Natural Resources.

MN DNR (Minnesota Department of Natural Resources) - Natural Heritage Program (NHP). 1993. Minnesota's native vegetation: a key to natural communities, version 1.5. Minnesota DNR, Section of Wildlife, Biological Report No. 2: 1-111.

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

MN DNR (Minnesota Department of Natural Resources). 1997. Directions for natural resources: an ecosystem-based framework for setting natural resource management priorities - satrategic plan. Minnesota Department of Natural Resources, St. Paul. 44 pp.

MN DNR (Minnesota Department of Natural Resources). 1994. Old-growth forests guidelines. Minnesota Department of Natural Resources, St. Paul (signed by Commissioner R.W. Sando, 6 June 1994). 12 pp.

MN DNR (Minnesota Department of Natural Resources). 2007. Peat Inventory Data - Minnesota (ACCESS 2000). MN DNR Division of Lands and Minerals. Updated 2007. http://www.lmic.state.mn.us/chouse/metadata/peatinv.html

MN DNR (Minnesota Department of Natural Resources). 2005. Field Guide tho the Native Plant Communities of Minnesota: The Prairie Parkland and Tallgrass Aspen Parklands Provinces. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program, Minnesota Department of Natural Resources, St. Paul, MN.

MN DNR (Minnesota Department of Natural Resources). 1987b. Peat Resource Estimation in Minnesota, Final Report.

MN DNR (Minnesota Department of Natural Resources). 1987a. The Minnesota Peat Program Summary Report: 1981-1986.

MN DNR (Minnesota Department of Natural Resources). 1982b. Inventory of Peat Resources: Aitkin County, Minnesota. MN DNR Division of Minerals, Peat Inventory Project, Hibbing, Minnesota.

MN DNR (Minnesota Department of Natural Resources). 1984a. Inventory of Peat Resources, An Area of Beltrami and Lake of the Woods Counties, Minnesota.

MN DNR (Minnesota Department of Natural Resources). 1984b. Inventory of Peat Resources: an area of Beltrami and Lake of the Woods Counties, Minnesota. MN DNR Division of Minerals, Peat Inventory Project, Hibbing, Minnesota.

MN DNR (Minnesota Department of Natural Resources). 1989. Old-growth forests in Minnesota: a preliminary report. Natural Heritage Program, Section of Wildlife, Minnesota Department of Natural Resources - Biological Report No. 5. 13 pp.

MN DNR (Minnesota Department of Natural Resources). 2010. Official plant list of the Minnesota Department of Natural Resources. MS Access Database file (All_Herb16), personal communication from: Stacey Olszewski (may292010).

MN DNR (Minnesota Department of Natural Resources). 2006. Tomorrow's Habitat for the Wild and Rare: an action plan for Minnesota Wildlife, Comprehensive Wildlife Conservation Strategy. Division of Ecological Services, Minnesota of Natural Resources, St. Paul, MN.

MN DNR (Minnesota Department of Natural Resources). 2005. Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province. Ecological Land Classification Program. Minnesota County Biological Survey, and the Natural Heritage and Nongame Research Program. Minnesota Department of Natural Resources, St. Paul, MN.

MNDNR (Minnesota Department of Natural Resources). 2005. Field Guide tho the Native Plant Communities of Minnesota: The Prairie Parkland and Tallgrass Aspen Parklands Provinces. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program, Minnesota Department of Natural Resources, St. Paul, MN.

Morey, G.B. and J. Meints. 2000. Minnesota Bedrock Geology. 3rd Edition. State Map Series S-20 Minnesota Geological Survey, University of Minnesota. Scale 1:1,000,000. Digitized version.

Mueller-Dombois, D., & Ellenberg, H. 1974. Aims and methods of vegetation ecology.

National Assessment Synthesis Team. 2001. Climate Change Impacts on the United States: The potential consequences of climate variability and change. Report for the US Global Change Research Program, Cambridge University Press, Cambridge UK, 620pp.

Nichols, H. 1969. Chronology of peat growth in Canada. Palaeogeography, Palaeoclimatology, Palaeoecology 6: 61-65.

NOAA Paleoclimatology Program. 2000. North American Drought: a paleo perspective. Website for the National Oceanic and Atmosphere Administration (www.ngdc.noaa.gov/paleo/paleo.html).

Nowacki, G.J., M.D. Abrams, and C.G. Lorimer. 1990. Composition, structure, and historical development of northern red oak stands along an edaphic gradient in north-central Wisconsin. Forest Science, vol. 36 (2): 276-292.

NRCS (Natural Resources Conservation Service). 2008. Custom Soil Resource Report for Becker County, Minnesota. U.S. Department of Agriculture (USDA), Natural Resources Conservation Service.

NRCS (Natural Resources Conservation Service). 2008. Soil Survey Geographic (SSURGO) database for Becker County, Minnesota. U.S. Department of Agriculture (USDA), Natural Resources Conservation Service. Online_Linkage: URL:http://SoilDataMart.nrcs.usda.gov

NRCS (Natural Resources Conservation Service). 2007. The Plants Database (http://plants.usda.gov) 27 January 2007. U. S. Department of Agriculture, Natural Resources Conservation Service, National Plant Data Center, Baton Rouge, LA.

Ogden, J. G., 3rd. 1967. Radiocarbon and pollen evidence for a sudden change in climate in the Great Lakes region approximately 10,000 years ago. In E. J. Cushing and H. E. Wright. Jr. (Eds), Quaternary Paleoecology, 7: 117-127. Proceedings of the 7th Congress International Association for Quaternary Research.

Ojakangas, R.W., and C.L. Matsch. 1982. Chapter 7: The Quaternary Period. In: Minnesota's Geology. University of Minnesota Press, Minneapolis.

Ovenden, L. 1990. Peat accumulation in northern wetlands. Quaternary Research 33: 377-386.

Palmer, A.N. and M.V. Palmer. 1993a. Geology and origin of mystery cave: technical report. Unpublished report to the Minnesota Department of Natural Resources, Division of Parks and Recreation. 137 pp.

Pearson, C. W. 1998. Planning for the birds. Section of Ecological Services, Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota. 34 pp.

Perry, D. A. and M. P. Amranthus. 1997. Disturbance, Recovery and Stability, in: A Creating a Forestry for the 21st Century@, edited by Kathryn A. Kohm and Jerry F. Franklin, Island Press.

Petraborg, W.H., and D.W. Burcalow. 1965. White-tail deer in Minnesota, pp 11-48. In J.R. Moyle (ed), Big game in Minnesota. Technical bulletin 9, Minnesota Department of Conservation, St. Paul.

Pewe, T.L. 1983. The periglacial environment in North America during Wisconsin time. In S.C. Porter and H.E. Wright (eds). Late-Quaternary environments of the United States. Volume 1: the late pleistocene. University of Minnesota Press, Minneapolis, pp 157-189.

Rose. F. 1992. Temperate forest management: its effects on bryophyte and lichen floras and habitats, pp 212-243. In J.W. Bates and A.M. Farmer (eds). Bryophytes and lichens in a changing environment. Clarendon press, Oxford.

Ruhe, R.V. 1956. Geomophic surfaces and the nature of soils. Soil Science 82: 441-445.

Ruhe, R.V. 1965. The Iowa Quarternary, pp 110-126. In Schultz, C.B. and H.T.U. Smith (eds). Guidebook for field conference C - Upper Mississippi Valley. International Association for Quartenernary Research. VIIth Congress. Nebraska Academy of Science, Lincoln.

Ruhe, R.V. 1969. Quaternary landscapes in Iowa. Iowa State University Press, Ames.

Ruhe, R.V. 1983a. Depositional environment of the late Wisconsin loess in the midcontinental United States. In S.C. Porter and H.E. Wright (eds). Late-Quaternary environments of the United States. Volume 1: the late pleistocene. University of Minnesota Press, Minneapolis, pp 130-137.

Ruhe, R.V. 1983b. Aspects of Holocene pedology in the United States. In H.E. Wright, Jr., (ed), Late-Quarternary environments of the United States, vol. 2, The Holocene, University of Minnesota Press, Minneapolis, pp 12-25.

Scholz, H. F. 1948. Diameter-growth studies of northern red oak and their possible silvicultural implications. Iowa State College Journal of Science 22(4):421-429.

Scholz, H.F. 1948. Diameter growth studies of northern red oak and their possible silvicultural implications. Iowa State College Journal of Science 22(4): 421-429.

Scholz, H.F. 1952. Age variability of northern red oak in the Upper Mississippi Woodlands. Journal of Forestry 50(7): 518-520.

Shea, K. L., and G. R. Furnier. 1994. Genetic variation and spatial genetic structure in four balsam fir (Abies balsamea) populations. Abstract. American Journal of Botany 81(6): 62.

Shuman, B., P. Bartlein, N. Logar, P. Newby, and T. Webb III. 2002. Parallel climate and vegetation responses to the early Holocene collapse of the Laurentide Ice Sheet. Quaternary Science Reviews 21: 1793-1805.

Shuman, B., T. Webb III, P. Bartlein and J. W. Williams. 2002. The anatomy of a climatic oscillation: vegetation change in Eastern North America during the Younger Dryas chronozone. Quaternary Science Reviews 21: 1763-1916.

Sims, P. K., and G.B. Morey, eds. 1972. Geology of Minnesota: a centennial volume. Minnesota Geological Survey, University of Minnesota, Minneapolis.

Sims, R.A., Towill, W.D., Baldwin, K.A., Uhlig, P., and Wickware, G.M. 1989. Field guide to the forest ecosystem classification for northwestern Ontario. Thunder Bay Ontario Ministry of Natural Resources, Northwest Science and Technology.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://soils.usda.gov/

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions. Available online at http://soils.usda.gov/technical/classification/osd/index.html. Accessed [12/31/2011].

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Series Classification Database. Available online at http://soils.usda.gov/technical/classification/scfile/index.html. Accessed [month/day/year].

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database for [Survey Area, State]. Available online at http://soildatamart.nrcs.usda.gov. Accessed [month/day/year].

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. U.S. General Soil Map (STATSGO2). Available online at http://soildatamart.nrcs.usda.gov. Accessed [month/day/year].

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed [month/day/year].

National Cooperative Soil Survey. National Cooperative Soil Characterization Database. Available online at http://ssldata.nrcs.usda.gov. Accessed [month/day/year].

Teller, J. T. and L. Clayton. 1983. Glacial Lake Agassiz: geological association of Canada Special Paper 26, pp 451.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://soils.usda.gov/

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://soils.usda.gov/

Tester, J. R. 1989. Effects of fire frequency on oak savanna in east-central Minnesota. Bulletin of the Torrey Botanical Club 116(2): 134-144.

Tester, J. R. 1996. Effects of fire frequency on plant species in oak savanna in east-central Minnesota. Bulletin of the Torrey Botanical Club 123(4): 304-308.

Thorleifson, L. H. 1996. Review of Lake Agassiz History. in Sedimentology, Geomorphology, and History of the central Lake Agassiz Basin, Field Trip B2, Teller, J. T., Thorleifson, L. H., Matile, G., and Brisbin, W. C., eds., Geological Association of Canada Guidebook, p. 55-84.[PDF]

Thorne, R. F. Relict nature of the flora of white pine hollwo forest reserve, Dubuque County, Iowa. State University of Iowa Studies in Natural History 20(6): 1-33.

Transeau, E. N. 1935. The prairie peninsula. Ecology 16: 423-437.

United States Surveyor General. 1853 - 1855. Field notes: township exterior and subdivision lines. Minnesota State Archives, Minnesota Historical Society, St. Paul.

University of Minnesota. 1973. Minnesota soil atlas, St. Paul sheet. Agricultural Experiment Station, Miscellaneous Report 120: 1-57.

Upham, W. 1896a. Chapter VI. Beaches and deltas of the Herman stages. The Glacial Lake Agassiz. United States Geological Survey Monograph 25. [downloaded 04/22/2008]

Upham, W. 1896b. Chapter IX: changes in the levels of the beaches. The Glacial Lake Agassiz. United States Geological Survey Monograph 25. [downloaded 04/22/2008]

USDA, NRCS. 2012. The PLANTS Database (http://plants.usda.gov, 4 January 2012). National Plant Data Team, Greensboro, NC 27401-4901 USA.

USFWS (United State Fish and Wildlife Service). FWS. 2010. Tamarac National Wildlife Refuge Comprehensive Conservation Plan. U. S. Department of the Interior, Fish and Wildlife Service.

USFWS (United State Fish and Wildlife Service). 2005. Agassiz National Wildlife Refuge Comprehensive Conservation Plan. U. S. Department of the Interior, Fish and Wildlife Service.

USGS (United States Geological Survey). 2004. Workshop on invasive species strategy. Division of Biological Resources. Available online: biology.usgs.gov/cro/I-workshp/InvasiveWorkshopText.htm.

Van Zant, K. L., and G. R. Hallberb. 1976. A late-glacial pollen sequence from northeastern Iowa: Sumner Bog revisited. Technical Information Series July 1976 Number 3. Iowa Geological Survey, Iowa City, Iowa. 17 pp.

Wahlberg, H. 1975. The northland: A history of Roseau County. (Cited by Potts 2002).

Walter, E.D., J.P. Bradbury, R.Y. Anderson, and C.W. Barnosky. 1984. The variability of Holocene climate change: evidence from varved lake sediments. Science 226: 1191-1194.

Watts, W.A. 1983. Vegetational history of the eastern United States 25,000 to 10,000 years ago, pp 110-126. In S.C. Porter and H.E. Wright (eds). Late-Quaternary environments of the United States. Volume 1. The late Pleistocene. University of Minnesota Press, Minneapolis.

Webb III, T., E.J. Cushing, and H.E. Wright Jr. 1983. Holocene changes in the vegetation of the midwest, pp 142-165. In H.E. Wright, Jr., (ed). Late-Quarternary environments of the United States, vol. 2, The Holocene, University of Minnesota Press, Minneapolis.

Webb III, T., E.J. Cushing, and H.E. Wright Jr. 1983. Holocene changes in the vegetation of the Midwest. In Wright Jr., H.E. (Ed.). Late-Quaternary Environments of the United States, Volume 2: the Holocene. University of Minnesota Press, Minneapolis, pp 142-165.

Wells, P. V. 1965. Scarp woodlands, transported grassland soils, and concept of grassland climate in the Great Plains region. Science 148: 246-249

Wells, P. V. 1970. Postglacial vegetation history of the Great Plains. Science, 164: 1574-1582.

Wheeler, G.A., P.H. Glaser, E. Gorham, C.M. Wetmore, F.D. Bowers, and J.A. Janssens. 1983. Contributions to the flora of the Red Lake Peatland, Northern Minnesota, with special attention to Carex. The American Midwest Naturalist 110: 63-96.

White, P.S. 1979. Pattern, Process, and Natural Disturbance in Vegetation. Botanical Review 45:229-299.

White, P.S., and R.D. White. 1996. Old-growth oak and oak-hickory forests, pp 178-197. In M.B. Davis (ed). Eastern old-growth forest: prospects for rediscovery and recovery. Island press, Washington DC.

White Pine Regeneration Strategies Work Group. 1996. Minnesota's white pine: now and for the future. Minnesota Forest Resources Council, Minnesota Department of Natural Resources. December 19, 1996. 66 pp.

Whitlock, C., Partlein, P.J., & Watts, W.A. 1993. Vegetation history of Elk Lake. In Bradbury, J.P., and Dean, W.E (eds): Elk Lake, Minnesota: Evidence for rapid climate change in the North-Central United States. Geological Society of America, Special Paper 276. Pp 251-274.

Wilhelm, G. 1987. The arboretum's east woods: are they forever? The Morton Arboretum Quarterly 23(4): 54-62.

Winkler, M., A.M. Swain, J.E. Kutzback. 1986. Middle Holocene dry period in the Northern Midwestern United States: lake-levels and pollen stratigraphy. Quaternary Research 25: 235-250.

WISFLORA. 2010. Wisconsin Vascular Plant Species: Collection Database of the Wisconsin Botanical Information System. Wisconsin State Herbarium, University of Wisconsin - Madison. January 2010. http://www.botany.wisc.edu/herbarium/

Wovcha, D.S., B.C. Delaney & G.E. Nordquist. 1995. Minnesota's St. Croix River Valley and Anoka Sandplain: a guide to native habitats. University of Minnesota Press, Minneapolis.

Wright Jr., H. E. Introduction. In Wright Jr., H. E. (Ed.). Late-Quaternary Environments of the United States, Volume 2: the Holocene. University of Minnesota Press, Minneapolis, pp xi-xvii.

Wright Jr., H.E. 1992. Introduction. In: Wright, H.E., B.A. Coffin and N.E. Aaseng, Eds. The patterned peatlands of Minnesota. University of Minnesota Press, Minneapolis, pp xv-xx.

Wright Jr., H.E. 1993. History of the landscape in the Itasca region., in Bradbury, J.P., and Dean, W.E., eds., Elk Lake, Minnesota: Evidence for Rapid Climate Change in the Noth-Central United States: Boulder, Colorado, Geological Society of America Special Paper 276, pp 7-17.

Wright Jr., H.E. 1976. The dynamic nature of Holocene vegetation, a problem in paleoclimatology, biogeography and stratigraphic nomenclature. Quarternary Research 6: 581-596.

Wright. Jr., H.E. 1972a. Quaternary History of Minnesota. In P.K. Sims and G.B. Morey, eds. Geology of Minnesota: A Centennial Volume, Chapter VII Cenozoic. Minnesota Geological Survey, University of Minnesota, St. Paul, pp 515-547.

Zager, S.C. 2006. Itasca State Park: native plant community and other non-natural cover types. Unpublished report submitted to the Division of Parks and Trails, Minnesota Department of Natural Resources, St. Paul, MN, 89pp with figures.

Zenner, E.K., and J.E. Peck. 2009. Maintaining a pine legacy in Itasca State Park. Natural Areas Journal 29: 157-166.

APPENDIX 1

DEFINITIONS OF TERMS and METADATA RELATED TO THE ECOLOGICAL LAND CLASSIFICATION HIERARCHY

APPENDIX 1

Ecological Land Classification Hierarchy[1]

The Minnesota DNR and the U.S. Forest Service have developed an ecological classification system (ECS) for ecological mapping and landscape classification in Minnesota following the National Hierarchical Framework of Ecological Units (ECOMAP 1993). Ecological land classifications are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The system uses associations of biotic and environmental factors, including climate, geology, topography, soils, hydrology, and vegetation. There are eight levels of ECS units in the United States. Six of these units occur in Minnesota: provinces, sections, subsections, land type associations, land types, and land type phases. Provinces will be the only ECS unit addressed in this report.

Provinces are units of land defined using major climate zones, native vegetation, and biomes such as prairies, deciduous forests, or boreal forests. There are four provinces in Minnesota (see Fig. 1a).

Native Plant Community Classification Hierarchy[1]

Ecological Systems are one of the highest of the six levels of Minnesota's hierarchical classification of Native Plant Communities (NPC). Ecological Systems are groups of NPC units that are unified by strong influence from a major ecological process or set of processes, especially nutrient cycling and natural disturbances. NPC polygons delineated by Scott Zager, Wildlands Ecological Services, were assigned attribute fields for NPC System. These attributes describe the ecological system most applicable to the area defined by individual polygons.

In Figure 5, all NPC and Non-Natural polygons were identified by their potential system. These include the NPC Systems: AP = Acid Peatland, FD = Fire Dependent, FP = Forested Peatland, GL = Grass Lands (Prairie), MH = Mesic Hardwoods, MR = Emergent Marsh, NN = Non-Natural Cover Types, OP = Open (Rich) Peatland, W = Water, WF = Wet Forest, WM = Wet Meadow / Shrubs. Area polygons of Non-Natural cover types were assigned "potential system" codes to indicate the area's potential NPC System for restoration and management.

Floristic Regions are divisions within ecological systems that reflect the distribution of Minnesota's plant species into characteristic groups or floras: northern, northwestern, central, southern, and prairie. The important influences on these species distributions appear to be climate and paleohistory (that is, the modern distribution of plants in Minnesota reflects influence from past as well as present climate regimes).

NPC Classes are units of vegetation that generally have uniform soil texture, soil moisture, soil nutrients, topography, and disturbance regimes (MN DNR 2005). NPC classes in this field guide are roughly equivalent to habitat types as defined for Minnesota (Kotar and Burger 2000), Wisconsin (Kotar and Burger 1996), and Michigan (Coffman et al. 1984). NPC classes change rather gradually along ecological gradients, especially in amount of water and nutrients available to plants. Therefore, classes within a system overlap broadly with one another in species composition.

NPC polygons were assigned NPC Class attributes defining an area's potential for management and restoration. Non-Natural cover types were assigned to NPC Classes that best indicate the area's potential for restoration under current and expected climates (see Figs. 8, 10 & 12).

NPC Types are defined by canopy dominants, variation in substrate, or fine-scale differences in environmental factors such as moisture or nutrients MN DNR 2005). For wooded communities, each type – unlike the NPC classes – is usually uniform in tree canopy composition;

[1] **Taken from MN DNR 2005: "Field Guide to the Native Plant Communities of Minnesota - Eastern Broadleaf Forest Province. Text in italics apply specifically to this report.**

APPENDIX 1

in some cases NPC types represent successional stages of the community. Type distinctions were also made to describe geographic patterns within the class, substrate relationships, and variability in dominant species, especially if a group within a class represented a unit described in previous studies of vegetation in Minnesota. NPC types are roughly equivalent to associations in the U.S. National Vegetation Classification and to forest and wetland ecosystems in Ontario (Sims et al. 1989; Harris et al. 1996).

NPC Type and Non-Natural Cover Type codes were assigned to all NPC polygons in order to classify the existing status, or extant, vegetation currently within the area of the polygon (see Figs 7, 9 & 11).

Attribute Codes for Native Plant Community Floristic Regions, Classes and Types.

The names of the NPC classes and types are based on floristic region, soil moisture or nutrient regimes, and vegetation or habitat features. For wooded communities, NPC Type names are based on dominate tree species, sometimes qualified with understory species or minor canopy species that help separate that particular type from other types in the same NPC Class. If the NPC Type within a class have distinct geographic ranges or substrate affinities, these are often indicated in the name as well.

NPC Class codes include five digits (e.g., FDc24, MHc26, WFn55). The first two capitalized letters indicate the NPC System (e.g., FDc24 = FD, Fire Dependent System). The third digit is a lower case letter indicating the Floristic Region within the NPC System (e.g, FDc24 = c, Central Floristic Region). The fourth digit is a number on a scale of "0" to "9" indicating the moisture gradient position from "0" being the driest, and "9" being the wettest (e.g., FDc24 = 2, Dry). The fifth digit is a number on a scale of "0" to "9" indicating the nutrient scale position from "0" being the poorest, to "9" being the richest (e.g., FDc24 = 4, Rich).

Non-Natural cover types were assigned a "Potential Class" code indicating the polygon area's potential for NPC restoration and management based on soil properties, geologic landformation and other natural characteristics.

NPC Type codes include all the previous five digits of the NPC Class, including a sixth digit comprised of a lower case letter (e.g, FDc24a = "Jack Pine - (Bush honeysuckle) Woodland" Type of the NPC Class, "Central Rich Dry Pine Woodland".

Non-Natural codes have no distinct protocol and simply serve to identify the extant status of the existing vegetation or describe current landuse within the area circumscribed by the polygon.

DEFINITION OF SURVEY TERMS

Vegetation assessment begins with the segmentation of land according to a defined category or classification (i.e. NPC, Native Plant Community). The process of identifying, partitioning, and classifying land is called "entitation". Entitation is subjective because there is often wide variation within communities and some community types intergrade or overlap in their characteristics. It is important that the area within the delineated boundaries be as uniform or homogenous as possible in respect to the community type and its ecological condition or quality. Assessment of ecological quality of a natural community is necessary in areas altered by human management or mismanagement. Essentially the ecologist must determine the level of human disturbance and the effects these impacts have had upon the vegetation as it presently exists.

In order to classify an area into NPC type(s) and then rank these communities according to their ecological quality; I must recognize and determine which ecological characteristics or variables best distinguish communities and which environmental conditions indicate ecological quality or level of past disturbance(s). I always ask: to what degree does this natural community differ from an idealized natural community (in this area) that has never been managed

APPENDIX 1

and whose natural ecological processes have not been interrupted? Other questions include: are there similarities between certain management practices and natural events? What ecological changes to a community occur naturally? How important are natural processes in maintaining the region's biodiversity?

I have selected characteristics which enable me to describe a forest as rapidly as possible. My task is to record and later report comparable information efficiently. Yet a balance exists between speed of data collection and consistent accuracy. Several methods of ecological assessment exist which are only appropriate when research goals are clearly defined. The selection of a particular method depends on the type of study conducted and the level of accuracy needed to draw the correct conclusions. Of course, the finer the data, the more rigorous the methodology must be. Statistical sampling may require a large number of randomly selected samples where the data collected at each sample may be actual counts, weights, volumes, etc. Descriptive assessment may be very detailed or as simple as noting the presence or absence of a particular feature.

NATIVE PLANT COMMUNITY TYPES

Forest community types are defined by Minnesota Department of Natural Resources (MN DNR 2003, 2005a & 2005b).

FOREST STRUCTURE/HEIGHT STRATA

Forests where described by the vegetation at different layers or strata of height. In general, these include: Super Canopy, Canopy, Subcanopy, Shrub layer, Seedling and Herbaceous Layer. The estimated height ranges for these categories are given in the description of each natural community. Mostly these layers are distinct and easily observable but vary from one community to the next. Sometimes it was noted that trees of all size classes were present in the community and their various heights intergraded from one layer into then next; therefore the height limits of these layers were arbitarily assigned and the phrase "blending into" was used.

Usually only the total percent cover is given for all species occurring at that strata. Seldomly are percent cover estimates given for individual species except in detailed plot samples (Releve Plot Samples). Species abundance or dominance are recorded using Frequency/Density descriptors that are discussed below.

Canopy refers to the upper most layer of trees. The category of "Super Canopy" is used in circumstances when there is a relatively small percentage of exceptionally tall trees in the community. For example, a stand of White pines 30-50 meters tall (90-120 feet) towering above an oak canopy of about 20-25 meters (60-75 feet). The term "super canopy" is generally not used in partially cut forests where, for example, 50% of the canopy has been removed leaving subcanopy trees as the dominant cover. In instances where canopy gaps exist, the phrase " subcanopy becoming canopy in gaps" is used (e.g., Subcanopy, 10-20 meters height, 75% cover, becoming canopy in gaps).

Subcanopy refers to the layer immediately below the canopy and is mostly shaded except in canopy gaps. These include "gap species" such as hickories or cherries or other shade tolerant trees such as basswood or sugar maple.

The shrub layer refers to all woody species including young trees.

The "Seedling" category always includes all woody species below 18 inches height (50 cm). Percent cover refers to the percentage of the total ground cover. Percentages for seedlings and and herbaceous plants are considered together but cited separately (e.g., seedlings 5%; herbs 50-75%; inferring that the remaining area is bare ground or devoid of vegetation.

DIAMETER BREAST HEIGHT (DBH)

DBH refers to the diameter of a tree trunk at 4.5 feet above the ground. In any forest, trees have a range of trunk widths which vary from the smallest to the largest trees. Even trees of the same age can vary due to growth factors such as shading, soil type, etc. For each

APPENDIX 1

forest, trees where divided into diameter classes for each forest strata. In the canopy, there is usually a size class which has more trees than any other class, i.e., trees of this size class are the most prevalent with a lesser number of trees which are either larger or smaller. This prevalent size class has been called the "Mode DBH" and supposedly these trees would be about the same age. Trees larger than the mode are called the maximum size class and are denoted as "MAX DBH".

Generally, modal sized trees are "common" throughout the community and easily observed with out extensive sampling and in this case a narrow range for the mode is given (e.g., an even age stand of trees of uniform width and height). Instances where the variation is so great, a wider range of widths are given to reflect the uncertainty by which the precise number of modal trees can readily be observed.

FOREST AGE

The age of the most prevalent size class of trees in the canopy is significant consideration because it indicates the duration in which this community has been in its present condition. Since I cannot age every stand with an increment bore, I take sample ages in the area and assume that there is an association between age and trunk width as measured by DBH. Keeping in mind that ages of individual trees of a species can vary considerably depending on soil type, shading, historic land-use, etc. The estimated age of the community is determined from trees in the mode DBH class unless maximum size class have a remarkably high cover abundance value.

DESCRIPTOR	AGE ESTIMATE @ DBH	DBH/SITE INDEX POOR RICH
SEEDLING LAYER	0 TO 50 CM (18")	
SAPLINGS	"SHRUB LAYER"	
YOUNG	10 - 29 Years	
IMMATURE	30 - 59 Years	
MATURING	60 - 79 Years	
MATURE	80 - 119 Years	
OLD	> 120 Years	

TOTAL TREE HEIGHT TO WIDTH (CROWN SPREAD) RATIO

This is the general ratio of the height of individual trees divided by the spread of their crown widths. Open grown trees, sometimes referred to as "wolf trees", typically have broad-spreading branches and short trunks. Ratios of these trees are about one-to-one (1:1). Oaks, growing in savannas and pastures, epitomize this shape.

Mature, deciduous trees in dense stands typically have narrower canopy widths and elongated trunks. Competition for light results in ratios as high as 3 or 4 (3-4:1). Trees, which for a period of time had grown in open sun, often later lose their lower limbs as these become shaded by an enclosing forest canopy. The buttresses of these limbs (limb collars) create a convoluted or crooked appearence to the trunk and such trees generally have ratios of 1.5-2.5:1. Oaks with

APPENDIX 1

"crooked" trunks are seen in intermediate forest types (seral stages) characteristic of succession. In addition, trees on steep slopes often have ratios of about 2-2.5 because these gradients - along with more xeric aspects - seldom produce entirely closed canopies. Often there is asymetric growth on the down-hill side and these trees tend to arch outward towards the light.

Ratio: Tree Height/Crown Width	Habit of Growth or Community Type
1 to 1.5	Open Grown: Savanna, Woodland, Pasture
1.5 to 2.5	Partial Canopy, Woodland, Steep Slopes
> 2.5	Closed Canopy: Dense Forests

FREQUENCY OF OCCURRENCE - DENSITY

Another important criteria is the density of certain features of a community. To accomplish this, I employ a plotless technic, I call "field-of-view" as a sample point. It is similar to the 360 degree, circular sweep that a forester does with a basal area gauge in order to assess standing timber volume of a stand. The forester sweeps a point and then moves beyond the range of his vision (field-of-view) before making another sweep. The sweeps, which never overlap their field-of-view, can be used to estimate density by counting the number of times a species occurs within a sweep or sample point.

In my abbreviated version, I divide the 360 degree sweep into eight segments on the basis of the eight cardinal points of a compass (north, northeast, east, etc.). I then count the number of segments the feature occurs within a sample point (e.g., snag, trees of a certain size class). For the sake of convention, if two snags occur within one segment, I only report one occurrence. I then compare the data of this sample with other samples to determine the consistency by which this feature occurs at that particular density throughout the stand. I then adjust the density value up or down according to the perceived average of the samples. I report these densities in terms of a fraction, for example, the feature occurs in one segment out of eight or two segments, etc. This means that in each field-of-view, will appear in one of the segments (1/8), two segments (2/8), etc.

In describing these densities, I often use descriptive terms to define other situations. For example, the term "occassional" is used when generally only "one occurrence" of the feature appears consistently in the fields. "Rare" when the feature only occurs once or seldom in the community. "Rare to occassional" suggests that the feature occurs more than once but is not consistently found in all the fields. "Common" features are typically found in 4 segments throughout nearly all the samples. "Abundant" is when the feature consistently occurs in 6 segments or more. "Dominant" is an adjective which describes a species which is the most "abundant" in the canopy.

The terms: "occassional", "common", "abundant" and "dominant"; imply a consistent occurrence of the feature in the samples at the specified density. However, the terms "infrequent" and "frequent" defined here imply an inconsistency in density from one sample to the next. "Frequent" is generally more than 4/8 cardinal points but not in every sample. "Infrequent" features vary between l segment and less than 4 segments but is never consistently found at these densities.

APPENDIX 1

Frequency/density	Descriptions
Rare	Found Only Once in the Community
Rare to Occassional (< 1/8)	Found More than Once but Averages less than One Segment Throughout Community
Occassional (1/8)	Consistently Occurs at about One Segment for Each Sample Point
Infrequent (>1/8 but <4/8)	Density Varies Between 1 and 4 Segments per Sample
Common (4/8)	Consistently Found in 4 Segments per Sample
Frequent (5/8)	Density Varies but Occurs in More than 4 Segments per Sample
Abundant (6/8)	Density Consistently Found at 6 Segments or More but Is Not Dominant
Dominant (6/8)	Density Consistently Found at 6 Segments or More and Is the Most Prevalent in the Canopy.
Codominant	The Most Abundant Species with Nearly Equal Canopy Cover.

SNAGS, DEBRIS, STUMPS AND LEVEL OF DECAY

Snags refer to any dead tree or portion thereof, that remains standing in the forest. Often the presence of a large number of snags in the canopy is related to the overall percent cover.

Debris refers to woody material on the forest floor and is noted as whether it includes tip-ups snags which have fallen over or cut limbs and branches.

Stumps refer to the remains of logged trees and are reported either by frequency of occurrence/density descriptors or as merely "area select log" or "partial (clear) cut". The latter then refers to the total percent canopy.

Decay is given on a scale from one to five:	
1 = Recent	Freshly cut or recent: no visible decay except drying.
2 = Partial	Wood solid; side bark peeling off. Snag with bark and but some large limbs broken.
3 = Moderate	Wood about 50% decayed, some of the bark remains. Snag fairly solid, most branches are gone and without bark.
4 = Very	Wood mostly decayed, but still evident, bark gone. Snag mostly decayed but still standing.
5 = Completely	Wood completely decayed into a pile of organic material.

GENERAL ATTRIBUTES FOR DESCRIBING HERBACEOUS VEGETATION

Traditionally, vegetation has three general attributes by which the plants within a natural community are described: frequency, abundance, and density.

Frequency is a measure of the number of times an individual of a species (or any other ecological characteristic) occurs within a given area. It is recorded as a percentage of points within an area where a species was found to be present. A species with a high

APPENDIX 1

frequency of occurrence is expected to be encountered often within the community. A floristic list of one community can be combined with other community floras to determine the frequency of occurrences of species within a region. likewise plots within a community can be floristically inventoried and species frequencies of a community can be determined.

Density is related to frequency but instead measures the number of times an individual occurs within a defined area. Generally, frequency refers to the number of points where a species is present; while density measures the number of individuals of a species in a given point. Density values are usually an average of all the points of an area.

Abundance refers to the dominance that a particular species has over a particular area. Abundance is measured in weights, volumes or surface area (coverage). For example, in a forest community, tree species can be measured in terms of the basal or stumpage area (area covered by tree trunks at ground level); by canopy cover (the percentage of the area covered by the combined canopies of all the trees of a particular species); by volume (linear board feet per acre); or by weighing the combined mass of trunks, limbs and leaves for each species.

Often sampling methods record different manifestation of the same characteristic of the feature. For example, a forester may record dominance or abundance of a species in terms of basal area or board feet while a plant ecologist may opt to record abundance in terms of the percentage of canopy area occupied by a species.

FREQUENCY

Merely Present - Rare	Inconsistently Found	Consistently Found Throughout

DENSITY

Few or Sparse Where Found	Intermediately Dense or Patchy	Dense Throughout

PERCENT COVER ABUNDANCE

<1%	1-5%	5-25%	25-50%	50-75%	75-100%

These three attributes can be combined to characterize vegetation in more detail:

FREQUENT-DENSE-ABUNDANT

For example, a field can be described as follows: corn occurs in every acre; with 10 plants per square yard or meter; covering 90% of the ground and producing, 4 tons of biomass per acre (i.e. corn occurs frequently, it is dense throughout (dominant throughout the field).

FREQUENT-SPARCE-LOW ABUNDANCE

While on average, 10 plants of the weedy, foxtail grass are found in every acre, but the combined coverage is minimal (i.e. high frequency, low density and low abundance).

RARELY OCCURS-LOCALLY DOMINANT

Velvet leaf completely covers one acre which was flooded early in the spring but is not found elsewhere in the field (i.e. low frequency, patchy, locally abundant).

**INFREQUENT-PATCHY-
NEVER DOMINANT OR ABUNDANT**

Blackberries thickets are found in one of three samples where the density varies from sparse to thick in patches; cover abundance varies from 5-50% total ground cover (infrequent, sparse-to-patchy but never dominant).

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC Metadata and Description of Digital Files.		
Associated File	**Fields**	**Description**
ARCGIS 9.3	**Projected Coordinate System:** NAD_1983_UTM_Zone_15N Projection: Transverse_Mercator False_Easting: 500000.00000000 False_Northing: 0.00000000 Central_Meridian: -93.00000000 Scale_Factor: 0.99960000 Latitude_Of_Origin: 0.00000000 Linear Unit: Meter **Geographic Coordinate System:** GCS_North_American_1983 Datum: D_North_American_1983 Prime Meridian: Greenwich Angular Unit: Degree	
aitkin2007.ecw	A ESRI GIS Layer in ARCMAP 9.3. Color-Infrared aerial photos flown and printed at a scale of 1:15,840 (4" per mile). Photographs scanned, rectified and merged into one continuous raster cover for Aitkin County, Minnesota. Provided by the Aitkin County Land Department.	

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC
Metadata and Description of Digital Files.

Associated File	Fields	Description
Lakeside_NPC.lyr		A ESRI GIS Layer in ARCMAP 9.3. A cover map of existing vegetation was created by Scott C. Zager, Wildlands Ecological Services, using ARCVIEW v9.3 for Aitkin County Land Department (ACLD) Management Units (Appendix 2, Fig. 8 and Appendix 3, Table 1). Polygons of native plant community (NPC) types were delineated over patterns visible on rectified images of air photo mosaics. GPS locations of sample waypoints were uploaded into ARCVIEW and used as bench marks during air photo interpretation of the vegetation cover. Map units of native vegetation were classified according to Native Plant Community (NPC) types developed by the Minnesota Department of Natural Resources (MN DNR 2003, 2005a, 2005b). Non-natural and other natural cover types, such as roads, utility corridors and various categories of open water, were developed by MN DNR Parks. NPC types for ACLD Units were determined from analysis and evaluation by Scott Zager of vegetation data collected at waypoint sample locations (MS ACCESS Database: ACLD Unit Waypoint Data; Table 5). These data helped interpret vegetation patterns seen on air photos. Vegetation patterns were also compared with GIS digitized soil map units classified according their soil moisture regime (Figure 4) and by using contour lines of digitized USGS 7.5 minute topographical maps. NPC polygons were delineated on the basis of multiple factors: dominant plant cover, soil type, topographic slope position and aspect, and recorded vegetation data. The recorded vegetation data associated with GIS points were derived from standardized vegetation plots (relevés), species lists and other ecological observations.
Aitkin ECS Waypoint Samples.lyr		A ESRI GIS Layer in ARCMAP 9.3. Waypoints were sampled for vegetation; in addition, soil pits were dug to record soil data in plots (Appendix 2, Fig. 4). It was important to collect data throughout ACLD Units and to capture the range of variation expressed by each NPC cover type. Soil samples were collected from pits dug to 1.5 m depth. Soil properties were entered into an ACCESS database along with general observations, floristic lists and species' cover abundance. Waypoint samples were uploaded as a GIS shapefile and served as reference points for photo-interpreting, rectified air photos. Vegetation data included species lists with cover abundance values. By associating vegetation with soil and topographic characteristics, it is easier to understand how native plant communities (NPC) are distributed across the landscape within the study area. Understanding these relationships, facilitates the delineation of NPC map units over vegetation patterns visible on the air photographs while using NRCS soil map units and USGS topographic contour lines.

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC Metadata and Description of Digital Files.		
Associated File	**Fields**	**Description**
MS ACCESS 2007 & EXCEL		
ACLD Units - ECS Database v3.15c3 (final dft).mdb	Data recorded at waypoint sample locations were recorded on data forms or within a field notebook. Later data was entered into a relational database MS ACCESS 2007. This database includes forms for easy data entry. The data is stored in the following tables exported as MS EXCEL files. These tables are listed below with their fields.	
Table 5 Waypoint Sample Descriptions.xlsx	Data taken from General Description Field (see below). Available as a separate spreadsheet for printing or viewing.	
lkp_AbundanceCodes.xlsx	Abundance_code / Description (-1) PRESENT (0) Outside Plot (1) Single (r) (2) <1% (few 2-20) (3) 1-5% (many >20) (4) >5-25% (5) >25-50% (6) >50-75% (7) >75-100%	A lookup table or spreadsheet within the MS ACCESS Database. About 200 waypoint samples were formal Relevé plots within 400 m^2 circular plots for forest NPC types. For open communities such as fens and wet meadows, circular plots were 100 m^2. The abundance of vegetation species within the plots were recorded by standard value states using abundance codes for rapid data entry.
lkp_CertaintyCodes.xlsx	Cert_code / Description (0) Variety / Subsp. Certain (1) cf. Variety or Subspecies (2) Species Certain (3) Species Complex (4) cf. Species (5) Genus Certain (6) cf. Genus (7) Unknown	A lookup table or spreadsheet within the MS ACCESS Database. Vascular plant taxa observed within relevé plots were assigned codes to communicate the level of certainty by the researcher for accurate taxonomic identification. The default value is Cert_Code 2, where the ID is certain to the species level.
lkp_NPC_Code.xlsx	See File: FinalClassType_formatwithprkdata.pdf	A lookup table or spreadsheet within the MS ACCESS Database. MN DNR: Minnesota Native Plant Community Classification; Systems, Classes, Types, and Subtypes; January 2005. Native Plant Communities follow those defined by MN DNR 2003, 2005a & 2005b.

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC Metadata and Description of Digital Files.		
Associated File	**Fields**	**Description**
lkp_Species.xlsx	This is a lookup table or spreadsheet related to data tables for rapid entry of plant names based upon alphanumeric codes. During the study and consequent data entry into ACCESS 2007, the taxonomic nomenclature was essentially Ownbey and Morley (1993) as adapted by MN DNR. However, the lists presented in this report have been converted to the most recent synonymy for Minnesota, essentially using Cholewa (2011). Below is the metadata for the NPC floras presented: Wildlands Mn Taxa, Draft Version 2011-07-15 © was compiled by Scott C. Zager in this format from floras created by Dr. Anita Cholewa, Bell Museum Herbarium, MNDNR's MN Taxa v. (v. July 2011), Milburn et al. (2007), Kartez & Meacham (1999), FNA (1993+) and USDA-NRCS 2010. Recently I have begun adding codes to taxonomic names from USDA Plants Database and from "Integrated Taxonomic Information System (ITIS)". In the future, ITIS will constitute the main link for undates. However, this is a work in progress and not all names have been coded. Taxonomic names (HERBNAME) listed within "[ ]" are either synonyms or are otherwise taxa not documented in Minnesota. Each taxa is given an unique code (UNIQCODE, formerly ANALCODE). Synonyms for currently accepted names are assigned a reference code (SYN_CODE) to the accepted name. Taxonomic names split into two or more accepted names are noted. This flora is intended by Scott Zager to integrate academic and political lists for the State of Minnesota. Efforts were made to recognize accepted names in literature, with acknowledgment to taxa in dispute. Permission to use this format is available upon written request. Scott C. Zager, Wildlands Ecological Services, (wildlands@comcast.net). This list has been modified to include woody taxa of tree and shrub species in the seedling layer (codes designated with "*12* are seedlings; e.g., "ABIE12BA" identifies observations of Abies balsamea in the seedling stage. This version adds codes matching USDA Plants Database (USDACODE) for many plant names.	
Species.xlsx	A table or spreadsheet within the MS ACCESS Database. Included within the ACCESS Database is a table of all vascular plant species observed at each waypoint. Woody species are treated as “psuedospecies” for analytical purposes recoding the species at each height stratum where it is present. Various fields have lookup values from above tables (i.e, cover abundance, taxonomic reliability of the identification). Following is anxplanation of the fields occurring within the “Species” table:	
Species.xlsx	AutoID_Species	A unique number assigned by ACCESS for each species occurrence record.
Species.xlsx	WayPointId	The unique waypoint number (see “UniquePoint_ID” within the Waypoint Table below) where the species occurrence was recorded from.

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC Metadata and Description of Digital Files.		
Associated File	**Fields**	**Description**
Species.xlsx	SpeciesID	Species are recorded within the "Data Entry" form in ACCESS using the alphanumeric species code "ANALCODE" or "UNIQCODE"; however, ACCESS records the unique number code for each plant species.
Species.xlsx	Certainty	The certainty by the researcher that the taxonomic identification for a plant is accurate (see lookup table above).
Species.xlsx	Abundance	A numeric code for data entry used to describe the "abundance class" (e.g., 5-25%; see lookup table above).
Species.xlsx	Abd_Value	A description of the abundance class, for example, 5-25% cover.
Species.xlsx	StructuralLayer	A prescribed definition for each "psuedospecies" as follows: Canopy, Subcanopy (Understory), Shrub or Sapling, Subshrub, Seedling, Herb, Graminoid (grass or sedge), Vine.
Species.xlsx	KeyName	a combination of the scientific and common name accepted for Minnesota by a previous version of the accepted taxonomy by MN DNR.
Species.xlsx	Variety	The subspecies status of a taxon (variety, subspecies).
Species.xlsx	MNStatus	The official legal status of a species within the State of Minnesota as defined by MN DNR: State Endangered, State Threatened, State Special Concern - plus the category of "NON" which has no legal status but is monitored by the MN DNR.
Waypoint.xlsx	A table or spreadsheet within the MS ACCESS Database. Data collected from 347 waypoint samples were located using Garmin Map GPS 76c and Garmin GPSmap 62s. Locations are located with an accuracy of about 15 meters radius area. The following are fields within the database and waypoint spreadsheet.	
Waypoint.xlsx	AutoID_Pt	Sequential numbers assigned to each waypoint sample. Essentially a unique record number.
Waypoint.xlsx	Unique_PointID	A number assigned in the field to record data locations. Called a Waypoint Number. It is the primary field for sorting unique labels for each sample location.

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC
Metadata and Description of Digital Files.

Associated File	Fields	Description
Waypoint.xlsx	DataSheet	Text field documenting the datasheet number used to record data in the field. Other observations were recorded in notebooks by volume and page number (e.g., nb 2: 103)
Waypoint.xlsx	Unique_PolyID	Unused. Intended to convey the unique polygon number where a waypoint occurred.
Waypoint.xlsx	Eco_Rank	Unused. MN DNR evaluates the ecological quality of NPC units on a scale of A-D.
Waypoint.xlsx	Eco_Justify	Brief description of the waypoint's ecological quality. See basal area, standing snags & CWD below.
Waypoint.xlsx	NPC_Code	Native Plant Community. See ECS NPC definitions in Volume 1, Appendix 1. This is the unique code to identify plant communities to the NPC type or subtype level.
Waypoint.xlsx	NPC_System	NPC classification is hierarchal. NPC system communicates prevailing ecological processes determining plant distribution.
Waypoint.xlsx	NPC_Class	NPC classification is hierarchal. NPC Class is used in this report for all polygons to communicate potential vegetation or Desired Future State.
Waypoint.xlsx	NPC_Type	NPC classification is hierarchal. NPC type is the primary classification used in this report. Each native community is discussed.
Waypoint.xlsx	NPC_SubType	Unused. NPC classification is hierarchal. NPC subtype represents a fine level of classification communicating seral stage or state-wide geographic distribution.
Waypoint.xlsx	Date	Recorded date of observation.
Waypoint.xlsx	Management_Unit	Unused.
Waypoint.xlsx	Evaluator	Scott C. Zager, Wildlands Ecological Services.
Waypoint.xlsx	Releve_No	A few of the waypoint samples were originally collected by the Minnesota County Biological Survey. These vegetation plots are called relevés the number in this field references MCBS MN DNR Relevé Database records.
Waypoint.xlsx	Evaluator_Org	Wildlands Ecological Services or Minnesota County Biological Services (MCBS).

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC
Metadata and Description of Digital Files.

Associated File	Fields	Description
Waypoint.xlsx	UTM_Easting	See geographic coordinate system above. This field conveys the "x" coordinate for GIS mapping in UTM Zone 15 NAD83.
Waypoint.xlsx	UTM_Northing	See geographic coordinate system above. This field conveys the "y" coordinate for GIS mapping in UTM Zone 15 NAD83.
Waypoint.xlsx	UTM_Zone	GIS mapping in UTM Zone 15 NAD83. See geographic coordinate system above.
Waypoint.xlsx	SiteName	Unique management unit with ACLD Units used by refuge staff.
Waypoint.xlsx	County	Becker County, Minnesota
Waypoint.xlsx	Township	Public Land Survey legal description.
Waypoint.xlsx	Range	Public Land Survey legal description
Waypoint.xlsx	Section	Public Land Survey legal description
Waypoint.xlsx	SubSection	Quarter, Quarter section (40 acres^2)
Waypoint.xlsx	Disturbances	Field recorded man made effects to native communities including damage by non-native or invasive plants or animals.
Waypoint.xlsx	Exotics	List of non-native species affecting NPC polygon.
Waypoint.xlsx	GeneralDesc	Primary description of the waypoint or the broader NPC polygon.
Waypoint.xlsx	LandscapeDesc	A description of geology and soils.
Waypoint.xlsx	NotableFeaturesDesc	Description of notable animal or plant species. Often includes basal area measurements and/or tree girths.
Waypoint.xlsx	Elevation	Unused. Elevation above Mean Sea Level (MSL).
Waypoint.xlsx	Soil_MapUnit	The soil map code used by the USDA Natural Resource Conservation Agency.
Waypoint.xlsx	Aspect	Prevailing direction a slope or hillside faces toward.
Waypoint.xlsx	SlopePosition	General locations: Interfluvial ridge, ravine, nose slope, terrace crest, terrace rise, crest, upper slope, mid-slope, lower slope, footslope, toe-slope, depression, floodplain, etc.

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC
Metadata and Description of Digital Files.

Associated File	Fields	Description
Waypoint.xlsx	DrainageType	Soil drainage categories: Excessively drained, somewhat excessively drained, well drained, moderately drained, somewhat poorly drained, poorly drained, very poorly drained & wet.
Waypoint.xlsx	Gradient	Slope recorded as “Percent Slope” where 45 degrees = 100% slope.
Waypoint.xlsx	LitterType	Soil data are recorded from the top of the organic layer (= “0") downward in centimeters to bottom of the layer described. Litter or duff layer including recently fallen leaves that have no decomposition.
Waypoint.xlsx	LitterDepth	The lower limit (bottom) of the “Litter Layer”.
Waypoint.xlsx	HumusType	Humus layer is described as “Mor” characteristically a mat of partially decomposed organic material. Or “Moder”, stratified layers of decomposed organic material at all stages of decay from leaf litter, partial leaf fragments, fibrous & fully-decomposed sapric or silty peat.
Waypoint.xlsx	HumusDepth	The lower limit (bottom) of the of the humus layer.
Waypoint.xlsx	A_Horizon	A mixture of organic silt and mineral soil.
Waypoint.xlsx	A_Depth	The lower limit (bottom) of the A Horizon.
Waypoint.xlsx	E_Horizon	The soil layer immediately below the A Horizon, typically a zone where soil particulates and soluble minerals are leached as surface water infiltrates the soil and percolates downward through the ground.
Waypoint.xlsx	E_Depth	The lower limit (bottom) of the E Horizon.
Waypoint.xlsx	B_Horizon	The zone where leached particulates are deposited and minerals solidify.
Waypoint.xlsx	B_Depth	The lower limit (bottom) of the of the B Horizon.
Waypoint.xlsx	C_Horizon	The parent or original material in the development of a soil.
Waypoint.xlsx	C_Depth	The lower limit (bottom) of the of the C1 Horizon.
Waypoint.xlsx	C2_Horizon	A distinct separate layer of original material.
Waypoint.xlsx	C2_Depth	The lower limit (bottom) of the of the C2 Horizon.

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC
Metadata and Description of Digital Files.

Associated File	Fields	Description
Waypoint.xlsx	BedrockCover	The surface area of exposed bedrock. Mostly unused in ACLD Units except to communicate percent coverage of glacial erratics of boulders and / or cobbles.
Waypoint.xlsx	BedrockDepth	Unused. Depth to bedrock strata.
Waypoint.xlsx	BedrockDesc	Description of the prevailing surficial bedrock.
Waypoint.xlsx	BedrockHeight	Height in meters of exposed bedrock as cliffs or rock outcrops.
Waypoint.xlsx	BareGround	The percentage of the soil surface not covered by vegetation; includes bare exposed ground or leaf litter.
Waypoint.xlsx	WaterPoolDepth	Depth of standing water.
Waypoint.xlsx	WaterPoolsCover	Percent of an area covered by standing water.
Waypoint.xlsx	CanopyCover	The percent cover of the highest forest stratum defined as the combined drip-line of all canopy trees. Conversely the uncovered areas communicate exposed sky in canopy gaps. Sometimes canopy is qualified as being “closed” except for periodic gaps attributed to individual tree loss due to windthrow or mortality.
Waypoint.xlsx	CanopyHeight	The height in meters of all the trees considered to be in the canopy layer.
Waypoint.xlsx	Canopy_DBH	If basal area of all canopy trees were graphed according to diameter classes to create a bell-shaped curve, then: the most frequent class or modal class is recorded as the center size class in centimeters (e.g., 15-25 (30-40 cm) 85 cm). The lowest girth sizes on the left hand represents the lower quartile. The value on the right represents the largest tree recorded.
Waypoint.xlsx	SubcanopyCover	The combined coverage of all trees and tall shrubs below the defined canopy and above the defined shrub layer. Theoretically could be more than 100% cover to characterize overlapping sublayers. Sometimes when there are many young trees of various crown heights and age classes, the subcanopy forms a continuous blend from the shrub layer into the canopy.
Waypoint.xlsx	SubcanopyHeight	The defined range in height of the subcanopy. The percent cover may actually include two or more subcanopy strata.

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC
Metadata and Description of Digital Files.

Associated File	Fields	Description
Waypoint.xlsx	Subcanopy_DBH	An additional variable used to define the class of trees within a range of girth sizes.
Waypoint.xlsx	ShrubCover	A definition of shrub species that fall within the defined shrub layer height range. This variable express the total percent coverage of all shrubs and tree saplings within the height range.
Waypoint.xlsx	ShrubHeight	The arbitrarily defined height range of tall shrubs and tree saplings. The default range is >0.5 m (knee high) to 2 m tall.
Waypoint.xlsx	SubshrubCover	A definition of shrub species of short stature (e.g., blueberries, Vaccinium spp.) and tree seedlings within a defined height range. Variable expressed as total percent cover.
Waypoint.xlsx	SubshrubHeight	The range in height of all defined subshrubs and tree seedlings. The default range is $\leq$ 0.5 m (about knee high).
Waypoint.xlsx	ForbsCover	The total percent cover of all herbaceous plants that are not sedges and grasses (graminoids).
Waypoint.xlsx	GramminoidCover	The total percent cover of all sedges and grasses (non-forb) species of herbaceous plants.
Waypoint.xlsx	MossLichenCover	The total percent cover of all non-vascular plants including mosses, liverworts and lichens.
Waypoint.xlsx	Basal Area	Basal area counts of trees within a one-tenth acre circular area as recorded by 10x prism. No unique filed was assigned to this data, which are recorded in the description field.
Waypoint.xlsx	CWD = Coarse Woody Debris	Coarse Woody Debris (CWD) expressed as the total percent cover of a down woody debris lying on the forest floor.
Waypoint.xlsx	CWD Description	Description of the woody debris covering the forest floor: tipups, broken trunks or limbs, branches, twigs, etc. Often expressed in terms of stages of decay from recent to very decomposed to woody peat.

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC Metadata and Description of Digital Files.		
Associated File	**Fields**	**Description**
Waypoint.xlsx	Snags (standing dead trees)	This value was recorded inconsistently using different measures: The total number of dead standing trees > 2 m tall within visual range from a particular point; sometimes expressed as a fraction (e.g., 4/8) describing the number of cardinal points (an pie-shaped arc of 12.5 degrees) with dead snags. An alternative measure were the number of snags recorded by a 10x basal area gauge; as a ratio of the total number of snags seen in a circular scan from a single point.
Waypoint.xlsx	ExplanationOfPurpose	Unused.
Waypoint.xlsx	Latitude	Decimal Degrees (see above)
Waypoint.xlsx	Longitude	Decimal Degrees (see above)
Waypoint.xlsx	**Descriptive measures of frequency-abundance**: Rare, Infrequent, Occassional, Frequent, Common, Abundant & Dominant. Within the description fields qualitative terms defining the spatial distribution of a species, snag, surficial rocks, etc. that occur within a define area (plot or polygon). An example of the methodology includes a random walk through a forest with a number of separate (non-overlapping) observation points where a species or object occurs: **Rare**, only occurs once within a define area in the total number of observations; **Infrequent**, occurs more than once but inconsistently (e.g., one point it is present, then next two points absent); **Occassional**, occurs once repeatedly and consistently at each point in the series of observations (but never more abundantly at any given location); **Frequent**, occurs repeatedly and consistently at each location but each point has two or more of the species or object; **Common**, found consistently (ubiquitous) throughout an area at various densities, but never abundant or dominant; **Abundant**, a commonly occurring species or object that may be locally dominant at one or more points but is other wise common; **Dominant**, basically within the entire polygon or plot, the species or object covers more than 50% of the total area (**Codominant** refers to two or more species that mutually dominate more than half a defined area). The terms "Abundant" and "Dominance" can be described for any particular point as being "**Locally Abundant**" or "**Locally Dominant**". In such situations, an object or species can be described as being "Locally Dominant" occasionally, infrequently, etc. throughout the polygon.	

APPENDIX 1

APPENDIX 7 - DIGITAL DATA ON ATTACHED COMPACT DISC Metadata and Description of Digital Files.		
Associated File	**Fields**	**Description**
Waypoint.xlsx	**A second method of recording frequency/abundance** involves a circular scan from a fixed point. Dividing the circle into eight cardinal points (45° arc: N, NE, E, SE, S, etc.). For example, a scan for standing dead trees (snags) counts the presence of one or more snags within an arc. Counts are expressed as a ratio except where noted: **Rare** = "Found only once in the polygon"; **Rare to Occassional (<1/8)** = "found more than once but averages less than one segment throughout polygon"; **Occassional (1/8**) = "consistently occurs at about one segment for each sample point"; **Infrequent (>1/8 but <4/8)** = "density varies between 1 and 4 segments per sample"; **Common (4/8)** = " consistently found in 4 segments per sample"; **Frequent (5/8)** = "density varies but occurs in more than 4 segments per sample"; **Abundant (6/8)** = "density consistently found at 6 segments or more but is not dominant"; **Dominant (≥6/8)** = "density consistently found at 6 segments or more and is the most prevalent in the canopy"; **Codominant** = "two or more species of equal abundances and whose combined density is 6 segments or more, and together are the most prevalent cover species".	
Digital Photographs - Folders arranged by Survey Year, Photographer & Waypoint Number © Scott C. Zager Wildlands Ecological Services.		
Data Files of Tables, Species Lists, NPC Descriptions, Final Report, etc.		

APPENDIX 2

Report Tables

Aitkin Co. Land Department: Lakeside Management Unit

Table 1: Acreage of Native Plant Community Non-Natural Cover Types (*Undisturbed Natural Communities Highlighted in Gray* **).**

UNIT NAME	SYSGROUP	NPC SYS	NPC CODE	NPC CLASS	FREQ	SUM Acres	Area Percent	NPC NAME
Lakeside	Non-Natural Community	NON	1.8	1.8	1	0.9	0.14%	1.8 = Non-Natural Community System / Developed & Use Areas / Roads/Trails - Buffered
Lakeside	Non-Natural Community	NON	2.1	2.1	2	1.0	0.15%	2.1 = Non-Natural Community System / Open, Non-Developed / Old Field
Lakeside	Other Natural Communities	W	5.7	W	2	0.6	0.09%	5.7 = Other Natural Community System / Open Water / Lakes
Lakeside	Upland Forests and Woodlands	MH	2.1	MHc36	1	0.1	0.01%	2.1 = Non-Natural Community System / Open, Non-Developed / Old Field
Lakeside	Upland Forests and Woodlands	MH	2.4	MHc36	1	2.6	0.41%	2.4 = Non-Natural Community System / Open, Non-Developed / Clearcuts, Blow-Downs
Lakeside	Upland Forests and Woodlands	MH	2.6A	MHc36	5	7.2	1.13%	2.6a = Non-Natural Community System / Open, Non-Developed / Young Forest / Young Forest - (deciduous)
Lakeside	Upland Forests and Woodlands	MH	MHc36b	MHc36	22	112.0	17.65%	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)
Lakeside	Upland Forests and Woodlands	MH	2.4	MHn35	1	3.0	0.48%	2.4 = Non-Natural Community System / Open, Non-Developed / Clearcuts, Blow-Downs
Lakeside	Upland Forests and Woodlands	MH	2.6A	MHn35	4	8.5	1.34%	2.6a = Non-Natural Community System / Open, Non-Developed / Young Forest / Young Forest - (deciduous)
Lakeside	Upland Forests and Woodlands	MH	MHn35b	MHn35	21	55.9	8.80%	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest
Lakeside	Upland Forests and Woodlands	MH	2.6A	MHn46	1	0.3	0.05%	2.6a = Non-Natural Community System / Open, Non-Developed / Young Forest / Young Forest - (deciduous)
Lakeside	Upland Forests and Woodlands	MH	MHn46a	MHn46	8	6.0	0.95%	MHn46a = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Aspen - Ash Forest
Lakeside	Upland Forests and Woodlands	MH	MHn46b	MHn46	31	32.3	5.09%	MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest
Lakeside	Wetland Forests	WF	WFn55b	WFn55	16	25.1	3.95%	WFn55b = Wet Forest System / Northern Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Basswood Swamp (Eastcentral)
Lakeside	Wetland Forests	WF	2.4	WFn64	3	56.0	8.82%	2.4 = Non-Natural Community System / Open, Non-Developed / Clearcuts, Blow-Downs

Aitkin Co. Land Department: Lakeside Management Unit

Table 1: Acreage of Native Plant Community Non-Natural Cover Types (*Undisturbed Natural Communities Highlighted in Gray* **).**

UNIT NAME	SYSGROUP	NPC SYS	NPC CODE	NPC CLASS	FREQ	SUM Acres	Area Percent	NPC NAME
Lakeside	Wetland Forests	WF	WFn64b	WFn64	8	200.6	31.59%	WFn64b = Wet Forest System / Northern Very Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Alder Swamp (Eastcentral)
Lakeside	Wetland Grasslands, Shrublands, and Marshes	FP	FPn73a	FPn73	6	3.7	0.58%	FPn73a = Forested Rich Peatland System / Northern Rich Alder Swamp / Alder - (Maple - Loosestrife) Swamp
Lakeside	Wetland Grasslands, Shrublands, and Marshes	MR	MRn93a	MRn93	1	0.7	0.11%	MRn93a = Marsh System / Northern Bulrush-Spikerush Marsh / Bulrush Marsh (Northern)
Lakeside	Wetland Grasslands, Shrublands, and Marshes	WM	WMn82a	WMn82	11	65.9	10.38%	WMn82a = Wet Meadow/Carr System / Northern Wet Meadow/Carr / Willow - Dogwood Shrub Swamp
Lakeside	Wetland Grasslands, Shrublands, and Marshes	WM	WMn82b	WMn82	7	52.4	8.25%	WMn82b = Wet Meadow/Carr System / Northern Wet Meadow/Carr / Sedge Meadow
	Total Acres				152	634.9	100.00%	Total Acres for Lakeside Management Unit
	Total Cut and recovering forest acres.					21.7	3.42%	Total Area of logged and recovering forests (this estimate does not include selectively logged areas & small clear cuts).

Acreage values for NPC and Non-Natural Cover Types were recorded by NPC Code, which essentially documents extant vegetation observed on the ground. In addition, NPC Class depicts potential vegetation or "Desired Future State" as determined by ecological attributes. Acreage was recorded by categories of NPC Code and NPC Class. For example, 7.2 acres of young deciduous forest (2.6A) was recorded within polygons with the potential NPC Class of MHn36. A total of 21.7 acres were mapped as cut or recovering forests. However, these data do not include very small clear-cuts and selectively-logged forest stands that were considered inclusions within otherwise natural community stands. Undisturbed natural communities are highlighted in gray. Managed, cut or recovering communities including trails, clearings, old fields, young deciduous forests and clear cuts are in clear fields.

Aitkin County Land Dept. Table 2: Soil Moisture-Texture Values Assigned to USDA Soil Map Units in Blind Lake, Rice Lake, Lakeside, Wagner, Libby Lowlands, Seavey and Cornish Areas in Aitkin County.

MAP UNIT	Drainage Code	Soil Moisture	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
454B	1 = ED	02 = Dry-Mesic Sand	Mahtomedi loamy coarse sand, 2 to 6 percent slopes	Mixed, frigid	Entisols	Typic	Udi	psamments
454C	1 = ED	02 = Dry-Mesic Sand	Mahtomedi loamy coarse sand, 6 to 12 percent slopes	Mixed, frigid	Entisols	Typic	Udi	psamments
454E	1 = ED	02 = Dry-Mesic Sand	Mahtomedi loamy coarse sand, 12 to 25 percent slopes	Mixed, frigid	Entisols	Typic	Udi	psamments
454F	1 = ED	02 = Dry-Mesic Sand	Mahtomedi gravelly loamy sand, 25 to 40 percent slopes	Mixed, frigid	Entisols	Typic	Udi	psamments
458B	1 = ED	02 = Dry-Mesic Sand	Menahga loamy sand, 1 to 6 percent slopes	Mixed, frigid	Entisols	Typic	Udi	psamments
458C	1 = ED	02 = Dry-Mesic Sand	Menahga loamy sand, 6 to 12 percent slopes	Mixed, frigid	Entisols	Typic	Udi	psamments
458E	1 = ED	02 = Dry-Mesic Sand	Menahga loamy sand, 12 to 35 percent slopes	Mixed, frigid	Entisols	Typic	Udi	psamments
188B	2 = SED	02 = Dry-Mesic Sand	Omega loamy fine sand, 2 to 6 percent slopes	Mixed, frigid	Spodosols	Typic	Hapl	orthods
188C	2 = SED	02 = Dry-Mesic Sand	Omega loamy fine sand, 6 to 12 percent slopes	Mixed, frigid	Spodosols	Typic	Hapl	orthods
268B	2 = SED	02 = Dry-Mesic Sand	Cromwell fine sandy loam, 1 to 6 percent slopes	Sandy, isotic, frigid	Inceptisols	Typic	Dystr	udepts
268C	2 = SED	02 = Dry-Mesic Sand	Cromwell sandy loam, 6 to 12 percent slopes	Sandy, isotic, frigid	Inceptisols	Typic	Dystr	udepts
268E	2 = SED	02 = Dry-Mesic Sand	Cromwell fine sandy loam, 12 to 25 percent slopes	Sandy, isotic, frigid	Inceptisols	Typic	Dystr	udepts
268F	2 = SED	02 = Dry-Mesic Sand	Cromwell fine sandy loam, 25 to 40 percent slopes	Sandy, isotic, frigid	Inceptisols	Typic	Dystr	udepts
629B	3 = WD	02 = Dry-Mesic Sand	Wawina loamy very fine sand, 1 to 10 percent slopes	Coarse-loamy, mixed, superactive, frigid	Inceptisols	Typic	Dystr	udepts
1375B	3 = WD	03 = Dry-Mesic Loam	Alban fine sandy loam, 3 to 8 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Typic	Gloss	udalfs
302B	3 = WD	03 = Dry-Mesic Loam	Rosholt fine sandy loam, 2 to 6 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
302C	3 = WD	03 = Dry-Mesic Loam	Rosholt fine sandy loam, 6 to 12 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs

Aitkin County Land Dept. Table 2: Soil Moisture-Texture Values Assigned to USDA Soil Map Units in Blind Lake, Rice Lake, Lakeside, Wagner, Libby Lowlands, Seavey and Cornish Areas in Aitkin County.

MAP UNIT	Drainage Code	Soil Moisture	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
504C	3 = WD	03 = Dry-Mesic Loam	Duluth fine sandy loam, 6 to 12 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
870B	3 = WD	03 = Dry-Mesic Loam	Itasca-Goodland complex, 2 to 6 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
870C	3 = WD	03 = Dry-Mesic Loam	Itasca-Goodland complex, 6 to 12 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
870E	3 = WD	03 = Dry-Mesic Loam	Itasca-Goodland complex, 12 to 25 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
928C	3 = WD	03 = Dry-Mesic Loam	Cushing-Mahtomedi complex, 2 to 10 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
928D	3 = WD	03 = Dry-Mesic Loam	Cushing-Mahtomedi complex, 10 to 25 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
928F	3 = WD	03 = Dry-Mesic Loam	Cushing-Mahtomedi complex, 25 to 40 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
119C	3 = WD	04 = Mesic Sand	Pomroy loamy fine sand, 6 to 12 percent slopes	Loamy, mixed, superactive, frigid	Alfisols	Arenic Oxyaquic	Hapl	udalfs
564	4 = MD	04 = Mesic Sand	Friendship loamy sand	Mixed, frigid	Entisols	Typic	Udi	psamments
152C	3 = WD	05 = Mesic Loam	Milaca fine sandy loam, 8 to 15 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
152E	3 = WD	05 = Mesic Loam	Milaca fine sandy loam, 15 to 25 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
204C	3 = WD	05 = Mesic Loam	Cushing loam, 6 to 12 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
204E	3 = WD	05 = Mesic Loam	Cushing loam, 12 to 25 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
504E	3 = WD	05 = Mesic Loam	Duluth fine sandy loam, 12-25 percent slopes	fine-loamy, mixed superactive fridgid	Alfisols	Haplic	Gloss	udalfs
618B	3 = WD	05 = Mesic Loam	Itasca silt loam, 1 to 6 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
738C	3 = WD	05 = Mesic Loam	Milaca-Millward complex, 8 to 15 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
133B	4 = MD	05 = Mesic Loam	Dalbo very fine sandy loam, 1 to 6 percent slopes	Fine, smectitic, frigid	Alfisols	Oxyaquic Vertic	Hapl	udalfs
1353B	4 = MD	05 = Mesic Loam	Cutaway loamy fine sand, 1 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Hapl	udalfs

Aitkin County Land Dept. Table 2: Soil Moisture-Texture Values Assigned to USDA Soil Map Units in Blind Lake, Rice Lake, Lakeside, Wagner, Libby Lowlands, Seavey and Cornish Areas in Aitkin County.

MAP UNIT	Drainage Code	Soil Moisture	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
1354A	4 = MD	05 = Mesic Loam	Aftad fine sandy loam, 0 to 3 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
152B	4 = MD	05 = Mesic Loam	Milaca fine sandy loam, 3 to 8 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
164B	4 = MD	05 = Mesic Loam	Mora fine sandy loam, 1 to 4 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
204B	4 = MD	05 = Mesic Loam	Branstad loam, 2 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
240B	4 = MD	05 = Mesic Loam	Warba very fine sandy loam, 1 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
464B	4 = MD	05 = Mesic Loam	Brennyville silt loam, 2 to 5 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
469B	4 = MD	05 = Mesic Loam	Hillcity silt loam, 1 to 6 percent slopes	Coarse-silty, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
504B	4 = MD	05 = Mesic Loam	Duluth fine sandy loam, 1 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
738B	4 = MD	05 = Mesic Loam	Milaca-Millward complex, 2 to 8 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
186	5 = SWPD	06 = Wet-Mesic Sand	Nemadji loamy fine sand	Sandy, mixed, frigid	Spodosols	Aquentic	Hapl	orthods
615	5 = SWPD	06 = Wet-Mesic Sand	Cowhorn loamy very fine sand	Coarse-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Aeric	Endo	aquepts
167B	4 = MD	07 = Wet-Mesic Loam	Baudette silt loam, 1 to 5 percent slopes	Fine-silty, mixed, superactive, frigid	Alfisols	Aquic	Hapl	udalfs
166	5 = SWPD	07 = Wet-Mesic Loam	Ronneby loam	Coarse-loamy, mixed, superactive, frigid	Alfisols	Aeric	Gloss	aqualfs
243	5 = SWPD	07 = Wet-Mesic Loam	Stuntz very fine sandy loam	fine-loamy, mixed superactive fridgid	Alfisols	Aeric	Gloss	aqualfs
266	5 = SWPD	07 = Wet-Mesic Loam	Freer silt loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aeric	Gloss	aqualfs
292	5 = SWPD	07 = Wet-Mesic Loam	Alstad loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
502	5 = SWPD	07 = Wet-Mesic Loam	Dusler silt loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
685	5 = SWPD	07 = Wet-Mesic Loam	Oesterle fine sandy loam	Coarse-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs

Aitkin County Land Dept. Table 2: Soil Moisture-Texture Values Assigned to USDA Soil Map Units in Blind Lake, Rice Lake, Lakeside, Wagner, Libby Lowlands, Seavey and Cornish Areas in Aitkin County.

MAP UNIT	Drainage Code	Soil Moisture	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
732B	5 = SWPD	07 = Wet-Mesic Loam	Bushville loamy fine sand, 1 to 6 percent slopes	Loamy, mixed, superactive, frigid	Alfisols	Aquic	Hapl	udalfs
736	5 = SWPD	07 = Wet-Mesic Loam	Ronneby-Mora complex	Coarse-loamy, mixed, superactive, frigid	Alfisols	Aeric	Gloss	aqualfs
124	6 = PD	07 = Wet-Mesic Loam	Brickton silt loam	fine, smectitic, frigid chromic	Alfisols	Vertic	Alba	aqualfs
1372	6 = PD	08 = Wet Sand	Wealthwood loamy fine sand	Loamy, mixed, superactive, frigid	Alfisols	Arenic	Epi	aqualfs
218	6 = PD	08 = Wet Sand	Watab fine sand	Loamy, mixed, superactive, frigid	Alfisols	Arenic	Epi	aqualfs
625	6 = PD	08 = Wet Sand	Sandwick loamy sand	Loamy, mixed, superactive, frigid	Alfisols	Arenic	Gloss	aqualfs
1982	5 = SWPD	09 = Wet Loam	Baudette-Spooner complex	fine-silty, mixed superactive	Alfisols	Oxyaquic / Mollic	Hapl / Endo	udalfs / aqualfs
1150	6 = PD	09 = Wet Loam	Jevne fine sandy loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
147	6 = PD	09 = Wet Loam	Spooner silt loam	Fine-silty, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
346	6 = PD	09 = Wet Loam	Talmoon fine sandy loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
672	6 = PD	09 = Wet Loam	Willosippi loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
759	6 = PD	09 = Wet Loam	Waukenabo fine sandy loam	Coarse-loamy, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
428	7 = VPD	09 = Wet Loam	Hassman muck	fine, smectitic, nonacid, frigid	Inceptisols	Vertic	Endo	aquepts
980	7 = VPD	09 = Wet Loam	Blackhoof and Mahtowa soils	Fine-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts
990	7 = VPD	09 = Wet Loam	Twig and Giese soils	Coarse-loamy, isotic, nonacid, frigid	Inceptisols	Typic	Hum	aquepts
1002	7 = VPD	10 = Peat	Borosaprists and Fluvaquents soils, frequently flooded		Histosols	Histic	Boro	saprists / aquents
1154	7 = VPD	10 = Peat	Sax muck	Fine-silty, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts

Aitkin County Land Dept. Table 2: Soil Moisture-Texture Values Assigned to USDA Soil Map Units in Blind Lake, Rice Lake, Lakeside, Wagner, Libby Lowlands, Seavey and Cornish Areas in Aitkin County.

MAP UNIT	Drainage Code	Soil Moisture	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
1878	7 = VPD	10 = Peat	Hamre muck	Fine-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts
1983	7 = VPD	10 = Peat	Cathro muck, stratified substratum		Histosols	Terric	Hapl	saprists
1984	7 = VPD	10 = Peat	Leafriver muck	Sandy, mixed, frigid	Inceptisols	Histic	Hum	aquepts
531	7 = VPD	10 = Peat	Beseman muck	Loamy, mixed, dysic, frigid	Histosols	Terric	Hapl	saprists
532	7 = VPD	10 = Peat	Sago muck	Coarse-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts
533	7 = VPD	10 = Peat	Loxley peat	Dysic, frigid	Histosols	Typic	Hapl	saprists
540	7 = VPD	10 = Peat	Seelyeville muck	Euic, frigid	Histosols	Typic	Hapl	saprists
541	7 = VPD	10 = Peat	Rifle peat	Euic, frigid	Histosols	Typic	Hapl	hemists
543	7 = VPD	10 = Peat	Markey muck	Sandy or sandy-skeletal, mixed, euic, frigid	Histosols	Terric	Hapl	saprists
544	7 = VPD	10 = Peat	Cathro muck	Loamy, mixed, euic, frigid	Histosols	Terric	Hapl	saprists
546	7 = VPD	10 = Peat	Lupton muck	Euic, frigid	Histosols	Typic	Hapl	saprists
549	7 = VPD	10 = Peat	Greenwood peat	Dysic, frigid	Histosols	Typic	Hapl	hemists
563	7 = VPD	10 = Peat	Northwood muck	Sandy over loamy, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts
628	7 = VPD	10 = Peat	Talmoon muck, depressional	Muck over Fine-loamy, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
1031	7 = VPD	10 = Peat / Water	Histosols, ponded	Peat / water	Histosols	water	Water	water
W	Water	11 = Water	Water	water	water	water	water	water

Aitkin County Land Department - Lakeside Management Unit

Table 3: Percentage of NRCS Soil Types For Each Native Plant Community (NPC) Class (see Table 1).*

NPC	NRCS Soil Unit Name	Soil Order & Total % NPC	Soil Symbol	Soil Moisture	Drainage	Poly Freq	NPC-Soil Sum Acres	NPC Soil % Cover
MHc36	Mora fine sandy loam, 1 to 4 percent	Alfisols	164B	05 = Mesic Loam	4 = MD	2	33.6	27.55%
MHc36	Brennyville silt loam, 2 to 5 percent	Alfisols	464B	05 = Mesic Loam	4 = MD	5	30.1	24.65%
MHc36	Freer silt loam	Alfisols	266	07 = Wet-Mesic Loam	5 = SWPD	4	27.1	22.20%
MHc36	Milaca fine sandy loam, 3 to 8 percer	Alfisols	152B	05 = Mesic Loam	4 = MD	5	20.7	16.98%
MHc36	Twig and Giese soils	Inceptisols	990	09 = Wet Loam	7 = VPD	2	5.8	4.75%
MHc36	Ronneby loam	Alfisols	166	07 = Wet-Mesic Loam	5 = SWPD	3	3.9	3.23%
MHc36	Lupton muck	Histosols	546	10 = Peat	7 = VPD	1	0.6	0.48%
MHc36	Cathro muck	Histosols	544	10 = Peat	7 = VPD	1	0.1	0.08%
MHc36	Seelyeville muck	Histosols	540	10 = Peat	7 = VPD	1	0.1	0.07%
MHn35	Brennyville silt loam, 2 to 5 percent	Alfisols	464B	05 = Mesic Loam	4 = MD	6	26.2	38.85%
MHn35	Mora fine sandy loam, 1 to 4 percent	Alfisols	164B	05 = Mesic Loam	4 = MD	2	15.1	22.46%
MHn35	Milaca fine sandy loam, 3 to 8 percer	Alfisols	152B	05 = Mesic Loam	4 = MD	3	12.8	18.99%
MHn35	Freer silt loam	Alfisols	266	07 = Wet-Mesic Loam	5 = SWPD	3	5.8	8.55%
MHn35	Ronneby loam	Alfisols	166	07 = Wet-Mesic Loam	5 = SWPD	2	4.8	7.17%
MHn35	Twig and Giese soils	Inceptisols	990	09 = Wet Loam	7 = VPD	2	2.3	3.46%
MHn35	Lupton muck	Histosols	546	10 = Peat	7 = VPD	1	0.3	0.42%
MHn35	Seelyeville muck	Histosols	540	10 = Peat	7 = VPD	1	0.1	0.11%
MHn46	Mora fine sandy loam, 1 to 4 percent	Alfisols	164B	05 = Mesic Loam	4 = MD	1	14.9	38.59%
MHn46	Freer silt loam	Alfisols	266	07 = Wet-Mesic Loam	5 = SWPD	3	6.5	16.74%
MHn46	Twig and Giese soils	Inceptisols	990	09 = Wet Loam	7 = VPD	2	5.5	14.14%
MHn46	Ronneby loam	Alfisols	166	07 = Wet-Mesic Loam	5 = SWPD	3	4.4	11.30%
MHn46	Brennyville silt loam, 2 to 5 percent	Alfisols	464B	05 = Mesic Loam	4 = MD	5	3.9	10.03%
MHn46	Milaca fine sandy loam, 3 to 8 percer	Alfisols	152B	05 = Mesic Loam	4 = MD	3	1.4	3.74%
MHn46	Lupton muck	Histosols	546	10 = Peat	7 = VPD	1	1.1	2.80%
MHn46	Seelyeville muck	Histosols	540	10 = Peat	7 = VPD	2	1.0	2.66%
WFn55	Lupton muck	Histosols	546	10 = Peat	7 = VPD	1	13.5	53.65%
WFn55	Twig and Giese soils	Inceptisols	990	09 = Wet Loam	7 = VPD	2	8.5	34.04%

Aitkin County Land Department - Lakeside Management Unit

Table 3: Percentage of NRCS Soil Types For Each Native Plant Community (NPC) Class (see Table 1).*

NPC	NRCS Soil Unit Name	Soil Order & Total % NPC	Soil Symbol	Soil Moisture	Drainage	Poly Freq	NPC-Soil Sum Acres	NPC Soil % Cover
WFn55	Brennyville silt loam, 2 to 5 percent	Alfisols	464B	05 = Mesic Loam	4 = MD	3	1.1	4.45%
WFn55	Freer silt loam	Alfisols	266	07 = Wet-Mesic Loam	5 = SWPD	3	1.1	4.40%
WFn55	Mora fine sandy loam, 1 to 4 percent	Alfisols	164B	05 = Mesic Loam	4 = MD	2	0.8	3.24%
WFn55	Ronneby loam	Alfisols	166	07 = Wet-Mesic Loam	5 = SWPD	1	0.0	0.18%
WFn55	Milaca fine sandy loam, 3 to 8 percer	Alfisols	152B	05 = Mesic Loam	4 = MD	1	0.0	0.03%
WFn64	Lupton muck	Histosols	546	10 = Peat	7 = VPD	1	233.7	91.08%
WFn64	Twig and Giese soils	Inceptisols	990	09 = Wet Loam	7 = VPD	2	13.4	5.21%
WFn64	Mora fine sandy loam, 1 to 4 percent	Alfisols	164B	05 = Mesic Loam	4 = MD	2	3.0	1.16%
WFn64	Freer silt loam	Alfisols	266	07 = Wet-Mesic Loam	5 = SWPD	3	2.7	1.04%
WFn64	Ronneby loam	Alfisols	166	07 = Wet-Mesic Loam	5 = SWPD	2	2.5	0.96%
WFn64	Seelyeville muck	Histosols	540	10 = Peat	7 = VPD	1	1.0	0.38%
WFn64	Brennyville silt loam, 2 to 5 percent	Alfisols	464B	05 = Mesic Loam	4 = MD	3	0.4	0.17%

Table 3. ARCGIS polygons of native vegetation for the Lakeside Unit were delineated and classified according to their respective map units of Native Plant Community (NPC) classes and types (e.g., MHc36, MHn35b, etc.). GIS polygons of each NPC type were overlain upon the GIS soil cover. Soil map units were "clipped" according to polygons of Native Plant Community (NPC) types and classes. For each NPC map unit, soil units were arranged in Table 3 according a soil unit's total acreage occurring under each NPC unit. The relative importance of a soil unit for each NPC unit is presented as a percentage of the total area of each soil unit mapped within each NPC unit. This created an ARCGIS shapefile of soil polygons found underlying each NPC class. Sliver polygons of soil units were discarded because these represented only marginal occurrences of the NPC class. Major soil map units were determined when acreage values were added to each soil polygon. To determine the relative importance of a particular NRCS soil map unit for individual NPC classes and types, each soil unit is given as a percentage of the total area covered by each NPC type [e.g., Mora fine sandy loam, 1 to 4 percent slopes are beneath 27.55% (37.6 acres) of MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)]. Table 3 shows the results of this analysis sorted by NPC code (i.e., MHc36b, MHn35b, etc.) referenced to the full name of the NPC class in Table 1. Table 3 and its accompanying soils maps (Fig. 5) should be an invaluable tool in predicting potential outcomes to prescribed management practices (Figs 9 & 10).

Table 4 - Native Plant Community - Floristic Lists by NPC Type

Species lists of plants observed within waypoint sample plots and organized by Native Plant Community Type and the Non-Natural Cover Types. NPC floras are arranged by ACLD Site Name, NPC Code, Physignomic Structure (i.e., Canopy, Subcanopy, etc.), Abundance Code and Species Scientific Name. Unique plant names are listed for each height stratum (sugar maple in canopy, subcanopy, etc.). Abundance values are provided from plot data. The values presented here represent the highest abundances observed during the study for the site and NPC type (i.e., not all observed abundances are given). During the study and consequent data entry, the taxonomic nomenclature was essentially Ownbey and Morley (1993) as adapted by MN DNR. However, the lists presented below have converted to the most recent synonymy for Minnesota, essentially using Cholewa (2011). Below is the metadata for the NPC floras presented:

Wildlands Mn Taxa, Draft Version 2011-07-15 © was compiled by Scott C. Zager in this format from floras created by Dr. Anita Cholewa, Bell Museum Herbarium, MNDNR's MN Taxa v. (v. July 2011), Milburn et al. (2007), Kartez & Meacham (1999), FNA (1993+) and USDA-NRCS 2010. Recently I have begun adding codes to taxonomic names from USDA Plants Database and from "Integrated Taxonomic Information System (ITIS)". In the future, ITIS will constitute the main link for undates. However, this is a work in progress and not all names have been coded. Taxonomic names (HERBNAME) listed within "[ ]" are either synonyms or are otherwise taxa not documented in Minnesota. Each taxa is given an unique code (UNIQCODE, formerly ANALCODE). Synonyms for currently accepted names are assigned a reference code (SYN_CODE) to the accepted name. Taxonomic names split into two or more accepted names are noted. This flora is intended by Scott Zager to integrate academic and political lists for the State of Minnesota. Efforts were made to recognize accepted names in literature, with acknowledgement to taxa in dispute. Permission to use this format is available upon written request. Scott C. Zager, Wildlands Ecological Services, (wildlands@comcast.net). This list has been modified to include woody taxa of tree and shrub species in the seedling layer (codes designated with "*12* are seedlings; e.g., "ABIE12BA" identifies observations of Abies balsamea in the seedling stage. This version adds codes matching USDA Plants Database (USDACODE) for many plant names.

Cholewa, Anita F. 2011a. Comprehensively Annotated Checklist of the Flora of Minnesota, version July 2011, University of Minnesota, UM Herbarium (MIN) , J.F. Bell Museum of Natural History, Bell Museum of Natural History. http://www.bellmuseum.org/plants/check_list.htm"

Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 15+ vols. New York and Oxford. Vol. 1, 1993; vol. 2, 1993; vol. 3, 1997; vol. 4, 2003; vol. 5, 2005; vol.8, 2009; vol. 19, 2006; vol. 20, 2006; vol. 21, 2006; vol. 22, 2000; vol. 23, 2002; vol. 24, 2007; vol. 25, 2003; vol. 26, 2002; vol. 27, 2007.

Integrated Taxonomic Information System (ITIS). United States Geological Survey. http://www.itis.gov/

Kartesz, J.T., and C.A. Meacham. 1999. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.

Milburn, Scott A., Michael Bourdaghs, and Jason J. Husveth. 2007 Floristic Quality Assessment for Minnesota Wetlands. Minnesota Pollution Control Agency, St. Paul, MN. (http://www.pca.state.mn.us/water/biomonitoring/bio-wetlands.html)

MN DNR. 2008. Official plant list of the Minnesota Department of Natural Resources. MS Access Database file (All_Herb16), personal communication from: Stacey Olszewski, Sent: Wednesday, August 27, 2008 12:08 PM

Ownbey, G.B., and Morey, T. 1991. Vascular plants of Minnesota: a checklist and atlas. University of Minnesota Press, Minneapolis.

Smith, W.R. 2008. Trees and shrubs of Minnesota: the complete guide to species identification. Minnesota Department of Natural Resources. Published by University of Minnesota Press, Minneapolis.

USDA-NRCS. 2010. The PLANTS Database (http://plants.usda.gov, 18 October 2010). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	2.1	EUPAPERF	6 Herb	Common boneset	Eupatorium perfoliatum	-1	PRESENT
Lakeside	2.1	PERSARIF	6 Herb	halberd-leaf tearthumb	Persicaria arifolia	-1	PRESENT
Lakeside	2.1	SOLIGIGA	6 Herb	Giant goldenrod	Solidago gigantea	-1	PRESENT
Lakeside	2.1	VERBHAST	6 Herb	Blue vervain	Verbena hastata	-1	PRESENT
Lakeside	2.1	CAREPROJ	7 Graminoid	Projecting sedge	Carex projecta	-1	PRESENT
Lakeside	2.1	GLYCVAGR	7 Graminoid	Tall manna-grass	Glyceria grandis var. grandis	-1	PRESENT
Lakeside	2.1	PHALARUN	7 Graminoid	Reed canary-grass	Phalaris arundinacea	-1	PRESENT
Lakeside	2.1	POA_PALU	7 Graminoid	Fowl blue grass	Poa palustris	-1	PRESENT
Lakeside	2.1	SCIRCYPE	7 Graminoid	Wool-grass	Scirpus cyperinus	-1	PRESENT
Lakeside	2.4	AMPHBRAC	6 Herb	Hog-peanut, falcata	Amphicarpaea bracteata	-1	PRESENT
Lakeside	2.4	LYSIBORE	6 Herb	starflower	Lysimachia borealis	-1	PRESENT
Lakeside	2.4	OSMUCLAY	6 Herb	Interrupted fern	Osmunda claytoniana	-1	PRESENT
Lakeside	MHc36b	ACER69S2	1 Canopy	Sugar maple, T	Acer saccharum	7	>75-100%
Lakeside	MHc36b	QUER69MA	1 Canopy	Bur oak, T	Quercus macrocarpa	6	>50-75%
Lakeside	MHc36b	TILI69AM	1 Canopy	Basswood, T	Tilia americana	6	>50-75%
Lakeside	MHc36b	FRAX69PE	1 Canopy	Green ash, T	Fraxinus pennsylvanica	5	>25-50%
Lakeside	MHc36b	CARY69CO	1 Canopy	Bitternut hickory, T	Carya cordiformis	4	>5-25%
Lakeside	MHc36b	POPU69GR	1 Canopy	Big-toothed aspen, T	Populus grandidentata	4	>5-25%
Lakeside	MHc36b	QUER69RU	1 Canopy	Northern red oak, T	Quercus rubra	4	>5-25%
Lakeside	MHc36b	ACER69RU	1 Canopy	Red maple, T	Acer rubrum var. rubrum	3	1-5% (many >20)
Lakeside	MHc36b	FRAX69NI	1 Canopy	Black ash, T	Fraxinus nigra	3	1-5% (many >20)
Lakeside	MHc36b	BETU69PA	1 Canopy	Paper birch, T	Betula papyrifera	2	<1% (few 2-20)
Lakeside	MHc36b	ACER15S2	2 Understory	Sugar maple, U	Acer saccharum	7	>75-100%
Lakeside	MHc36b	CARP15CA	2 Understory	Blue beech, U	Carpinus caroliniana subsp. virginiana	5	>25-50%
Lakeside	MHc36b	OSTR15VI	2 Understory	Ironwood, U	Ostrya virginiana	5	>25-50%
Lakeside	MHc36b	FRAX15NI	2 Understory	Black ash, U	Fraxinus nigra	3	1-5% (many >20)
Lakeside	MHc36b	QUER15MA	2 Understory	Bur oak, U	Quercus macrocarpa	3	1-5% (many >20)
Lakeside	MHc36b	TILI15AM	2 Understory	Basswood, U	Tilia americana	3	1-5% (many >20)
Lakeside	MHc36b	ULMU15RU	2 Understory	Slippery elm, U	Ulmus rubra	3	1-5% (many >20)
Lakeside	MHc36b	ACERSAC2	3 Shrub	Sugar maple	Acer saccharum	6	>50-75%
Lakeside	MHc36b	CORYCORN	3 Shrub	Beaked hazelnut	Corylus cornuta subsp. cornuta	5	>25-50%
Lakeside	MHc36b	CARPCARO	3 Shrub	Blue beech	Carpinus caroliniana subsp. virginiana	3	1-5% (many >20)
Lakeside	MHc36b	DIRCPALU	3 Shrub	Leatherwood	Dirca palustris	3	1-5% (many >20)
Lakeside	MHc36b	OSTRVIRG	3 Shrub	Ironwood	Ostrya virginiana	3	1-5% (many >20)
Lakeside	MHc36b	TILIAMER	3 Shrub	Basswood	Tilia americana	3	1-5% (many >20)
Lakeside	MHc36b	AMEL_SPP	3 Shrub	Juneberry	Amelanchier sp.	2	<1% (few 2-20)
Lakeside	MHc36b	CARYCORD	3 Shrub	Bitternut hickory	Carya cordiformis	2	<1% (few 2-20)
Lakeside	MHc36b	DIERLONI	3 Shrub	Bush honeysuckle	Diervilla lonicera	2	<1% (few 2-20)
Lakeside	MHc36b	FRAXNIGR	3 Shrub	Black ash	Fraxinus nigra	2	<1% (few 2-20)
Lakeside	MHc36b	FRAXPENN	3 Shrub	Green ash	Fraxinus pennsylvanica	2	<1% (few 2-20)
Lakeside	MHc36b	LONICANA	3 Shrub	Fly honeysuckle	Lonicera canadensis	2	<1% (few 2-20)
Lakeside	MHc36b	LONIHIRS	3 Shrub	Hairy honeysuckle.	Lonicera hirsuta	2	<1% (few 2-20)
Lakeside	MHc36b	RIBECYNO	3 Shrub	Prickly gooseberry	Ribes cynosbati	2	<1% (few 2-20)
Lakeside	MHc36b	RIBE_SPP	3 Shrub	Currant; Gooseberry	Ribes sp	2	<1% (few 2-20)
Lakeside	MHc36b	RIBETRIS	3 Shrub	Swamp red currant	Ribes triste	2	<1% (few 2-20)
Lakeside	MHc36b	RIBEAMER	3 Shrub	Wild black currant	Ribes americanum	1	Single (r)
Lakeside	MHc36b	RIBEHIRT	3 Shrub	Swamp gooseberry	Ribes hirtellum	1	Single (r)

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHc36b	TOXIRYDB	3 Shrub	Western Poison ivy	Toxicodendron rydbergii	1	Single (r)
Lakeside	MHc36b	BETUALLE	3 Shrub	Yellow birch	Betula alleghaniensis	-1	PRESENT
Lakeside	MHc36b	CORYAMER	3 Shrub	American hazelnut	Corylus americana	-1	PRESENT
Lakeside	MHc36b	JUGLCINE	3 Shrub	Butternut	Juglans cinerea	-1	PRESENT
Lakeside	MHc36b	LONIVAVI	3 Shrub	mountain fly honeysuckle	Lonicera caerulea var. villosa	-1	PRESENT
Lakeside	MHc36b	ACER12S2	4 Seedling	Sugar maple	Acer saccharum	4	>5-25%
Lakeside	MHc36b	CARP12CA	4 Seedling	Blue beech	Carpinus caroliniana subsp. virginiana	4	>5-25%
Lakeside	MHc36b	CORY12SC	4 Seedling	Beaked hazelnut	Corylus cornuta subsp. cornuta	4	>5-25%
Lakeside	MHc36b	CARY12CO	4 Seedling	Bitternut hickory	Carya cordiformis	3	1-5% (many >20)
Lakeside	MHc36b	DIRC12PA	4 Seedling	Leatherwood	Dirca palustris	3	1-5% (many >20)
Lakeside	MHc36b	FRAX12PE	4 Seedling	Green ash	Fraxinus pennsylvanica	3	1-5% (many >20)
Lakeside	MHc36b	OSTR12VI	4 Seedling	Ironwood	Ostrya virginiana	3	1-5% (many >20)
Lakeside	MHc36b	PRUN12VI	4 Seedling	Chokecherry	Prunus virginiana	3	1-5% (many >20)
Lakeside	MHc36b	ACER12RU	4 Seedling	Red maple	Acer rubrum	2	<1% (few 2-20)
Lakeside	MHc36b	CORN12AL	4 Seedling	Pagoda dogwood	Cornus alternifolia	2	<1% (few 2-20)
Lakeside	MHc36b	FRAX12NI	4 Seedling	Black ash	Fraxinus nigra	2	<1% (few 2-20)
Lakeside	MHc36b	POPU12GR	4 Seedling	Big-toothed aspen SE	Populus grandidentata	2	<1% (few 2-20)
Lakeside	MHc36b	QUER12MA	4 Seedling	Bur oak	Quercus macrocarpa	2	<1% (few 2-20)
Lakeside	MHc36b	QUER12RU	4 Seedling	Northern red oak	Quercus rubra	2	<1% (few 2-20)
Lakeside	MHc36b	TILI12AM	4 Seedling	Basswood	Tilia americana	2	<1% (few 2-20)
Lakeside	MHc36b	BETU12PA	4 Seedling	Paper-birch	Betula papyrifera	1	Single (r)
Lakeside	MHc36b	VIBU12LE	4 Seedling	Nannyberry	Viburnum lentago	1	Single (r)
Lakeside	MHc36b	VIBU12RA	4 Seedling	Downy arrow-wood	Viburnum rafinesquianum	1	Single (r)
Lakeside	MHc36b	BETU12AL	4 Seedling	Yellow birch	Betula alleghaniensis	-1	PRESENT
Lakeside	MHc36b	PARTVITA	4 Subshrub	Virginia creeper	Parthenocissus vitacea	2	<1% (few 2-20)
Lakeside	MHc36b	RUBUSSID	4 Subshrub	Red raspberry	Rubus idaeus subsp. idaeus	-1	PRESENT
Lakeside	MHc36b	ATHYVAAN	6 Herb	northern lady fern	Athyrium filix-femina var. angustum	4	>5-25%
Lakeside	MHc36b	EURYMACR	6 Herb	big-leaf aster	Eurybia macrophylla	4	>5-25%
Lakeside	MHc36b	OSMUCLAY	6 Herb	Interrupted fern	Osmunda claytoniana	4	>5-25%
Lakeside	MHc36b	ADIAPEDA	6 Herb	Maidenhair fern	Adiantum pedatum	3	1-5% (many >20)
Lakeside	MHc36b	ALLITRIC	6 Herb	Wild leek	Allium tricoccum	3	1-5% (many >20)
Lakeside	MHc36b	AMPHBRAC	6 Herb	Hog-peanut, falcata	Amphicarpaea bracteata	3	1-5% (many >20)
Lakeside	MHc36b	ANEMAMER	6 Herb	round-lobed hepatica	Anemone americana	3	1-5% (many >20)
Lakeside	MHc36b	ARALNUDI	6 Herb	Wild sarsaparilla	Aralia nudicaulis	3	1-5% (many >20)
Lakeside	MHc36b	ARISTRIP	6 Herb	Jack-in-the-pulpit	Arisaema triphyllum	3	1-5% (many >20)
Lakeside	MHc36b	ASARCANA	6 Herb	Wild ginger	Asarum canadense varieties not recognized]	3	1-5% (many >20)
Lakeside	MHc36b	CIRCLUTE	6 Herb	Canada enchanter's nightshade	Circaea lutetiana var. canadensis	3	1-5% (many >20)
Lakeside	MHc36b	DESMGLUT	6 Herb	Pointed-leaved tick-trefoil	Desmodium glutinosum	3	1-5% (many >20)
Lakeside	MHc36b	FRAGVIRG	6 Herb	Common strawberry	Fragaria virginiana	3	1-5% (many >20)
Lakeside	MHc36b	GALITRI2	6 Herb	Three-flowered bedstraw	Galium triflorum var. triflorum	3	1-5% (many >20)
Lakeside	MHc36b	GERAMACU	6 Herb	Wild geranium	Geranium maculatum	3	1-5% (many >20)

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHc36b	GOODPUBE	6 Herb	Downy rattlesnake-plantain	Goodyera pubescens	3	1-5% (many >20)
Lakeside	MHc36b	HYDRVIRG	6 Herb	Virginia waterleaf	Hydrophyllum virginianum var. virginianum	3	1-5% (many >20)
Lakeside	MHc36b	LATHOCHR	6 Herb	Pale vetchling	Lathyrus ochroleucus	3	1-5% (many >20)
Lakeside	MHc36b	MAIACANA	6 Herb	Canada mayflower	Maianthemum canadense	3	1-5% (many >20)
Lakeside	MHc36b	OSMOCLAY	6 Herb	Clayton's sweet cicely	Osmorhiza claytonii	3	1-5% (many >20)
Lakeside	MHc36b	PYROELLI	6 Herb	Common pyrola	Pyrola elliptica	3	1-5% (many >20)
Lakeside	MHc36b	RUBUPUBE	6 Herb	Dwarf raspberry	Rubus pubescens	3	1-5% (many >20)
Lakeside	MHc36b	SANGCANA	6 Herb	Bloodroot	Sanguinaria canadensis	3	1-5% (many >20)
Lakeside	MHc36b	SOLIFLEX	6 Herb	Zig-zag goldenrod	Solidago flexicaulis	3	1-5% (many >20)
Lakeside	MHc36b	STRELANC	6 Herb	rosy twisted stalk	Streptopus lanceolatus	3	1-5% (many >20)
Lakeside	MHc36b	SYMPLATE	6 Herb	calico aster	Symphyotrichum lateriflorum	3	1-5% (many >20)
Lakeside	MHc36b	THALDIOI	6 Herb	Early meadow-rue	Thalictrum dioicum	3	1-5% (many >20)
Lakeside	MHc36b	TRILCERN	6 Herb	Nodding trillium	Trillium cernuum	3	1-5% (many >20)
Lakeside	MHc36b	UVULGRAN	6 Herb	Yellow bellwort	Uvularia grandiflora	3	1-5% (many >20)
Lakeside	MHc36b	UVULSESS	6 Herb	Pale bellwort	Uvularia sessilifolia	3	1-5% (many >20)
Lakeside	MHc36b	VIOLCANA	6 Herb	Rugulose violet	Viola canadensis var. rugulosa	3	1-5% (many >20)
Lakeside	MHc36b	VIOL_SPP	6 Herb	Violet	Viola sp.	3	1-5% (many >20)
Lakeside	MHc36b	ACTARUBR	6 Herb	Red baneberry	Actaea rubra	2	<1% (few 2-20)
Lakeside	MHc36b	ANEMVAQU	6 Herb	Wood-anemone	Anemone quinquefolia var. quinquefolia	2	<1% (few 2-20)
Lakeside	MHc36b	APOCANDR	6 Herb	Spreading dogbane	Apocynum androsaemifolium	2	<1% (few 2-20)
Lakeside	MHc36b	ARALRACE	6 Herb	American spikenard	Aralia racemosa	2	<1% (few 2-20)
Lakeside	MHc36b	BOTRVIRG	6 Herb	Rattlesnakefern	Botrychium virginianum	2	<1% (few 2-20)
Lakeside	MHc36b	CAULTHAL	6 Herb	Blue cohosh	Caulophyllum thalictroides	2	<1% (few 2-20)
Lakeside	MHc36b	CLINBORE	6 Herb	Bluebead lily	Clintonia borealis	2	<1% (few 2-20)
Lakeside	MHc36b	CRYPCANA	6 Herb	Honewort	Cryptotaenia canadensis	2	<1% (few 2-20)
Lakeside	MHc36b	CYPRVAP1	6 Herb	greater yellow lady's-slipper var. pubescens	Cypripedium parviflorum var. pubescens	2	<1% (few 2-20)
Lakeside	MHc36b	DOELUMBE	6 Herb	parasol whitetop	Doellingeria umbellata variety unknown]	2	<1% (few 2-20)
Lakeside	MHc36b	DRYOCART	6 Herb	Spinulose shield-fern	Dryopteris carthusiana	2	<1% (few 2-20)
Lakeside	MHc36b	EQUIARVE	6 Herb	Field horsetail	Equisetum arvense	2	<1% (few 2-20)
Lakeside	MHc36b	EQUIPRAT	6 Herb	Meadow horsetail	Equisetum pratense	2	<1% (few 2-20)
Lakeside	MHc36b	EQUISYLV	6 Herb	Wood horsetail	Equisetum sylvaticum	2	<1% (few 2-20)
Lakeside	MHc36b	GALIASPR	6 Herb	Rough bedstraw	Galium asprellum	2	<1% (few 2-20)
Lakeside	MHc36b	GEUMVAST	6 Herb	Yellow avens	Geum aleppicum var. strictum	2	<1% (few 2-20)
Lakeside	MHc36b	GEUMCANA	6 Herb	White avens	Geum canadense	2	<1% (few 2-20)
Lakeside	MHc36b	GYMNDRYO	6 Herb	Common oak-fern	Gymnocarpium dryopteris	2	<1% (few 2-20)

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHc36b	LATHVENO	6 Herb	Veiny pea	Lathyrus venosus var. intonsus	2	<1% (few 2-20)
Lakeside	MHc36b	LYSIBORE	6 Herb	starflower	Lysimachia borealis	2	<1% (few 2-20)
Lakeside	MHc36b	LYSICILI	6 Herb	Fringed loosestrife	Lysimachia ciliata	2	<1% (few 2-20)
Lakeside	MHc36b	MAIASSRA	6 Herb	feathery false lily-of-the-valley	Maianthemum racemosum subsp. racemosum	2	<1% (few 2-20)
Lakeside	MHc36b	MATTSTRU	6 Herb	Ostrich-fern	Matteuccia struthiopteris var. pensylvanica	2	<1% (few 2-20)
Lakeside	MHc36b	MONOUNIF	6 Herb	Indian pipe	Monotropa uniflora	2	<1% (few 2-20)
Lakeside	MHc36b	ONOCSENS	6 Herb	Sensitive fern	Onoclea sensibilis	2	<1% (few 2-20)
Lakeside	MHc36b	PETAFRIG	6 Herb	Palmate sweet coltsfoot	Petasites frigidus var. palmatus	2	<1% (few 2-20)
Lakeside	MHc36b	PHRYLEPT	6 Herb	Lopseed	Phryma leptostachya	2	<1% (few 2-20)
Lakeside	MHc36b	POLYPUBE	6 Herb	Hairy Solomon's-seal	Polygonatum pubescens	2	<1% (few 2-20)
Lakeside	MHc36b	SANIGREG	6 Herb	Gregarious black snakeroot	Sanicula gregaria	2	<1% (few 2-20)
Lakeside	MHc36b	SANIMARI	6 Herb	Mariland black snakeroot	Sanicula marilandica	2	<1% (few 2-20)
Lakeside	MHc36b	SYMPLANC	6 Herb	white panicled aster;	Symphyotrichum lanceolatum	2	<1% (few 2-20)
Lakeside	MHc36b	TARAOFFI	6 Herb	Common dandelion	Taraxacum officinale	2	<1% (few 2-20)
Lakeside	MHc36b	VICIAMER	6 Herb	American vetch	Vicia americana	2	<1% (few 2-20)
Lakeside	MHc36b	DRYOCRIS	6 Herb	Crested fern	Dryopteris cristata	1	Single (r)
Lakeside	MHc36b	GOODPUBE	6 Herb	Downy rattlesnake-plantain	Goodyera pubescens	1	Single (r)
Lakeside	MHc36b	LILIMICH	6 Herb	Michigan lily	Lilium michiganense	1	Single (r)
Lakeside	MHc36b	POLYBIFL	6 Herb	giant solomon's-seal	Polygonatum biflorum	1	Single (r)
Lakeside	MHc36b	PRENALBA	6 Herb	White rattlesnake-root	Prenanthes alba	1	Single (r)
Lakeside	MHc36b	SMILLASI	6 Herb	Hairy-nerved carrion-flower	Smilax lasioneura	1	Single (r)
Lakeside	MHc36b	IMPA_SPP	6 Herb	Touch me not	Impatiens sp.	0	Outside Plot
Lakeside	MHc36b	SYMPPUNI	6 Herb	purple-stem aster	Symphyotrichum puniceum var. puniceum	0	Outside Plot
Lakeside	MHc36b	ASCLSYRI	6 Herb	Common milkweed	Asclepias syriaca	-1	PRESENT
Lakeside	MHc36b	CIRSARVE	6 Herb	Canada thistle	Cirsium arvense	-1	PRESENT
Lakeside	MHc36b	CIRSDISC	6 Herb	Field thistle	Cirsium discolor	-1	PRESENT
Lakeside	MHc36b	CAREPEDU	7 Graminoid	Long-stalked sedge	Carex pedunculata	4	>5-25%
Lakeside	MHc36b	CAREPENS	7 Graminoid	Pennsylvania sedge	Carex pensylvanica	4	>5-25%
Lakeside	MHc36b	BRACEREC	7 Graminoid	Bearded shorthusk	Brachyelytrum erectum	3	1-5% (many >20)
Lakeside	MHc36b	CAREARC2	7 Graminoid	Drooping wood-sedge	Carex arctata	3	1-5% (many >20)
Lakeside	MHc36b	CAREINTU	7 Graminoid	Bladder sedge	Carex intumescens	3	1-5% (many >20)
Lakeside	MHc36b	CARERADI	7 Graminoid	Stellate sedge	Carex radiata	3	1-5% (many >20)
Lakeside	MHc36b	FESTSUBV	7 Graminoid	Nodding fescue	Festuca subverticillata	3	1-5% (many >20)
Lakeside	MHc36b	ORYZASPE	7 Graminoid	Mountain rice-grass	Oryzopsis asperifolia	3	1-5% (many >20)
Lakeside	MHc36b	CAREDEWE	7 Graminoid	Dewey's sedge	Carex deweyana var. deweyana	2	<1% (few 2-20)
Lakeside	MHc36b	CARELUPU	7 Graminoid	Hop-sedge	Carex lupulina	2	<1% (few 2-20)
Lakeside	MHc36b	ELYMHYST	7 Graminoid	Bottlebrush grass	Elymus hystrix	2	<1% (few 2-20)
Lakeside	MHc36b	LUZUACUM	7 Graminoid	Pointed wood-rush	Luzula acuminata var. acuminata	2	<1% (few 2-20)

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHc36b	MILIEFFU	7 Graminoid	Woodland millet grass	Milium effusum var. cisatlanticum	2	<1% (few 2-20)
Lakeside	MHc36b	POA_PALU	7 Graminoid	Fowl blue grass	Poa palustris	2	<1% (few 2-20)
Lakeside	MHc36b	BROMCILI	7 Graminoid	Fringed brome	Bromus ciliatus	1	Single (r)
Lakeside	MHc36b	SCHIPURP	7 Graminoid	False melic grass	Schizachne purpurascens	1	Single (r)
Lakeside	MHc36b	CAREGRAC	7 Graminoid	Graceful sedge	Carex gracillima	-1	PRESENT
Lakeside	MHc36b	PHALARUN	7 Graminoid	Reed canary-grass	Phalaris arundinacea	-1	PRESENT
Lakeside	MHc36b	PHLEPRAT	7 Graminoid	Cultivated timothy	Phleum pratense subsp. pratense	-1	PRESENT
Lakeside	MHn35b	ACER69S2	1 Canopy	Sugar maple, T	Acer saccharum	6	>50-75%
Lakeside	MHn35b	POPU69GR	1 Canopy	Big-toothed aspen, T	Populus grandidentata	6	>50-75%
Lakeside	MHn35b	QUER69RU	1 Canopy	Northern red oak, T	Quercus rubra	5	>25-50%
Lakeside	MHn35b	TILI69AM	1 Canopy	Basswood, T	Tilia americana	5	>25-50%
Lakeside	MHn35b	BETU69PA	1 Canopy	Paper birch, T	Betula papyrifera	3	1-5% (many >20)
Lakeside	MHn35b	CARY69CO	1 Canopy	Bitternut hickory, T	Carya cordiformis	3	1-5% (many >20)
Lakeside	MHn35b	FRAX69PE	1 Canopy	Green ash, T	Fraxinus pennsylvanica	1	Single (r)
Lakeside	MHn35b	FRAX69NI	1 Canopy	Black ash, T	Fraxinus nigra	0	Outside Plot
Lakeside	MHn35b	ACER15S2	2 Understory	Sugar maple, U	Acer saccharum	7	>75-100%
Lakeside	MHn35b	OSTR15VI	2 Understory	Ironwood, U	Ostrya virginiana	7	>75-100%
Lakeside	MHn35b	TILI15AM	2 Understory	Basswood, U	Tilia americana	3	1-5% (many >20)
Lakeside	MHn35b	CARY15CO	2 Understory	Bitternut hickory, U	Carya cordiformis	1	Single (r)
Lakeside	MHn35b	ACERSAC2	3 Shrub	Sugar maple	Acer saccharum	5	>25-50%
Lakeside	MHn35b	OSTRVIRG	3 Shrub	Ironwood	Ostrya virginiana	4	>5-25%
Lakeside	MHn35b	CARPCARO	3 Shrub	Blue beech	Carpinus caroliniana subsp. virginiana	3	1-5% (many >20)
Lakeside	MHn35b	CORYCORN	3 Shrub	Beaked hazelnut	Corylus cornuta subsp. cornuta	3	1-5% (many >20)
Lakeside	MHn35b	LONICANA	3 Shrub	Fly honeysuckle	Lonicera canadensis	3	1-5% (many >20)
Lakeside	MHn35b	LONIHIRS	3 Shrub	Hairy honeysuckle.	Lonicera hirsuta	3	1-5% (many >20)
Lakeside	MHn35b	TILIAMER	3 Shrub	Basswood	Tilia americana	3	1-5% (many >20)
Lakeside	MHn35b	BETUALLE	3 Shrub	Yellow birch	Betula alleghaniensis	2	<1% (few 2-20)
Lakeside	MHn35b	CARYCORD	3 Shrub	Bitternut hickory	Carya cordiformis	2	<1% (few 2-20)
Lakeside	MHn35b	DIRCPALU	3 Shrub	Leatherwood	Dirca palustris	2	<1% (few 2-20)
Lakeside	MHn35b	FRAXPENN	3 Shrub	Green ash	Fraxinus pennsylvanica	2	<1% (few 2-20)
Lakeside	MHn35b	POPUGRAN	3 Shrub	Big-toothed aspen	Populus grandidentata	2	<1% (few 2-20)
Lakeside	MHn35b	RIBECYNO	3 Shrub	Prickly gooseberry	Ribes cynosbati	2	<1% (few 2-20)
Lakeside	MHn35b	RIBETRIS	3 Shrub	Swamp red currant	Ribes triste	2	<1% (few 2-20)
Lakeside	MHn35b	DIERLONI	3 Shrub	Bush honeysuckle	Diervilla lonicera	1	Single (r)
Lakeside	MHn35b	PRUNVIRG	3 Shrub	Chokecherry	Prunus virginiana	1	Single (r)
Lakeside	MHn35b	RIBEAMER	3 Shrub	Wild black currant	Ribes americanum	1	Single (r)
Lakeside	MHn35b	ACER12S2	4 Seedling	Sugar maple	Acer saccharum	4	>5-25%
Lakeside	MHn35b	CARY12CO	4 Seedling	Bitternut hickory	Carya cordiformis	3	1-5% (many >20)
Lakeside	MHn35b	OSTR12VI	4 Seedling	Ironwood	Ostrya virginiana	3	1-5% (many >20)
Lakeside	MHn35b	TILI12AM	4 Seedling	Basswood	Tilia americana	3	1-5% (many >20)
Lakeside	MHn35b	BETU12AL	4 Seedling	Yellow birch	Betula alleghaniensis	2	<1% (few 2-20)
Lakeside	MHn35b	CARP12CA	4 Seedling	Blue beech	Carpinus caroliniana subsp. virginiana	2	<1% (few 2-20)
Lakeside	MHn35b	CORN12AL	4 Seedling	Pagoda dogwood	Cornus alternifolia	2	<1% (few 2-20)
Lakeside	MHn35b	CORY12SC	4 Seedling	Beaked hazelnut	Corylus cornuta subsp. cornuta	2	<1% (few 2-20)
Lakeside	MHn35b	DIRC12PA	4 Seedling	Leatherwood	Dirca palustris	2	<1% (few 2-20)
Lakeside	MHn35b	FRAX12PE	4 Seedling	Green ash	Fraxinus pennsylvanica	2	<1% (few 2-20)
Lakeside	MHn35b	POPU12GR	4 Seedling	Big-toothed aspen SE	Populus grandidentata	2	<1% (few 2-20)

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHn35b	PRUN12VI	4 Seedling	Chokecherry	Prunus virginiana	2	<1% (few 2-20)
Lakeside	MHn35b	QUER12RU	4 Seedling	Northern red oak	Quercus rubra	2	<1% (few 2-20)
Lakeside	MHn35b	ABIE12BA	4 Seedling	Balsam fir	Abies balsamea	1	Single (r)
Lakeside	MHn35b	BETU12PA	4 Seedling	Paper-birch	Betula papyrifera	1	Single (r)
Lakeside	MHn35b	FRAX12NI	4 Seedling	Black ash	Fraxinus nigra	1	Single (r)
Lakeside	MHn35b	POPU12TR	4 Seedling	Quaking aspen SE	Populus tremuloides	1	Single (r)
Lakeside	MHn35b	VIBU12RA	4 Seedling	Downy arrow-wood	Viburnum rafinesquianum	1	Single (r)
Lakeside	MHn35b	RUBUSSID	4 Subshrub	Red raspberry	Rubus idaeus subsp. idaeus	6	>50-75%
Lakeside	MHn35b	PARTVITA	4 Subshrub	Virginia creeper	Parthenocissus vitacea	2	<1% (few 2-20)
Lakeside	MHn35b	CIRSARVE	6 Herb	Canada thistle	Cirsium arvense	5	>25-50%
Lakeside	MHn35b	ARALNUDI	6 Herb	Wild sarsaparilla	Aralia nudicaulis	4	>5-25%
Lakeside	MHn35b	EURYMACR	6 Herb	big-leaf aster	Eurybia macrophylla	4	>5-25%
Lakeside	MHn35b	SOLIGIGA	6 Herb	Giant goldenrod	Solidago gigantea	4	>5-25%
Lakeside	MHn35b	AMPHBRAC	6 Herb	Hog-peanut, falcata	Amphicarpaea bracteata	3	1-5% (many >20)
Lakeside	MHn35b	ANEMAMER	6 Herb	round-lobed hepatica	Anemone americana	3	1-5% (many >20)
Lakeside	MHn35b	ANEMVAQU	6 Herb	Wood-anemone	Anemone quinquefolia var. quinquefolia	3	1-5% (many >20)
Lakeside	MHn35b	ARALRACE	6 Herb	American spikenard	Aralia racemosa	3	1-5% (many >20)
Lakeside	MHn35b	ATHYVAAN	6 Herb	northern lady fern	Athyrium filix-femina var. angustum	3	1-5% (many >20)
Lakeside	MHn35b	BOTRVIRG	6 Herb	Rattlesnakefern	Botrychium virginianum	3	1-5% (many >20)
Lakeside	MHn35b	DESMGLUT	6 Herb	Pointed-leaved tick-trefoil	Desmodium glutinosum	3	1-5% (many >20)
Lakeside	MHn35b	LATHOCHR	6 Herb	Pale vetchling	Lathyrus ochroleucus	3	1-5% (many >20)
Lakeside	MHn35b	MAIACANA	6 Herb	Canada mayflower	Maianthemum canadense	3	1-5% (many >20)
Lakeside	MHn35b	SANGCANA	6 Herb	Bloodroot	Sanguinaria canadensis	3	1-5% (many >20)
Lakeside	MHn35b	THALDIOI	6 Herb	Early meadow-rue	Thalictrum dioicum	3	1-5% (many >20)
Lakeside	MHn35b	TRILCERN	6 Herb	Nodding trillium	Trillium cernuum	3	1-5% (many >20)
Lakeside	MHn35b	URTIDIOI	6 Herb	Stinging nettle	Urtica dioica	3	1-5% (many >20)
Lakeside	MHn35b	UVULSESS	6 Herb	Pale bellwort	Uvularia sessilifolia	3	1-5% (many >20)
Lakeside	MHn35b	VIOLCANA	6 Herb	Rugulose violet	Viola canadensis var. rugulosa	3	1-5% (many >20)
Lakeside	MHn35b	VIOLPUBE	6 Herb	Yellow violet	Viola pubescens	3	1-5% (many >20)
Lakeside	MHn35b	ACTARUBR	6 Herb	Red baneberry	Actaea rubra	2	<1% (few 2-20)
Lakeside	MHn35b	ALLITRIC	6 Herb	Wild leek	Allium tricoccum	2	<1% (few 2-20)
Lakeside	MHn35b	APOCANDR	6 Herb	Spreading dogbane	Apocynum androsaemifolium	2	<1% (few 2-20)
Lakeside	MHn35b	ARISTRIP	6 Herb	Jack-in-the-pulpit	Arisaema triphyllum	2	<1% (few 2-20)
Lakeside	MHn35b	ASARCANA	6 Herb	Wild ginger	Asarum canadense varieties not recognized]	2	<1% (few 2-20)
Lakeside	MHn35b	ASCLSYRI	6 Herb	Common milkweed	Asclepias syriaca	2	<1% (few 2-20)
Lakeside	MHn35b	CAULTHAL	6 Herb	Blue cohosh	Caulophyllum thalictroides	2	<1% (few 2-20)
Lakeside	MHn35b	CIRCLUTE	6 Herb	Canada enchanter's nightshade	Circaea lutetiana var. canadensis	2	<1% (few 2-20)
Lakeside	MHn35b	CRYPCANA	6 Herb	Honewort	Cryptotaenia canadensis	2	<1% (few 2-20)

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHn35b	FALLSCAN	6 Herb	climbing false buckwheat	Fallopia scandens	2	<1% (few 2-20)
Lakeside	MHn35b	FRAGVIRG	6 Herb	Common strawberry	Fragaria virginiana	2	<1% (few 2-20)
Lakeside	MHn35b	GALIASPR	6 Herb	Rough bedstraw	Galium asprellum	2	<1% (few 2-20)
Lakeside	MHn35b	GALITRI2	6 Herb	Three-flowered bedstraw	Galium triflorum var. triflorum	2	<1% (few 2-20)
Lakeside	MHn35b	GERAMACU	6 Herb	Wild geranium	Geranium maculatum	2	<1% (few 2-20)
Lakeside	MHn35b	HYDRVIRG	6 Herb	Virginia waterleaf	Hydrophyllum virginianum var. virginianum	2	<1% (few 2-20)
Lakeside	MHn35b	LATHVENO	6 Herb	Veiny pea	Lathyrus venosus var. intonsus	2	<1% (few 2-20)
Lakeside	MHn35b	LYSIBORE	6 Herb	starflower	Lysimachia borealis	2	<1% (few 2-20)
Lakeside	MHn35b	MAIASSRA	6 Herb	feathery false lily-of-the-valley	Maianthemum racemosum subsp. racemosum	2	<1% (few 2-20)
Lakeside	MHn35b	OSMOCLAY	6 Herb	Clayton's sweet cicely	Osmorhiza claytonii	2	<1% (few 2-20)
Lakeside	MHn35b	OSMUCLAY	6 Herb	Interrupted fern	Osmunda claytoniana	2	<1% (few 2-20)
Lakeside	MHn35b	PHRYLEPT	6 Herb	Lopseed	Phryma leptostachya	2	<1% (few 2-20)
Lakeside	MHn35b	PTERAQUI	6 Herb	Bracken fern	Pteridium aquilinum var. latiusculum	2	<1% (few 2-20)
Lakeside	MHn35b	SANIMARI	6 Herb	Mariland black snakeroot	Sanicula marilandica	2	<1% (few 2-20)
Lakeside	MHn35b	SOLIFLEX	6 Herb	Zig-zag goldenrod	Solidago flexicaulis	2	<1% (few 2-20)
Lakeside	MHn35b	STRELANC	6 Herb	rosy twisted stalk	Streptopus lanceolatus	2	<1% (few 2-20)
Lakeside	MHn35b	SYMPLANC	6 Herb	white panicled aster;	Symphyotrichum lanceolatum	2	<1% (few 2-20)
Lakeside	MHn35b	SYMPLATE	6 Herb	calico aster	Symphyotrichum lateriflorum	2	<1% (few 2-20)
Lakeside	MHn35b	SYMPPUNI	6 Herb	purple-stem aster	Symphyotrichum puniceum var. puniceum	2	<1% (few 2-20)
Lakeside	MHn35b	TARAOFFI	6 Herb	Common dandelion	Taraxacum officinale	2	<1% (few 2-20)
Lakeside	MHn35b	UVULGRAN	6 Herb	Yellow bellwort	Uvularia grandiflora	2	<1% (few 2-20)
Lakeside	MHn35b	VICIAMER	6 Herb	American vetch	Vicia americana	2	<1% (few 2-20)
Lakeside	MHn35b	VIOL_SPP	6 Herb	Violet	Viola sp.	2	<1% (few 2-20)
Lakeside	MHn35b	ADIAPEDA	6 Herb	Maidenhair fern	Adiantum pedatum	1	Single (r)
Lakeside	MHn35b	AGASFOEN	6 Herb	Blue giant-hyssop	Agastache foeniculum	1	Single (r)
Lakeside	MHn35b	ARCTMINU	6 Herb	Common burdock	Arctium minus	1	Single (r)
Lakeside	MHn35b	ASCLVAI1	6 Herb	Swamp milkweed	Asclepias incarnata var. incarnata	1	Single (r)
Lakeside	MHn35b	CYPRVAP1	6 Herb	greater yellow lady's-slipper var. pubescens	Cypripedium parviflorum var. pubescens	1	Single (r)
Lakeside	MHn35b	DRYOCART	6 Herb	Spinulose shield-fern	Dryopteris carthusiana	1	Single (r)
Lakeside	MHn35b	EPILCOLO	6 Herb	Purple-leaved willow-herb	Epilobium coloratum	1	Single (r)
Lakeside	MHn35b	EUTRMACU	6 Herb	spotted joe-pye-weed	Eutrochium maculatum	1	Single (r)
Lakeside	MHn35b	GEUMCANA	6 Herb	White avens	Geum canadense	1	Single (r)
Lakeside	MHn35b	HIERUMBE	6 Herb	narrow-leaf hawkweed	Hieracium umbellatum	1	Single (r)
Lakeside	MHn35b	LYSITHYR	6 Herb	Tufted loosestrife	Lysimachia thyrsiflora	1	Single (r)

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHn35b	POLYPUBE	6 Herb	Hairy Solomon's-seal	Polygonatum pubescens	1	Single (r)
Lakeside	MHn35b	PRENALBA	6 Herb	White rattlesnake-root	Prenanthes alba	1	Single (r)
Lakeside	MHn35b	PYROELLI	6 Herb	Common pyrola	Pyrola elliptica	1	Single (r)
Lakeside	MHn35b	SCUTLATE	6 Herb	Mad-dog skullcap	Scutellaria lateriflora	1	Single (r)
Lakeside	MHn35b	SMILLASI	6 Herb	Hairy-nerved carrion-flower	Smilax lasioneura	1	Single (r)
Lakeside	MHn35b	VERBURTI	6 Herb	White vervain	Verbena urticifolia	1	Single (r)
Lakeside	MHn35b	CAREPENS	7 Graminoid	Pennsylvania sedge	Carex pensylvanica	7	>75-100%
Lakeside	MHn35b	CARE_SPP	7 Graminoid	Sedge	Carex sp.	4	>5-25%
Lakeside	MHn35b	CAREDEWE	7 Graminoid	Dewey's sedge	Carex deweyana var. deweyana	3	1-5% (many >20)
Lakeside	MHn35b	ORYZASPE	7 Graminoid	Mountain rice-grass	Oryzopsis asperifolia	3	1-5% (many >20)
Lakeside	MHn35b	SCIRCYPE	7 Graminoid	Wool-grass	Scirpus cyperinus	3	1-5% (many >20)
Lakeside	MHn35b	BRACEREC	7 Graminoid	Bearded shorthusk	Brachyelytrum erectum	2	<1% (few 2-20)
Lakeside	MHn35b	CAREGRAC	7 Graminoid	Graceful sedge	Carex gracillima	2	<1% (few 2-20)
Lakeside	MHn35b	CAREPEDU	7 Graminoid	Long-stalked sedge	Carex pedunculata	2	<1% (few 2-20)
Lakeside	MHn35b	CAREPROJ	7 Graminoid	Projecting sedge	Carex projecta	2	<1% (few 2-20)
Lakeside	MHn35b	CINNLATI	7 Graminoid	Drooping woodreed	Cinna latifolia	2	<1% (few 2-20)
Lakeside	MHn35b	FESTSUBV	7 Graminoid	Nodding fescue	Festuca subverticillata	2	<1% (few 2-20)
Lakeside	MHn35b	LUZUACUM	7 Graminoid	Pointed wood-rush	Luzula acuminata var. acuminata	2	<1% (few 2-20)
Lakeside	MHn35b	MILIEFFU	7 Graminoid	Woodland millet grass	Milium effusum var. cisatlanticum	2	<1% (few 2-20)
Lakeside	MHn35b	SCHIPURP	7 Graminoid	False melic grass	Schizachne purpurascens	2	<1% (few 2-20)
Lakeside	MHn35b	CARECOMM	7 Graminoid	Colonial sedge	Carex communis [variety unknown see var. communis]	1	Single (r)
Lakeside	MHn35b	GLYCSTRI	7 Graminoid	Fowl manna-grass	Glyceria striata	1	Single (r)
Lakeside	MHn35b	MUHLMEXI	7 Graminoid	Mexican satin-grass	Muhlenbergia mexicana	1	Single (r)
Lakeside	MHn35b	POA_ALSO	7 Graminoid	Wood bluegrass	Poa alsodes	1	Single (r)
Lakeside	MHn35b	POA__SPP	7 Graminoid	Bluegrass; Meadow-grass	Poa sp	1	Single (r)
Lakeside	MHn46b	FRAX69NI	1 Canopy	Black ash, T	Fraxinus nigra	6	>50-75%
Lakeside	MHn46b	ACER69RU	1 Canopy	Red maple, T	Acer rubrum var. rubrum	4	>5-25%
Lakeside	MHn46b	FRAX69PE	1 Canopy	Green ash, T	Fraxinus pennsylvanica	4	>5-25%
Lakeside	MHn46b	TILI69AM	1 Canopy	Basswood, T	Tilia americana	4	>5-25%
Lakeside	MHn46b	ACER69S2	1 Canopy	Sugar maple, T	Acer saccharum	3	1-5% (many >20)
Lakeside	MHn46b	BETU69PA	1 Canopy	Paper birch, T	Betula papyrifera	-1	PRESENT
Lakeside	MHn46b	CARY69CO	1 Canopy	Bitternut hickory, T	Carya cordiformis	-1	PRESENT
Lakeside	MHn46b	ACER15RU	2 Understory	Red maple, U	Acer rubrum	5	>25-50%
Lakeside	MHn46b	ACER15S2	2 Understory	Sugar maple, U	Acer saccharum	5	>25-50%
Lakeside	MHn46b	FRAX15NI	2 Understory	Black ash, U	Fraxinus nigra	3	1-5% (many >20)
Lakeside	MHn46b	TILI15AM	2 Understory	Basswood, U	Tilia americana	3	1-5% (many >20)
Lakeside	MHn46b	ULMU15AM	2 Understory	American elm, U	Ulmus americana	3	1-5% (many >20)
Lakeside	MHn46b	ULMU15RU	2 Understory	Slippery elm, U	Ulmus rubra	3	1-5% (many >20)
Lakeside	MHn46b	OSTR15VI	2 Understory	Ironwood, U	Ostrya virginiana	1	Single (r)
Lakeside	MHn46b	CARP15CA	2 Understory	Blue beech, U	Carpinus caroliniana subsp. virginiana	-1	PRESENT
Lakeside	MHn46b	CARY15CO	2 Understory	Bitternut hickory, U	Carya cordiformis	-1	PRESENT

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHn46b	ILEXVERT	3 Shrub	Winterberry	Ilex verticillata var. verticillata	4	>5-25%
Lakeside	MHn46b	RIBECYNO	3 Shrub	Prickly gooseberry	Ribes cynosbati	3	1-5% (many >20)
Lakeside	MHn46b	TOXIRYDB	3 Shrub	Western Poison ivy	Toxicodendron rydbergii	3	1-5% (many >20)
Lakeside	MHn46b	CORYCORN	3 Shrub	Beaked hazelnut	Corylus cornuta subsp. cornuta	2	<1% (few 2-20)
Lakeside	MHn46b	FRAXNIGR	3 Shrub	Black ash	Fraxinus nigra	2	<1% (few 2-20)
Lakeside	MHn46b	FRAXPENN	3 Shrub	Green ash	Fraxinus pennsylvanica	2	<1% (few 2-20)
Lakeside	MHn46b	RIBEAMER	3 Shrub	Wild black currant	Ribes americanum	2	<1% (few 2-20)
Lakeside	MHn46b	RIBETRIS	3 Shrub	Swamp red currant	Ribes triste	2	<1% (few 2-20)
Lakeside	MHn46b	TILIAMER	3 Shrub	Basswood	Tilia americana	2	<1% (few 2-20)
Lakeside	MHn46b	ULMUAMER	3 Shrub	American elm	Ulmus americana	2	<1% (few 2-20)
Lakeside	MHn46b	VIBULENT	3 Shrub	Nannyberry	Viburnum lentago	2	<1% (few 2-20)
Lakeside	MHn46b	PRUNVIRG	3 Shrub	Chokecherry	Prunus virginiana	1	Single (r)
Lakeside	MHn46b	ACERSAC2	3 Shrub	Sugar maple	Acer saccharum	-1	PRESENT
Lakeside	MHn46b	ALNUINCA	3 Shrub	Speckled alder	Alnus incana subsp. rugosa	-1	PRESENT
Lakeside	MHn46b	BETUPAPY	3 Shrub	Paper-birch	Betula papyrifera	-1	PRESENT
Lakeside	MHn46b	CARPCARO	3 Shrub	Blue beech	Carpinus caroliniana subsp. virginiana	-1	PRESENT
Lakeside	MHn46b	LONICANA	3 Shrub	Fly honeysuckle	Lonicera canadensis	-1	PRESENT
Lakeside	MHn46b	RHAMALNI	3 Shrub	Alder-leaved buckthorn	Rhamnus alnifolia	-1	PRESENT
Lakeside	MHn46b	ULMURUBR	3 Shrub	Slippery elm	Ulmus rubra	-1	PRESENT
Lakeside	MHn46b	ACER12S2	4 Seedling	Sugar maple	Acer saccharum	2	<1% (few 2-20)
Lakeside	MHn46b	BETU12AL	4 Seedling	Yellow birch	Betula alleghaniensis	2	<1% (few 2-20)
Lakeside	MHn46b	CARY12CO	4 Seedling	Bitternut hickory	Carya cordiformis	2	<1% (few 2-20)
Lakeside	MHn46b	FRAX12NI	4 Seedling	Black ash	Fraxinus nigra	2	<1% (few 2-20)
Lakeside	MHn46b	FRAX12PE	4 Seedling	Green ash	Fraxinus pennsylvanica	2	<1% (few 2-20)
Lakeside	MHn46b	ILEX12VE	4 Seedling	Winterberry	Ilex verticillata var. verticillata	2	<1% (few 2-20)
Lakeside	MHn46b	POPU12BA	4 Seedling	Balm-of-Gilead SE	Populus balsamifera	2	<1% (few 2-20)
Lakeside	MHn46b	TILI12AM	4 Seedling	Basswood	Tilia americana	2	<1% (few 2-20)
Lakeside	MHn46b	ULMU12AM	4 Seedling	American elm	Ulmus americana	2	<1% (few 2-20)
Lakeside	MHn46b	VIBU12LE	4 Seedling	Nannyberry	Viburnum lentago	2	<1% (few 2-20)
Lakeside	MHn46b	ACER12RU	4 Seedling	Red maple	Acer rubrum	1	Single (r)
Lakeside	MHn46b	CORN12RU	4 Seedling	Round-leaved dogwood	Cornus rugosa	1	Single (r)
Lakeside	MHn46b	PRUN12VI	4 Seedling	Chokecherry	Prunus virginiana	1	Single (r)
Lakeside	MHn46b	QUER12MA	4 Seedling	Bur oak	Quercus macrocarpa	1	Single (r)
Lakeside	MHn46b	VIBU12RA	4 Seedling	Downy arrow-wood	Viburnum rafinesquianum	1	Single (r)
Lakeside	MHn46b	CARP12CA	4 Seedling	Blue beech	Carpinus caroliniana subsp. virginiana	-1	PRESENT
Lakeside	MHn46b	CORN12AL	4 Seedling	Pagoda dogwood	Cornus alternifolia	-1	PRESENT
Lakeside	MHn46b	ULMU12RU	4 Seedling	Slippery elm	Ulmus rubra	-1	PRESENT
Lakeside	MHn46b	PARTVITA	4 Subshrub	Virginia creeper	Parthenocissus vitacea	2	<1% (few 2-20)
Lakeside	MHn46b	RUBUSSID	4 Subshrub	Red raspberry	Rubus idaeus subsp. idaeus	2	<1% (few 2-20)
Lakeside	MHn46b	ATHYVAAN	6 Herb	northern lady fern	Athyrium filix-femina var. angustum	5	>25-50%
Lakeside	MHn46b	LAPOCANA	6 Herb	Wood-nettle	Laportea canadensis	4	>5-25%

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHn46b	MATTSTRU	6 Herb	Ostrich-fern	Matteuccia struthiopteris var. pensylvanica	4	>5-25%
Lakeside	MHn46b	ARISTRIP	6 Herb	Jack-in-the-pulpit	Arisaema triphyllum	3	1-5% (many >20)
Lakeside	MHn46b	ASARCANA	6 Herb	Wild ginger	Asarum canadense varieties not recognized]	3	1-5% (many >20)
Lakeside	MHn46b	CIRCLUTE	6 Herb	Canada enchanter's nightshade	Circaea lutetiana var. canadensis	3	1-5% (many >20)
Lakeside	MHn46b	CRYPCANA	6 Herb	Honewort	Cryptotaenia canadensis	3	1-5% (many >20)
Lakeside	MHn46b	DRYOCART	6 Herb	Spinulose shield-fern	Dryopteris carthusiana	3	1-5% (many >20)
Lakeside	MHn46b	EURYMACR	6 Herb	big-leaf aster	Eurybia macrophylla	3	1-5% (many >20)
Lakeside	MHn46b	GALITRI2	6 Herb	Three-flowered bedstraw	Galium triflorum var. triflorum	3	1-5% (many >20)
Lakeside	MHn46b	HYDRVIRG	6 Herb	Virginia waterleaf	Hydrophyllum virginianum var. virginianum	3	1-5% (many >20)
Lakeside	MHn46b	IMPACAPE	6 Herb	Spotted touch-me-not	Impatiens capensis	3	1-5% (many >20)
Lakeside	MHn46b	ONOCSENS	6 Herb	Sensitive fern	Onoclea sensibilis	3	1-5% (many >20)
Lakeside	MHn46b	OSMUCLAY	6 Herb	Interrupted fern	Osmunda claytoniana	3	1-5% (many >20)
Lakeside	MHn46b	PHRYLEPT	6 Herb	Lopseed	Phryma leptostachya	3	1-5% (many >20)
Lakeside	MHn46b	RUBUPUBE	6 Herb	Dwarf raspberry	Rubus pubescens	3	1-5% (many >20)
Lakeside	MHn46b	SANGCANA	6 Herb	Bloodroot	Sanguinaria canadensis	3	1-5% (many >20)
Lakeside	MHn46b	SANIMARI	6 Herb	Mariland black snakeroot	Sanicula marilandica	3	1-5% (many >20)
Lakeside	MHn46b	VIOLSORO	6 Herb	Common blue violet	Viola sororia	3	1-5% (many >20)
Lakeside	MHn46b	VIOL_SPP	6 Herb	Violet	Viola sp.	3	1-5% (many >20)
Lakeside	MHn46b	ADIAPEDA	6 Herb	Maidenhair fern	Adiantum pedatum	2	<1% (few 2-20)
Lakeside	MHn46b	AGRIGRYP	6 Herb	Stickweed	Agrimonia gryposepala	2	<1% (few 2-20)
Lakeside	MHn46b	ALLITRIC	6 Herb	Wild leek	Allium tricoccum	2	<1% (few 2-20)
Lakeside	MHn46b	AMPHBRAC	6 Herb	Hog-peanut, falcata	Amphicarpaea bracteata	2	<1% (few 2-20)
Lakeside	MHn46b	ARALNUDI	6 Herb	Wild sarsaparilla	Aralia nudicaulis	2	<1% (few 2-20)
Lakeside	MHn46b	ARALRACE	6 Herb	American spikenard	Aralia racemosa	2	<1% (few 2-20)
Lakeside	MHn46b	BOTRVIRG	6 Herb	Rattlesnakefern	Botrychium virginianum	2	<1% (few 2-20)
Lakeside	MHn46b	CALTPALU	6 Herb	Swamp marsh-marigold	Caltha palustris	2	<1% (few 2-20)
Lakeside	MHn46b	CAULTHAL	6 Herb	Blue cohosh	Caulophyllum thalictroides	2	<1% (few 2-20)
Lakeside	MHn46b	CICUMACU	6 Herb	Spotted water-hemlock	Cicuta maculata	2	<1% (few 2-20)
Lakeside	MHn46b	CIRSMUTI	6 Herb	Swamp thistle	Cirsium muticum	2	<1% (few 2-20)
Lakeside	MHn46b	CLINBORE	6 Herb	Bluebead lily	Clintonia borealis	2	<1% (few 2-20)
Lakeside	MHn46b	DESMGLUT	6 Herb	Pointed-leaved tick-trefoil	Desmodium glutinosum	2	<1% (few 2-20)
Lakeside	MHn46b	DRYOCRIS	6 Herb	Crested fern	Dryopteris cristata	2	<1% (few 2-20)
Lakeside	MHn46b	EQUISYLV	6 Herb	Wood horsetail	Equisetum sylvaticum	2	<1% (few 2-20)
Lakeside	MHn46b	FRAGVIRG	6 Herb	Common strawberry	Fragaria virginiana	2	<1% (few 2-20)
Lakeside	MHn46b	GERAMACU	6 Herb	Wild geranium	Geranium maculatum	2	<1% (few 2-20)
Lakeside	MHn46b	GEUMCANA	6 Herb	White avens	Geum canadense	2	<1% (few 2-20)
Lakeside	MHn46b	GYMNDRYO	6 Herb	Common oak-fern	Gymnocarpium dryopteris	2	<1% (few 2-20)

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHn46b	MAIACANA	6 Herb	Canada mayflower	Maianthemum canadense	2	<1% (few 2-20)
Lakeside	MHn46b	MITENUDA	6 Herb	Naked miterwort	Mitella nuda	2	<1% (few 2-20)
Lakeside	MHn46b	OSMOCLAY	6 Herb	Clayton's sweet cicely	Osmorhiza claytonii	2	<1% (few 2-20)
Lakeside	MHn46b	PETAFRIG	6 Herb	Palmate sweet coltsfoot	Petasites frigidus var. palmatus	2	<1% (few 2-20)
Lakeside	MHn46b	POLYPUBE	6 Herb	Hairy Solomon's-seal	Polygonatum pubescens	2	<1% (few 2-20)
Lakeside	MHn46b	PRENALBA	6 Herb	White rattlesnake-root	Prenanthes alba	2	<1% (few 2-20)
Lakeside	MHn46b	RANURECU	6 Herb	Hooked crowfoot	Ranunculus recurvatus var. recurvatus	2	<1% (few 2-20)
Lakeside	MHn46b	SCUTLATE	6 Herb	Mad-dog skullcap	Scutellaria lateriflora	2	<1% (few 2-20)
Lakeside	MHn46b	SOLIFLEX	6 Herb	Zig-zag goldenrod	Solidago flexicaulis	2	<1% (few 2-20)
Lakeside	MHn46b	SOLIGIGA	6 Herb	Giant goldenrod	Solidago gigantea	2	<1% (few 2-20)
Lakeside	MHn46b	STRELANC	6 Herb	rosy twisted stalk	Streptopus lanceolatus	2	<1% (few 2-20)
Lakeside	MHn46b	SYMPLATE	6 Herb	calico aster	Symphyotrichum lateriflorum	2	<1% (few 2-20)
Lakeside	MHn46b	TRILCERN	6 Herb	Nodding trillium	Trillium cernuum	2	<1% (few 2-20)
Lakeside	MHn46b	URTIDIOI	6 Herb	Stinging nettle	Urtica dioica	2	<1% (few 2-20)
Lakeside	MHn46b	VIOLCANA	6 Herb	Rugulose violet	Viola canadensis var. rugulosa	2	<1% (few 2-20)
Lakeside	MHn46b	ACTARUBR	6 Herb	Red baneberry	Actaea rubra	1	Single (r)
Lakeside	MHn46b	GALITRI1	6 Herb	Three-cleft bedstraw	Galium trifidum var. trifidum	1	Single (r)
Lakeside	MHn46b	LACT_SPP	6 Herb	wild lettuce species	Lactuca sp.	1	Single (r)
Lakeside	MHn46b	STACPALU	6 Herb	Woundwort	Stachys palustris	1	Single (r)
Lakeside	MHn46b	TARAOFFI	6 Herb	Common dandelion	Taraxacum officinale	1	Single (r)
Lakeside	MHn46b	BIDECERN	6 Herb	Nodding bur-marigold	Bidens cernua	-1	PRESENT
Lakeside	MHn46b	BIDEFRON	6 Herb	Leafy beggar-ticks	Bidens frondosa	-1	PRESENT
Lakeside	MHn46b	CIRCALPI	6 Herb	Small enchanter's nightshade	Circaea alpina var. alpina	-1	PRESENT
Lakeside	MHn46b	EPILPALU	6 Herb	Marsh willow-herb	Epilobium palustre	-1	PRESENT
Lakeside	MHn46b	EQUIFLUV	6 Herb	Water horsetail	Equisetum fluviatile	-1	PRESENT
Lakeside	MHn46b	EQUIPRAT	6 Herb	Meadow horsetail	Equisetum pratense	-1	PRESENT
Lakeside	MHn46b	GALI_SPP	6 Herb	Bedstraw; Cleavers	Galium sp.	-1	PRESENT
Lakeside	MHn46b	GEUMVAST	6 Herb	Yellow avens	Geum aleppicum var. strictum	-1	PRESENT
Lakeside	MHn46b	IRISVERS	6 Herb	Northern blue Flag	Iris versicolor	-1	PRESENT
Lakeside	MHn46b	LEMNMINO	6 Herb	Lesser duckweed	Lemna minor	-1	PRESENT
Lakeside	MHn46b	LYCOAMER	6 Herb	Cut-leaved bugleweed	Lycopus americanus	-1	PRESENT
Lakeside	MHn46b	LYCOUNIF	6 Herb	Northern bugleweed	Lycopus uniflorus	-1	PRESENT
Lakeside	MHn46b	MITEDIPH	6 Herb	Two-leaved miterwort	Mitella diphylla	-1	PRESENT
Lakeside	MHn46b	PERSARIF	6 Herb	halberd-leaf tearthumb	Persicaria arifolia	-1	PRESENT
Lakeside	MHn46b	RANUABOR	6 Herb	Kidney-leaf buttercup	Ranunculus abortivus	-1	PRESENT
Lakeside	MHn46b	SIUMSUAV	6 Herb	Water-parsnip	Sium suave	-1	PRESENT
Lakeside	MHn46b	SPIRPOLY	6 Herb	Greater duckweed	Spirodela polyrhiza	-1	PRESENT
Lakeside	MHn46b	THALDIOI	6 Herb	Early meadow-rue	Thalictrum dioicum	-1	PRESENT
Lakeside	MHn46b	TYPHLATI	6 Herb	Broad-leaved cattail	Typha latifolia	-1	PRESENT
Lakeside	MHn46b	UVULGRAN	6 Herb	Yellow bellwort	Uvularia grandiflora	-1	PRESENT

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	MHn46b	UVULSESS	6 Herb	Pale bellwort	Uvularia sessilifolia	-1	PRESENT
Lakeside	MHn46b	CARE_SPP	7 Graminoid	Sedge	Carex sp.	4	>5-25%
Lakeside	MHn46b	CAREINTU	7 Graminoid	Bladder sedge	Carex intumescens	3	1-5% (many >20)
Lakeside	MHn46b	CAREPEDU	7 Graminoid	Long-stalked sedge	Carex pedunculata	3	1-5% (many >20)
Lakeside	MHn46b	CAREPROJ	7 Graminoid	Projecting sedge	Carex projecta	3	1-5% (many >20)
Lakeside	MHn46b	CINNLATI	7 Graminoid	Drooping woodreed	Cinna latifolia	3	1-5% (many >20)
Lakeside	MHn46b	ELYMHYST	7 Graminoid	Bottlebrush grass	Elymus hystrix	3	1-5% (many >20)
Lakeside	MHn46b	FESTSUBV	7 Graminoid	Nodding fescue	Festuca subverticillata	3	1-5% (many >20)
Lakeside	MHn46b	BRACEREC	7 Graminoid	Bearded shorthusk	Brachyelytrum erectum	2	<1% (few 2-20)
Lakeside	MHn46b	CARERADI	7 Graminoid	Stellate sedge	Carex radiata	2	<1% (few 2-20)
Lakeside	MHn46b	CINNARUN	7 Graminoid	Stout woodreed	Cinna arundinacea	2	<1% (few 2-20)
Lakeside	MHn46b	MILIEFFU	7 Graminoid	Woodland millet grass	Milium effusum var. cisatlanticum	2	<1% (few 2-20)
Lakeside	MHn46b	POACEAE	7 Graminoid	Unknown grass	Poaceae (unknown	2	<1% (few 2-20)
Lakeside	MHn46b	CALACANA	7 Graminoid	Bluejoint grass	Calamagrostis canadensis	0	Outside Plot
Lakeside	MHn46b	CARELACU	7 Graminoid	Lake-sedge	Carex lacustris	0	Outside Plot
Lakeside	MHn46b	GLYCVAGR	7 Graminoid	Tall manna-grass	Glyceria grandis var. grandis	-1	PRESENT
Lakeside	MHn46b	GLYCSTRI	7 Graminoid	Fowl manna-grass	Glyceria striata	-1	PRESENT
Lakeside	MHn46b	LUZUACUM	7 Graminoid	Pointed wood-rush	Luzula acuminata var. acuminata	-1	PRESENT
Lakeside	WFn55b	FRAX69NI	1 Canopy	Black ash, T	Fraxinus nigra	-1	PRESENT
Lakeside	WFn55b	TILI69AM	1 Canopy	Basswood, T	Tilia americana	-1	PRESENT
Lakeside	WFn55b	QUER15MA	2 Understory	Bur oak, U	Quercus macrocarpa	-1	PRESENT
Lakeside	WFn55b	ACERNEGU	3 Shrub	Box elder	Acer negundo	-1	PRESENT
Lakeside	WFn55b	FRAX12NI	4 Seedling	Black ash	Fraxinus nigra	-1	PRESENT
Lakeside	WFn55b	ULMU12RU	4 Seedling	Slippery elm	Ulmus rubra	-1	PRESENT
Lakeside	WFn55b	PARTVITA	4 Subshrub	Virginia creeper	Parthenocissus vitacea	-1	PRESENT
Lakeside	WFn55b	RUBUSSID	4 Subshrub	Red raspberry	Rubus idaeus subsp. idaeus	-1	PRESENT
Lakeside	WFn55b	PERSARIF	6 Herb	halberd-leaf tearthumb	Persicaria arifolia	2	<1% (few 2-20)
Lakeside	WFn55b	ATHYVAAN	6 Herb	northern lady fern	Athyrium filix-femina var. angustum	-1	PRESENT
Lakeside	WFn55b	BIDECERN	6 Herb	Nodding bur-marigold	Bidens cernua	-1	PRESENT
Lakeside	WFn55b	CALTPALU	6 Herb	Swamp marsh-marigold	Caltha palustris	-1	PRESENT
Lakeside	WFn55b	CICUMACU	6 Herb	Spotted water-hemlock	Cicuta maculata	-1	PRESENT
Lakeside	WFn55b	CIRCALPI	6 Herb	Small enchanter's nightshade	Circaea alpina var. alpina	-1	PRESENT
Lakeside	WFn55b	CIRCLUTE	6 Herb	Canada enchanter's nightshade	Circaea lutetiana var. canadensis	-1	PRESENT
Lakeside	WFn55b	CLINBORE	6 Herb	Bluebead lily	Clintonia borealis	-1	PRESENT
Lakeside	WFn55b	CRYPCANA	6 Herb	Honewort	Cryptotaenia canadensis	-1	PRESENT
Lakeside	WFn55b	DRYOCART	6 Herb	Spinulose shield-fern	Dryopteris carthusiana	-1	PRESENT
Lakeside	WFn55b	EPILPALU	6 Herb	Marsh willow-herb	Epilobium palustre	-1	PRESENT
Lakeside	WFn55b	EQUISYLV	6 Herb	Wood horsetail	Equisetum sylvaticum	-1	PRESENT
Lakeside	WFn55b	EUTRMACU	6 Herb	spotted joe-pye-weed	Eutrochium maculatum	-1	PRESENT
Lakeside	WFn55b	GERAMACU	6 Herb	Wild geranium	Geranium maculatum	-1	PRESENT

Aitkin County Land Dept. Table 4: Species lists of vascular plants observed within NPC Types. Sorted by Site Name, NPC type code, Structural Code, Abundance Code (descending) and Scientific Name.

Site Name	NPC Code	SYN_CODE	Structural Layer	Common Name	Scientific Name	Abun Code	Abundance
Lakeside	WFn55b	GEUMVAST	6 Herb	Yellow avens	Geum aleppicum var. strictum	-1	PRESENT
Lakeside	WFn55b	GEUMCANA	6 Herb	White avens	Geum canadense	-1	PRESENT
Lakeside	WFn55b	HALEDEFL	6 Herb	Spurred gentian	Halenia deflexa var. deflexa	-1	PRESENT
Lakeside	WFn55b	IMPACAPE	6 Herb	Spotted touch-me-not	Impatiens capensis	-1	PRESENT
Lakeside	WFn55b	LAPOCANA	6 Herb	Wood-nettle	Laportea canadensis	-1	PRESENT
Lakeside	WFn55b	LILIMICH	6 Herb	Michigan lily	Lilium michiganense	-1	PRESENT
Lakeside	WFn55b	LYCOUNIF	6 Herb	Northern bugleweed	Lycopus uniflorus	-1	PRESENT
Lakeside	WFn55b	MATTSTRU	6 Herb	Ostrich-fern	Matteuccia struthiopteris var. pensylvanica	-1	PRESENT
Lakeside	WFn55b	MITEDIPH	6 Herb	Two-leaved miterwort	Mitella diphylla	-1	PRESENT
Lakeside	WFn55b	ONOCSENS	6 Herb	Sensitive fern	Onoclea sensibilis	-1	PRESENT
Lakeside	WFn55b	PERSSAGI	6 Herb	arrow-leaf tearthumb	Persicaria sagittata	-1	PRESENT
Lakeside	WFn55b	RUBUPUBE	6 Herb	Dwarf raspberry	Rubus pubescens	-1	PRESENT
Lakeside	WFn55b	SANIMARI	6 Herb	Mariland black snakeroot	Sanicula marilandica	-1	PRESENT
Lakeside	WFn55b	SANI_SPP	6 Herb	Black Snakeroot	Sanicula sp.	-1	PRESENT
Lakeside	WFn55b	SCUTLATE	6 Herb	Mad-dog skullcap	Scutellaria lateriflora	-1	PRESENT
Lakeside	WFn55b	SIUMSUAV	6 Herb	Water-parsnip	Sium suave	-1	PRESENT
Lakeside	WFn55b	SOLIGIGA	6 Herb	Giant goldenrod	Solidago gigantea	-1	PRESENT
Lakeside	WFn55b	STACPALU	6 Herb	Woundwort	Stachys palustris	-1	PRESENT
Lakeside	WFn55b	SYMPLATE	6 Herb	calico aster	Symphyotrichum lateriflorum	-1	PRESENT
Lakeside	WFn55b	SYMPPUNI	6 Herb	purple-stem aster	Symphyotrichum puniceum var. puniceum	-1	PRESENT
Lakeside	WFn55b	TYPHLATI	6 Herb	Broad-leaved cattail	Typha latifolia	-1	PRESENT
Lakeside	WFn55b	BRACEREC	7 Graminoid	Bearded shorthusk	Brachyelytrum erectum	-1	PRESENT
Lakeside	WFn55b	CAREBROM	7 Graminoid	Brome-like sedge	Carex bromoides [subsp. unknown]	-1	PRESENT
Lakeside	WFn55b	CARECRIS	7 Graminoid	Crested sedge	Carex cristatella	-1	PRESENT
Lakeside	WFn55b	CARELUPU	7 Graminoid	Hop-sedge	Carex lupulina	-1	PRESENT
Lakeside	WFn55b	CAREPROJ	7 Graminoid	Projecting sedge	Carex projecta	-1	PRESENT
Lakeside	WFn55b	CARERADI	7 Graminoid	Stellate sedge	Carex radiata	-1	PRESENT
Lakeside	WFn55b	CARESTIP	7 Graminoid	Awl-fruited sedge	Carex stipata var. stipata	-1	PRESENT
Lakeside	WFn55b	CINNARUN	7 Graminoid	Stout woodreed	Cinna arundinacea	-1	PRESENT
Lakeside	WFn55b	ELYMHYST	7 Graminoid	Bottlebrush grass	Elymus hystrix	-1	PRESENT
Lakeside	WFn55b	GLYCVAGR	7 Graminoid	Tall manna-grass	Glyceria grandis var. grandis	-1	PRESENT
Lakeside	WFn55b	GLYCSTRI	7 Graminoid	Fowl manna-grass	Glyceria striata	-1	PRESENT
Lakeside	WFn55b	PHALARUN	7 Graminoid	Reed canary-grass	Phalaris arundinacea	-1	PRESENT
Lakeside	WFn55b	SCIRATR2	7 Graminoid	Dark green bulrush	Scirpus atrovirens	-1	PRESENT
Lakeside	WFn55b	SCIRCYPE	7 Graminoid	Wool-grass	Scirpus cyperinus	-1	PRESENT

Aitkin County Land Dept.
Table 5: Waypoint Sample Descriptions, ECS Field Survey 2011 (sorted by Site Name and Waypoint #).

WYPT #	NPC Code	Site Name	NPC Name	General Description
5	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. Managed dry-mesic oak-Basswood forest (MHn35b) selectively logged of over-mature oaks leaving isolated stand of mature red oaks and Basswood with maturing sugar maple and paper birch. Canopy 25M tall, 75% cover, mode DBH 35-45 cm with smaller maples and Basswood common. Max trees absent (stumps to 85 cm). Subcanopy partial 25-35% cover, multiple layers, 2 - 10 m tall mostly sparsely dispersed throughout - never thick. Shrub layer (saplings) patchy with locally dense maples and ironwood within notable canopy gap. Shrubs thinly dispersed beneath oaks. Diverse dry-mesic flora with common trillium, sessile bellwort. Pennsylvania sedge patchy thick. Rich herbs and shrubs attributed to thin cap-layer of calcareous silt (wind-blown Des Moines lobe (loess)). Low lying moraine ridge dissected by outwash (now peat swamp). Superior lobe characterized by coarse sandy loam with greenstone and granite. Boulder at surface but infrequent. C-horizon densely compacted coarse red sand. Well-drained. Fresh. CWD: 25% recently cut tops, broken limbs and old decayed trunks BA (x10): 150, Snags: 3, infrequent, Tipups: absent in plot; rare - infrequent elsewhere Managed forest selectively logged. Understory patchy-dense but mostly thinly dispersed. Pen sedge patchy. Outside plot with ancient tipup mounds 2-3 ft, silty. UTM Zone 15 East461135.607868 North 5125255.259086 Lat 46.279769 Long -93.504471
6	MHn46b	Lakeside	MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest	Lakeside management unit. Lakeside Aitkin Co. Edge of oval-linear depression on moraine ridge bearing NW to SE. Standing water from recent rains. Dense cover of lake sedge, open canopy (25-50% cover) of black ash dbh 20-30 cm. Shrubs infrequent on border with speckled alder, Ilex spp. And young red elm. Low forest surrounding wetland with somewhat poorly drained soils on toe slope. MHn46 narrow width but variable. UTM Zone 15 East461066.257404 North 5125193.142131 Lat 46.279206 Long -93.505366
7	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. Narrow band of MHc36 rich forest on toe slope of moraine. Concave slope, level cross slope, except with slight rises from ancient tipup mounds and irregularities. Deep organic layer with no worms present. A horizon absent. E horizon is a silty cap over silty clay and clayey coarse sand. Dominated by maple-Basswoods. Canopy 20-25 m tall, several snags, cover 85%, mode DBH 20-30 cm; max infrequent to locally common 35-45 cm DBH. Subcanopy with abundant ironwood and maple. Rich herb flora and graminoids. Mesic but not wet-mesic. Waypoint 7b: Small clear-cut 1-5 acres parallel to basin margin. On slight rise of lower slope (convex). Level 5% gradient. Opening 5x longer than wide. 40x200 m area. Tall canopy borders on east edge. Open sunlight promoting rank growth of forbs and graminoids. Patchy saplings of ironwood and maple. Forest swamp margin: includes sugar maple 85cm dbh. Much of the area has been high graded to remove mature, old red oak. Toe slope of moraine, margin of wet basin. Foot slope (MHn35) moderately well drained. Toe slope somewhat poorly drained and (MHc36) proper. Thin wet margin of MHn46. Dark organic silt to 15 cm deep on silt cap over clay bands and clayey silt. C horizon coarse red-brown sand. CWD: 1-5%: mostly very decayed branches and trunks, small to large. BA(x10):, Snags: 4 BH, Tipups occasional to infrequent - large trees Common mesic herbs such as bloodroot. UTM Zone 15 East461006.572483 North 5125064.294264 Lat 46.278043 Long -93.50613

Aitkin County Land Dept.
Table 5: Waypoint Sample Descriptions, ECS Field Survey 2011 (sorted by Site Name and Waypoint #).

WYPT #	NPC Code	Site Name	NPC Name	General Description
7	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. Narrow band of MHc36 rich forest on toe slope of moraine. Concave slope, level cross slope, except with slight rises from ancient tipup mounds and irregularities. Deep organic layer with no worms present. A horizon absent. E horizon is a silty cap over silty clay and clayey coarse sand. Dominated by maple-Basswoods. Canopy 20-25 m tall, several snags, cover 85%, mode DBH 20-30 cm; max infrequent to locally common 35-45 cm DBH. Subcanopy with abundant ironwood and maple. Rich herb flora and graminoids. Mesic but not wet-mesic. Waypoint 7b: Small clear-cut 1-5 acres parallel to basin margin. On slight rise of lower slope (convex). Level 5% gradient. Opening 5x longer than wide. 40x200 m area. Tall canopy borders on east edge. Open sunlight promoting rank growth of forbs and graminoids. Patchy saplings of ironwood and maple. Forest swamp margin: includes sugar maple 85cm dbh. Much of the area has been high graded to remove mature, old red oak. Graminoid cover 75-100%; shrub cover 25-50%, forb cover 25%. Toe slope of moraine, margin of wet basin. Foot slope (MHn35) moderately well drained. Toe slope somewhat poorly drained and (MHc36) proper. Thin wet margin of MHn46. Dark organic silt to 15 cm deep on silt cap over clay bands and clayey silt. C horizon coarse red-brown sand. CWD: 1-5%: mostly very decayed branches and trunks, small to large. BA(x10):, Snags: 4 BH, Tipups occasional to infrequent - large trees Common mesic herbs such as bloodroot. UTM Zone 15 East461006.572483 North 5125064.294264 Lat 46.278043 Long -93.50613
8	2.4	Lakeside	2.4 = Non-Natural Community System / Open, Non-Developed / Clearcuts, Blow-Downs	Lakeside management unit. Frequent blowdowns with broken trunks. Additional species to toe slope. Waypoint 5-7 is largely a maple Basswood forests with oaks high-graded (cut) except in rare locations. However patchy openings and interrupted canopies cover 75-85%. With a partial subcanopy cover 5-25%, allows likely recruitment of red oaks while maintaining biodiversity of shrub, forb and graminoid flora. UTM Zone 15 East460921.043639 North 5125063.174152 Lat 46.278028 Long -93.50724
21	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. High silt content and deep organic A horizon promotes species richness approaching MHc36. Mesic MHn35b dominated by red oak, Basswood and sugar maple within an open canopy from periodic wind events. Tipups at all stages of decay including very large ancient mounds suggesting former pine canopy. Recent demise of paper birch canopy and several open grown large trees suggest woodland origins of stand. Canopy cover 50-75%, crowns 20-25 m tall. Bimodal DBH with 20-30 cm and 35-50 cm trees with nearly equal coverage. Subcanopy 75-100% nearly closed but allowing filtered, mottled light to substrate, dominated by ironwood with <5% coverage of maples. Heterogeneous distribution of forbs with rich diversity amid a nearly closed carpet of Pennsylvania sedge. Several central species present but with northern elements as well. Oval-shaped knoll sloping from all sides of plot bounded on north by road ditch. Supraglacial cap of brown very fine sandy silt with a B horizon of silty very fine sand and weak clay nodules. Deep A horizon yielded from sedge roots - possibly worms, but none seen. Glacial erratics 0.5 - 1 m dia, <1%, gravel and cobbles 5% in profile. BA(x10): 70, CWD: 20% Description: Tipups , large and small all stages of decay, Sand pit - 2 x 4 ma/a, Snags: 0/1, Ancient tipups - abundant 2-4' deep, Sand pit 2 x 4 ma/a (?) Ancient tipup mounds with deep microdepressions from large trees now fully decayed (2 - 4 feet depth). Several very decayed birch trunks on surface (8-12 " DBH); one paper birch snag outside of plot. UTM Zone 15 East460745.404788 North 5126445.593319 Lat 46.290459 Long -93.509635

WYPT #	NPC Code	Site Name	NPC Name	General Description
22	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. Immature to maturing bur oak and red oak. Canopy 15-20 m tall, DBH 15-25 cm with some trees to 29 cm. Cover 85% allowing patchy, mottled light to substrate. Subcanopy of mature ironwood and young red elm, patchy with large gaps. Shrub and seedlings patchy to thinly dispersed throughout. Forbs patchy thick, diverse species, frequent distribution. Associated with wet-mesic species from adjacent WFn55 swale. Excellent oak regeneration. Gentle foot slope of rolling moraine near perched wet meadow and WFn55 swale. Lower slope, somewhat poorly drained silt over clayey loam with clay bands. B2 horizon with gleyed clay and oxidized iron deposits. Moist, but no standing water in soil pit. BA(x10): 50, CWD: 1-5% Description: small limbs, trunks, one very large, very decayed bole, Snags: 1/1 - old large ironwood Immature and maturing oak stand nearly lacking subcanopy. Charcoal in A horizon. Small hook worms present., DBHs:, Bur oak: 19,20,28,24 cm, Red Oak: 29,23,27 cm, Black ash: 25 cm Basswood: 22 cm, (13 cm in understory) UTM Zone 15 East460786.996296 North 5126348.987685 Lat 46.289592 Long -93.509087
23	MHn46b	Lakeside	MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest	Lakeside management unit. Wet mesic deciduous forest on level to undulating crest of moraine, with micro rises and lows. Dominated by black ash with Basswood. Crowns 20-25 m tall, canopy 75-100% cover. Subcanopy 25-50% with sugar maple, crowns 5-10m tall. Red elm present. Shrub and seedling layer nearly absent. Herb layer lush, very diverse, all species nearly frequent throughout except swamp species, which are at margin of black ash swamp and in small wet swales/depressions. Fern species of ostrich and lady fern dominate large patches within a heterogeneous mosaic. Many diverse forbs in patches between ferns . Wood nettle abundant throughout (thinly dispersed in plot but dominating other MHn46 areas). Patterns suggest perched water in spring causing disturbances promoting annuals and weedy ferns. Level, undulating moraine top with perched wetlands/swamps and flowing rivulets or intermittent streams. Highly variable micro lows and rises (1-2 ft) with small rises and knolls 2-3 ft. Low area border of black ash swamp. Poorly drained, sapric peat over gleyed clay with iron deposits (oxidized). Boulders 0.25 - 3.5 m dia at surface <1%. No standing water; depth to water 36 cm. BA(x10): 120, CWD: 5% Description: Large decayed tipups, old very decayed stumps, Snags: 0/0 UTM Zone 15 East460937.383105 North 5126292.465208 Lat 46.289092 Long -93.50713

WYPT #	NPC Code	Site Name	NPC Name	General Description
24	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. Mesic upland forest (MHn35b) trending toward (MHc36). Relic red oak (DBH 40-50 cm) with younger sugar maple and Basswood succeeding small stand of paper birch and aspen (both species dead and litter substrate and/or snags). Crowns 20-30 m tall, canopy 80% cover, DBH 20-50 cm with a median size (35 cm DBH). Subcanopy with several layers of sugar maple (2-15 m plus), 80-90% cover (note sunlight reaches substrate from small patches; also small depressions and cut area/trail nearby). Shrub layer sparse 1-5% with sugar maple, ironwood, yellow birch and beaked hazel. Seedling layer sparse <25%, thinly dispersed. Forb layer 25-50%; most species are frequent throughout including several spikenard, trillium, rattlesnake fern, etc. Silt cap contributes to species abundance. Worms in humus. Edge of high ridge; plot on either interfluve or rim of ice-block depression, aspect sloping ENE and WSW about 8% gradient. Supraglacial deposits of fine silt with cobbles over hardpan fine sandy-clay loam and rock. Moderately well-drained upper horizon (A,E) with saturated soil above Bt horizon. Boulders scattered at surface. Small worms have eliminated humus layer. BA(x10): 120, CWD: 5-10%, Snags: 3/5: tipups infrequent; ancient tipups, common, 1-2' relief, Description: small to medium trees, decayed birch, ash Infrequent to occasional modern tipups of paper birch. Ancient tipups common with 1-2' relief between saddles and microdepressions. CWD 5-10% comprised of very decayed to medium decayed birch and ash. A seedling of Carya cordiformis observed within plot. Water seeping into pit due to perched depressions and recent rain., DBH:, Red oak: 49,43 cm, Sugar maple: 27,41,37,21,35,20,20,29 cm Basswood: 42,32 cm UTM Zone 15 East460442.014011 North 5125664.840633 Lat 46.283415 Long -93.513507
25	MHn35a	Lakeside	MHn35a = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Aspen - Birch - Basswood Forest	Lakeside management unit. Dry-mesic on excessively drained knoll with perched depressions capable of holding water (MHn35a). Canopy 70-85% cover (reduced by recent selective logging of red oaks). Dominated by Basswoods, sugar maples with infrequent large paper birch (many dead and dying). Pignut or yellow-bud hickory present in canopy and seedling layers. Partial subcanopy 25-50% cover with several layers. Open enough to let patchy light to substrate. Shrub/seedling layer dense with tall raspberries, shrubs and seedlings. Tall lush forbs (tick tre-foil, Joe-Pye weed, zig-zag goldenrod.) Most species very frequent to common Substrate dominated by pens sedge and other graminoids. Irregular micro relief from common tipup mounds with 1-2' relief. Highest knoll on irregularly shaped moraine with various slopes at all aspects, pocked with depressions (some holding water after recent rains). Excessively well-drained. Cap of supraglacial deposits of fine silt and cobblestones (5-25 cm dia) over red-brown very fine sand and clayey sandy loam with unsorted gravel, rock fragments, etc. Bt horizon hard pan with clay loam. BA(x10): 120, CWD: 5-20%, Snags: 0/3, Description: tree tops, ancient tipup mounds common (1-2' relief); no modern tipups; stumps frequent Recently, selectively logged to remove oaks and a few Basswoods. Canopy 70-85% cover. Release of tall herbs (raspberries), seedlings, shrubs and forbs. Earthworms observed. No humus., DBH:, Bitternut hickory: 29 cm Basswood: 32,35,39 cm, Sugar maple: 44,39,14,27 cm, Paper birch: 30 cm UTM Zone 15 East460482.569022 North 5125634.355082 Lat 46.283143 Long -93.512979

WYPT #	NPC Code	Site Name	NPC Name	General Description
26	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. MHc36a inclusion. Wet micro-depressions on mid-slope tread of moraine ridge descending toward tunnel valley wetland. Wet-mesic moderately to somewhat poorly drained with standing water in micro-depressions following recent rain. Canopy 50-75% cover (selectively logged), crowns 20-25 (30)m tall; Mode DBH 25-35 cm, subcanopy crowns 2-10 m tall; 25-75% cover, shrub/seedling layer patchy to sparse 5-25% cover. Forb cover 75-100% cover, dominated by abundant lady fern, maidenhair fern, and ostrich fern. Large snags occassional 2/8, CWD 1-5% with local brush piles. Large trunks to very decayed medium to small birch. UTM Zone 15 East460561.78683 North 5125530.172135 Lat 46.28221 Long -93.511941
27	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. Rich, mesic with wet-mesic inclusions (MHc36b) dominated by Basswood, sugar maple and with large paper birch (40 cm DBH). Small area of closed canopy surrounded by trails and partial cuts. Somewhat poorly drained, silt over clayey, sandy loam with high chroma mottles. Canopy 25-30 m tall, 95% cover, mode DBH 25-35 cm; frequent max 40-60 cm DBH. Subcanopy 2-20 m tall, several distinct layers dominated by sugar maple and ironwood. Shrub/seedling layer sparse. Diverse fern and herb layer 25-50% cover, graminoids rare 1-5%. Bare ground 50-75%. Rattlesnake orchid present. Outwash tread on lower slope near tunnel valley wetland. Supraglacial silt over clayey loam (very fine, fine red sand). Somewhat poorly drained with bright high chroma mottles near surface. B2 horizon with bright, large high-chroma mottles, water seeping between B1/B2 face. Small boulders (0.25 - 0.5 m dia) are occasional. BA(x10): 180, Snags: 0/1, CWD: 10-20%, Description: tree tops, large birch, small trees all stages of decay, Ancient tipup mounds: occasional 1-3' relief - No modern tipup mounds Diverse forb and fern species. All species frequent to locally common. Earthworms evident but not observed. Coarse woody debris 10-20% with tops of selectively logged trees, branches, small to medium logs of birch. All stages of decay. Old tipup mounds to 3 ft. relief. Depression with sensitive fern. Yellow-bud (bitternut) hickory seedlings infrequent., DBH: , Red maple: 53, 31 cm UTM Zone 15 East460551.096887 North 5125365.789159 Lat 46.28073 Long -93.512066
28	WFn55b	Lakeside	WFn55b = Wet Forest System / Northern Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Basswood Swamp (Eastcentral)	Lakeside management unit. Black Ash Swamp. Canopy 15-25 m tall, 50-75% cover. DBH 15-60 cm dominated by black ash. UTM Zone 15 East460729.863498 North 5125897.883651 Lat 46.285529 Long -93.509791

WYPT #	NPC Code	Site Name	NPC Name	General Description
71	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. Mesic central/northern deciduous forest dominated by sugar maple with Basswood, big-toothed aspen, bitternut hickory and red oak. Canopy 75-85% cover with occasional gaps from snags and down trees. Crown 25-30 m tall, DBH 25-55 cm with mode 30-40 cm DBH. Subcanopy in multiple layers (2-20 m tall) with musclewood, ironwood and sugar maple. Shrub layer sparse with sugar maple, musclewood and leatherleaf. Seedling layer sparse to patchy. Diverse forb layer with several central species (e.g. tick trefoil) and northern herbs (rosy twisted-stalk). Rich diverse forest on moderately well drained silt over clay hardpan with seasonal hydric indicators suggesting perched spring water. Abundant musclewood and bitternut hickory in canopy. Supraglacial deposits of large cobbles with silt over clayey silt above a Bt layer of silty clay. C horizon yellow-red loamy very fine sand, hard packed. B1 horizon clayey silt with 5-20% yellow-red mottles above B2 (Bt) layer (between 59-75 cm depth). Large boulders 0.5 - 1.5 m dia, occasional. BA(x10): 150, CWD: 1-5% Desc: small limbs, one decayed downed tree, Ancient tipups: infrequent to occasional, relief <1 ft, Modern tipups: Worm damage: from west of management unit to plot is decreasingly bad (mull) to moderately impacted with mixed, non-stratified moder humus. Goodyera tessalata - frequent. UTM Zone 15 East460792.254498 North 5124468.081168 Lat 46.272665 Long -93.508862
72	MHn46b	Lakeside	MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest	Lakeside management unit. WFn55 black ash swamp within small 1-2 acre depression on tread of lower slope above outwash valley. Standing water from recent rains with duck weed. Canopy 25-50% cover; 10-35 cm dbh, crowns 5-25 m tall. Red maple DBH 75 cm. Broad MHn46 border around margins of seasonally wet WFn55. Inclusion with MHc36. UTM Zone 15 East460851.437415 North 5124709.380135 Lat 46.27484 Long -93.508114
73	MHn46b	Lakeside	MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest	Lakeside management unit. Small inclusion within level depression on midslope tread. Somewhat poorly drained. Sapric humus over clayey silt, silt and red-mottled "B" horizon at 47 cm deep. Canopy 25-30 m tall; canopy 80-90% cover, DBH 25-65 cm. UTM Zone 15 East460677.042534 North 5124549.381228 Lat 46.27339 Long -93.510364
74	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. Dry-mesic mixed hardwoods. Silt cap over red-brown very fine loamy sand mixed with coarse sand and gravel. Well-drained, weak B horizon. Canopy 90-95% cover, crowns 25-30 m tall, DBH 20-45, mode 25-35 cm. Subcanopy in multi-layers, 2-15 m tall, 50-75%, cover dominated by sugar maple and ironwood. Shrub layer with mostly sugar maple and ironwood, but hornbeam (Carpinus caroliniana) present. Seedling layer sparse <25% mesic herbs, infrequent, low numbers, poorly dispersed. Penn sedge patchy to continuous. Well-drained supraglacial cap of silt with (1-10%) cobbles over silty very fine sand (red-brown) with 10-20% coarse sand and gravel. B horizon with weak mottles (iron oxide; 1-5%); weakly cemented clay nodules within loamy, very fine sand. Well-developed moder, non-stratified, mixed by observed small worms. BA(x10): 130, Snags: 0/1, CWD: 5-10% Desc.: small limbs, very decayed trees, Ancient tipups: occasional - frequent, 0-1" relief Nose ridge between two small clear-cut openings with E aspect. Compare with WYP #75. Ancient tipup mounds - occasional to frequent. Shallow relief (<1 ft). UTM Zone 15 East460927.930548 North 5124465.545139 Lat 46.27265 Long -93.507101

WYPT #	NPC Code	Site Name	NPC Name	General Description
75	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. Recent clear-cut of MHn35/MHc36 forest. Small opening (40 m diameter), few (<1%) subcanopy of sugar maple and ironwood. Shrub/seedling layer 1-5% cover with big-toothed aspen, maple, ironwood, green ash and red oak seedlings (3 seedlings in 400 sq m (11.28 dia)). Dense tall herbs (0.75 - 1.25 m tall) dominated by red raspberry, tall goldenrod, Canada thistle, nettle, etc. Plot includes some wet/wet-mesic forbs and grasses: (Glyceria striata, marsh milkweed, Scutellaria, etc.). Mesic woodland species frequent beneath dense herbs (~ 25 % cover). Adjacent to WPT #74: see soils. BA(x10): 0, Snags 0/0, CWD: 10-20% Clear-cut with dense herbs. Few oak seedlings. UTM Zone 15 East460945.324931 North 5124486.546049 Lat 46.27284 Long -93.506877
76	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. Rich MHc36 dominated by Basswood with several trees. Canopy closed (95%), crowns (20) - 30 m tall; DBH 20-50 cm, all age classes. Abundant large Basswood. Tall serviceberry but with sparse lower strata (2-20 m tall) some trees just beneath canopy. Shrub layer sparse to nearly absent; leatherleaf and maple (ironwood and Basswood stump sprouts only observed). Herb layer partial, thinly dispersed, many mesic forbs are frequent to locally common (wild leek). Unfortunately, these species under threat and stressed. Graminoid layer rare to patchy with abundant local patches of pedunculate sedge and husk grass. Understory very open. Midslope moraine silt cap over compact Bt horizon, moderately well drained. Heavy worm infestation compacting soil, susceptible to sheet erosion exposing roots of herbs. Mull humus. Deep A horizon. Exposed root crowns of many trees. Very sad! Lower slopes with MHn46 depressions on treads. BA(x10): 120, Snags: 0/2, CWD: 5-10 Desc.: small branchlets, limbs, old, very decayed logs, Ancient Tipups: frequent, relief 1-2', Modern Tipups: rare Leek bulbs exposed from compaction and surface erosion. Pignut/bitternuts common on mud/dirt. Rock exposed. Erosion/compaction. UTM Zone 15 East460533.060368 North 5123981.504004 Lat 46.268271 Long -93.512185
77	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. MHc36. Part of a series of worm infested areas with decreasing impacts as one travels away from developed land fill. This site less impacted as fine root hairs usually in humus layer are recently exposed by erosion and compaction resulting from worms. Butternut seed observed. UTM Zone 15 East460613.174847 North 5124096.659319 Lat 46.269312 Long -93.511155
78	2.1	Lakeside	2.1 = Non-Natural Community System / Open, Non-Developed / Old Field	Lakeside management unit. Forest opening planted with dense reed canary grass. A disastrous introduction. UTM Zone 15 East460763.563276 North 5124175.917775 Lat 46.270034 Long -93.50921
79	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. MHc36. Heavy worm impact. But apparently more recent invasion. More leaf litter present. Herb layer dense. UTM Zone 15 East460835.207445 North 5124196.903562 Lat 46.270227 Long -93.508282
80	2.4	Lakeside	2.4 = Non-Natural Community System / Open, Non-Developed / Clearcuts, Blow-Downs	Lakeside management unit. MHc36 clear cut. Series of photos demonstrated effects of canopy cover and increasing light and herb response to tall and dense vegetation of thistle. Over mesic forest herbs and tree seedlings. UTM Zone 15 East460870.991195 North 5124249.565724 Lat 46.270703 Long -93.507822
81	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. Bearing eastward from land fill on ATV trail. Each successive waypoint in MHc36 forest exhibits less impacts from worms. More duff remains and increasing healthier herbaceous vegetation in terms of height diversity, frequency and abundant. UTM Zone 15 East460929.116869 North 5124301.640699 Lat 46.271175 Long -93.507072

WYPT #	NPC Code	Site Name	NPC Name	General Description
82	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. High quality MHc36b forest but moderately impacted by worms. Canopy 30 m tall, 85% cover, DBH 25-50 cm dominated by sugar maple with large Basswoods. Subcanopy 2-15 m tall, multi-layered with Carpinus and Ostrya co-dominating with maple. Open sparse shrub/seedling layer. Rich forb layer. Very diverse, most species abundant and/or frequent. Healthy. CWD 5-10% comprised of old very decayed logs and few decayed stumps. One modern tipup observed in plot. Cypripedium orchids browsed. Frequent shinleaf (Pyrola elliptica). Lower slope of moraine, soil silt over clayey hardpan. Substrate fully covered by last year's matted leaves. Humus unstratified, partially impacted by worms to moder/mull consistency. Mod-well drained. BA(X10): 100, Snags: 1/4, CWD: 5-10% Desc.: large very decayed trees and stumps, Ancient tipups: Occasional; 1-3' relief, Modern tipups: Occasional Moderate worm impact. UTM Zone 15 East461021.747017 North 5124399.609315 Lat 46.272062 Long -93.505878
83	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. Mesic oak forest (MHn35b) comprised of mature red oak (DBH 35-45 cm; max DBH to 55 cm, infrequent in polygon, not plot). Plot with large grove of big-toothed aspen. Canopy 75-80% (due to wind broken aspen/oak). Crowns 25-30 m tall, with small mature paper birch in local cluster (nearly absent to infrequent elsewhere on ridge). Subcanopy mostly closed but with infrequent gaps (75-100%) dominated by maple with some ironwood. Seedling/shrub layer sparse to nearly absent with maple seedlings locally patchy. Dry-mesic herbs with more mesic species less frequent to infrequent/occasional. Mesic species often within small local depressions and tipup hollows. Well-drained silt over weakly cemented B horizon. Crest of interfluvial ridge near nose - on slight knoll of linear ridge descending from moraine. Mildly impacted by worms. BA(x10): , Snags: 2/4, CWD: 10-20 Desc: Recent wind, partial decayed trees, aspen, oak, Ancient tipups: Common - frequent; 1-3' relief, No modern tipups Tipups common with up to 3 feet relief. Recent wind damage breaking aspen trunks., DBH:, Red oak: 34, 44 cm, Paper birch: 27, 30 cm Basswood: 32 cm UTM Zone 15 East461061.067918 North 5124608.702046 Lat 46.273946 Long -93.505385
84	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. Dry-mesic maple-Basswood forest (MHn35b) on excessively well-drained knoll at apex of interfluvial ridge. Open grown canopy, now closed but with occasional gaps. Canopy 20-25 m tall, 75-85% cover, DBH 20-50 cm (mode 30-45 cm). Subcanopy of ironwood and maple, 2-15 m tall overall 50-75% cover, but locally 100% closed. Open/sparse shrub/seedlings with few Carpinus, ironwood and sugar maple. Penn sedge forms carpet. Dry-mesic and mesic herbs, sparse, infrequently to rarely dispersed in forest. Apex of interfluvial ridge with oval shaped knoll. Silt over weakly cemented B horizon. Moder - well-developed, stratified all stages of decay. Excessively well drained. BA(x10): 130, Snags: 1/1, CWD: 1-5 Desc.: trunks, all stages, very decayed stumps, Ancient tipups: Frequent - common 1-3' relief, Modern tipups: None Very open understory with carpet of Penn sedge. UTM Zone 15 East460754.6982 North 5124739.113449 Lat 46.275102 Long -93.509372
85	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. MHc36b. Approaching MHn46 on swale at lower slope. UTM Zone 15 East460696.734601 North 5124663.926831 Lat 46.274422 Long -93.510118

Aitkin County Land Dept.
Table 5: Waypoint Sample Descriptions, ECS Field Survey 2011 (sorted by Site Name and Waypoint #).

WYPT #	NPC Code	Site Name	NPC Name	General Description
86	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. MHc36b - no data. UTM Zone 15 East460524.029132 North 5124444.251745 Lat 46.272435 Long -93.512341
87	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. Remnant stand of mature maple and large Basswood on small knoll of moraine, (mostly surrounded by low-lying MHc36 with MHn46 in swales and depressions). Canopy 25-50% cover, crowns 25 m tall, DBH 25-65 cm with largest trees being Basswoods. Canopy gaps filled in with subcanopy maple and ironwood. Ironwood dominates knoll beneath large trees. Shrub/seedling layer open. Common dry-mesic herbs with some mesic herbs due to excellent humus and silty soil. Knoll of low moraine silt cap with <1% gravel over loamy very sine sand, with iron oxide. Aspect descends to MHc36 with swales and depressions of MHn46. BA(x10): 60, Snags: 1/4, CWD: 5-10 Desc.: All stages of decay, broken tops, small trees, limbs, Ancient tipups: Abundant 1-3' relief, Modern tipups: None Several small cuts around mature trees on knolls - variable retention harvest? UTM Zone 15 East460138.051039 North 5125186.240193 Lat 46.27909 Long -93.517413
88	MHn46b	Lakeside	MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest	Lakeside management unit. Wet-mesic, somewhat poorly drained swale dominated by black ash, red maple, Basswood, sugar maple and green ash. Canopy 75-100% cover, crowns 20-25 m tall, DBH 25-50 cm. Subcanopy 5-15 m tall, closed, dominated by sugar maple and red maple. Shrub/seedling layer sparse, poorly dispersed to patchy thick 1-5% cover to 25% cover. Wintergreen most abundant locally but several species are infrequent. Forb layer dominated by wet-mesic ferns and sedges, adapted to low-light and seasonal high water table. Swale of moraine, somewhat poorly drained. No stand in swale. Large boulders in swale (2-3 m diameter). BA(x10): , Snags: 3/3, CWD: 10-20 Desc: very decayed trunks, Ancient tipups: none, Modern tipups: none UTM Zone 15 East460047.315267 North 5125189.833227 Lat 46.279117 Long -93.518591
89	MHn35b	Lakeside	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	Lakeside management unit. MHn35. With large standing oak next to small patchy-cut. Adjacent to MHc36 swale to east. UTM Zone 15 East460125.724647 North 5125103.760855 Lat 46.278347 Long -93.517566
90	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. Mesic hardwoods on lower slopes dominated by Basswood, bur oak, green ash with black ash. Low areas with mud flat depressions. Dry-mesic. Canopy fairly even-aged, crowns 25 m tall, 75-100% cover. DBH 20-45 cm, includes all species as co-dominants. Understory with ironwood, maple and hop hornbeam (Carpinus). Abundant mesic herbs. Elsewhere cut-regrowth with young maples and bare ground heavily infested with worms. Lower slopes with small depressions. Somewhat to moderately drained. Boulders common. Worms have partially removed duff/litter. BA(x10): 160, Snags: 0/1, CWD: 1-5% Desc.: small branches, Ancient tipups: none, Modern tipups: none Bur oak. Elsewhere young regrowth of maples. UTM Zone 15 East460220.270577 North 5125140.812934 Lat 46.278686 Long -93.516342
91	MHc36b	Lakeside	MHc36b = Mesic Hardwood Forest System / Central Mesic Hardwood Forest (Eastern) / Red Oak - Basswood Forest (Calcareous Till)	Lakeside management unit. MHc36b. Heavy worms. Young maple and mature Basswood. UTM Zone 15 East459954.959956 North 5124981.649507 Lat 46.277238 Long -93.519772

Aitkin County Land Dept.
Table 5: Waypoint Sample Descriptions, ECS Field Survey 2011 (sorted by Site Name and Waypoint #).

Table 6. Aitkin County Land Department (ACLD) Evaluation Criteria Habitat Management Zones (HMZ) as possible candidates for High Conservation Value Forests (HCVF)		
1) Rare, threatened, endangered (RTE) plants and animals as documented in Natural Heritage database provided by the Minnesota Department of Natural Resources in 2004)		
	a. RTE located on ACLD forest lands	3
	b. RTE outside of ACLD lands, but is located in habitats within HMZ; however, similar RTE habitat occurs within ACLD lands.	2
	c. RTE habitat occurs in adjacent HMZ	1
2) Public forests		
	a. HMZ with high private development	3
	b. HMZ with high risk for private development	2
	c. HMZ < 50% forested	1
3) Landscape Objectives*		
	a. Clustered (large patch management)	3
	b. Mosaic (mixed patch management)	2
	c. Dispersed (small patch management)	1
4) Unique forest resources		
	a. Unusual forest types or forest components (i.e. upland cedar)	1
	b. High education/recreation/aesthetic values	1
	c. Significant riparian or floodplain forest frontage	1
	d. Location within MN DNR Natural Heritage "Priority Areas"	1
	e. Adjacent to designated reserve areas on other ownership (old growth, refuge, park)	1
	f. Areas with large patches of late-successional forest	1

* Each HMZ is classified as either Clustered, Dispersed, or Mosaic. These designations cover an area not an individual stand and are designed to provide guidance during planning. Generally, "Clustered" areas management seeks to increase the amount of interior forest while in "Dispersed" areas managers seek to increase the amount of edge habitat. "Mosaic" is considered a transition zone between Clustered and Dispersed.

Table 7. Rare, threatened, endangered (RTE) plants and animals within the MN DNR Heritage Database Recorded Within the ACLD Lakeside HCVF and Vicinity.

EOR NUM	ENAME	Common Name	MN STAT	Description
17	Floerkea proserpinacoides	False Mermaid	S2	The plant has been observed in several locations throughouth this area, south of Malmo. Populations have ranged in size from a few individuals to thousands. Some of the spots were visited later in the year and the plants were observed well into senescence as they were yellowed and limp. Typically the habitat is low, moist areas including ephemeral pools in a maple baswood forest. Associated species include: <i>Dentaria laciniata, Caltha palustris, Claytonia virginica, Anemone quinquefolia, Erythronium albidum</i>. See individual source feature for specific details.
17	Floerkea proserpinacoides	False Mermaid	S2	The plant has been observed in several locations throughouth this area, south of Malmo. Populations have ranged in size from a few individuals to thousands. Some of the spots were visited later in the year and the plants were observed well into senescence as they were yellowed and limp. Typically the habitat is low, moist areas including ephemeral pools in a maple baswood forest. Associated species include: <i>Dentaria laciniata, Caltha palustris, Claytonia virginica, Anemone quinquefolia, Erythronium albidum</i>. See individual source feature for specific details.
17	Floerkea proserpinacoides	False Mermaid	S2	The plant has been observed in several locations throughouth this area, south of Malmo. Populations have ranged in size from a few individuals to thousands. Some of the spots were visited later in the year and the plants were observed well into senescence as they were yellowed and limp. Typically the habitat is low, moist areas including ephemeral pools in a maple baswood forest. Associated species include: <i>Dentaria laciniata, Caltha palustris, Claytonia virginica, Anemone quinquefolia, Erythronium albidum</i>. See individual source feature for specific details.

Table 7. Rare, threatened, endangered (RTE) plants and animals within the MN DNR Heritage Database Recorded Within the ACLD Lakeside HCVF and Vicinity.

EOR NUM	ENAME	Common Name	MN STAT	Description
285	Botrychium matricariifolium	Matricary Grape	SNR	2000: In a rich mesic hardwood forest on nearly flat, gently undulating topography. Area characterized by frequent and subtle transitions between mesic and wet forests. Patchy canopy of Tilia americana and Acer saccharum. Thick spongy duff. 2002: Observed along an old winter logging road in a low moist area in a maple basswood forest. 2000: 100+ plants observed by Carlson on 6 June in a rich mesic hardwood forest on nearly flat, gently undulating topography. Area characterized by frequent and subtle transitions between mesic and wet forests. Patchy canopy of Tilia americana and Acer saccharum. Ground layer associates: Botrychium lanceolatum, Cornus alternifolia, Abies balsamea, Uvularia sessilifolia, Athyrium angustum, and Carex intumescens. Thick spongy duff. 2002: Dozens of plants observed by Dahleon 19 June along an old winter logging road that meanders south from 190th street. In a low moist area in a maple basswood forest. Collection made.
17	Floerkea proserpinacoides	False Mermaid	S2	The plant has been observed in several locations throughouth this area, south of Malmo. Populations have ranged in size from a few individuals to thousands. Some of the spots were visited later in the year and the plants were observed well into senescence as they were yellowed and limp. Typically the habitat is low, moist areas including ephemeral pools in a maple baswood forest. Associated species include: Dentaria laciniata, Caltha palustris, Claytonia virginica, Anemone quinquefolia, Erythronium albidum. See individual source feature for specific details.

Table 7. Rare, threatened, endangered (RTE) plants and animals within the MN DNR Heritage Database Recorded Within the ACLD Lakeside HCVF and Vicinity.

EOR NUM	ENAME	Common Name	MN STAT	Description
17	Floerkea proserpinacoides	False Mermaid	S2	The plant has been observed in several locations throughouth this area, south of Malmo. Populations have ranged in size from a few individuals to thousands. Some of the spots were visited later in the year and the plants were observed well into senescence as they were yellowed and limp. Typically the habitat is low, moist areas including ephemeral pools in a maple baswood forest. Associated species include: <i>Dentaria laciniata, Caltha palustris, Claytonia virginica, Anemone quinquefolia, Erythronium albidum</i>. See individual source feature for specific details.
17	Floerkea proserpinacoides	False Mermaid	S2	The plant has been observed in several locations throughouth this area, south of Malmo. Populations have ranged in size from a few individuals to thousands. Some of the spots were visited later in the year and the plants were observed well into senescence as they were yellowed and limp. Typically the habitat is low, moist areas including ephemeral pools in a maple baswood forest. Associated species include: <i>Dentaria laciniata, Caltha palustris, Claytonia virginica, Anemone quinquefolia, Erythronium albidum</i>. See individual source feature for specific details.
17	Floerkea proserpinacoides	False Mermaid	S2	The plant has been observed in several locations throughouth this area, south of Malmo. Populations have ranged in size from a few individuals to thousands. Some of the spots were visited later in the year and the plants were observed well into senescence as they were yellowed and limp. Typically the habitat is low, moist areas including ephemeral pools in a maple baswood forest. Associated species include: <i>Dentaria laciniata, Caltha palustris, Claytonia virginica, Anemone quinquefolia, Erythronium albidum</i>. See individual source feature for specific details.

Aitkin County Land Department
Table 8. NRCS Descriptions of Soil Series - Lakeside Management Unit.

Soil Series	Descriptions
BESEMAN SERIES	The Beseman series consists of very deep, very poorly drained soils that formed in a mantle of highly decomposed organic soil material 16 to 51 inches thick over loamy glacial sediments on glacial moraines, outwash, and lake plains. These soils have moderate slow to moderately rapid permeability in organic mantle and moderately slow permeability in loamy sediments. They have slopes of less than one percent. Beseman soils are in bogs primarily in rather shallow depressions chiefly on glacial moraines, lake plains, and outwash plains. They generally have slope gradients of less than 8 feet per mile. They developed in 16 to 51 inches of organic soil material that is derived primarily from herbaceous plants over loamy, noncalcareous glacial sediments of Late Wisconsinan Age. Glacial till is the most common sediment. Very poorly drained. Surface runoff is very slow or ponded. Permeability is moderate slow to moderately rapid in the upper part and moderately slow in the underlying material. The depth to an apparent seasonal high water table is as high as 2 feet above the surface at some time from January to December in most years for the undrained phase. Almost all of this soil is in native vegetation. Native vegetation consists primarily of sedges and grasses but sphagnum mosses are common in some areas. An overstory of scattered black spruce, tamarack, balsam fir, red maple or alder also are in some areas. Diagnostic horizons and features recognized are: Sapric soil materials from the surface to 36 inches (Oa1 and Oa2 horizons); terric subgroup with mineral material at 36 inches plus (Cg horizon); aquic soil moisture regime with low chroma matrix in the mineral material (Cg horizon).
BRENNYVILLE SERIES	The Brennyville series consists of very deep, somewhat poorly drained soils that formed in a silty mantle of loess or lacustrine deposits and dense loamy glacial till on ground and end moraines. A densic contact occurs at depths of 40 to 60 inches. Slopes range from 0 to 6 percent. These soils are on nearly level to gently sloping ground and end moraines. Slope range from 0 to 6 percent. Brennyville soils formed in loess or silty lacustrine deposits and the underlying dense loamy glacial till of the Late Wisconsinan Age. Somewhat poorly drained. Surface runoff is medium or low. Saturated hydraulic conductivity, measured in inches per hour, is .6 to 2.0 in the silty mantle, .06 to .6 in the lower part and .01 to .06 in the underlying dense till. A perched zone of saturation occurs as high as .5 foot during the months of April to May in years of normal rainfall. About half of this soil is cleared and used for pasture or cropped to corn and hay. The remainder is in woodland or wooded pasture. Native vegetation is deciduous forest or mixed deciduous and coniferous forest. Diagnostic horizons and features recognized in this pedon are: Ochric epipedon - the zone from the surface of the soil to a depth of 8 inches (Ap horizon); Glossic horizon - the zone from 8 to 11 inches (B/E horizon); Argillic horizon - the zone from 11 to 38 inches (Bt and 2Bt horizons); Other features are frigid temperature regime and aquic subgroup based upon low chroma redox within 10 inches of the top of the argillic horzion. The 2BCd horizon is considered to be a densic contact.

Aitkin County Land Department
Table 8. NRCS Descriptions of Soil Series - Lakeside Management Unit.

Soil Series	Descriptions
CATHRO SERIES	The Cathro series consists of very deep, very poorly drained organic soils moderately deep to loamy materials. They formed in organic material 16 to 51 inches thick overlying loamy glacial deposits on ground moraines, end moraines, outwash plains, lake plains, stream terraces, and flood plains. Permeability is moderately slow to moderately rapid in the organic material and moderately slow or moderate in the loamy material. Slopes range from 0 to 2 percent. Cathro soils commonly are in relatively small depressions mainly within ground moraines, end moraines, lake plains and outwash plains. A few areas are on narrow flood plains. Individual bodies range in size from about 10 to 100 acres. Slopes are 0 to 2 percent. The ground water carrying minerals from the surrounding upland, influences the composition of the organic deposit. Very poorly drained. Depth to the seasonal high saturation ranges from 1 foot above the surface to 0.5 foot below the surface at some time from October to June in most years. Ponded phases have a seasonal high saturation from 4 foot above the surface to 0.5 foot below the surface throughout the year. Surface runoff is negligible to low. Permeability is moderately rapid to moderately slow in the organic portion and moderately slow or moderate in the mineral substratum. Stratified substratum phases have saturated hydraulic conductivity ranging up to moderately rapid or rapid in the individual sand strata. Most of these soils are in woodland, however some are in sedge and cattails. Vegetation includes white cedar, alder, and balsam fir. Diagnostic horizons and features recognized in this pedon are: sapric material from the surface to 23 inches (Oa1, Oa2, and Oa3 horizons); terric feature at 23 inches (Cg horizon); aquic moisture regime (low chroma in the soil moisture control section.)
FREER SERIES	The Freer series consists of poorly drained soils that formed in a silty mantle of loess or lacustrine deposits and dense loamy glacial till on drumlins or moraines. These soils are moderately deep or deep to dense till (paralithic contact). These soils have moderate permeability in the silty mantle and very slow permeability in the dense till. Slopes range from 0 to 3 percent. Mean annual precipitation is about 26 inches. These soils have plane or slightly concave slopes and are on drumlins or moraines. Slope gradients range from 0 to 3 percent. Freer soils formed in silty sediments of eolian or lacustrine sediments and noncalcareous dense loamy glacial till of Late Wisconsinan Age. Poorly drained. Runoff is slow. Permeability is moderate in the upper part and very slow in the dense till. Depth to a perched seasonal high water table is as high as 1 to 2.5 feet at some time from November to June in most years. About half of this soil is cleared and cropped to corn, hay, and small grains. The remaining areas are pastured or forested. Native vegetation was mixed deciduous forest or mixed deciduous-coniferous forest. Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the surface to a depth of 13 inches (A and E horizons); glossic horizon- the zone from approximately 13 to 18 inches (B/E horizon); argillic horizon - the zone from approximately 13 to 32 inches (B/E, Bt1 and 2Bt2 horizons); the 2Bt3 horizon is considered argillic because of the lithologic discontinuity between the silt and coarser texture; aquic moisture regime based upon dominant chroma of 2 or less on ped surfaces or in matrix of the argillic horizon; aeric feature - has a horizon with chroma too high for typic subgroup due to a shorter saturation period. The Cd horizon is considered to be a paralithic contact.

Aitkin County Land Department
Table 8. NRCS Descriptions of Soil Series - Lakeside Management Unit.

Soil Series	Descriptions
GIESE SERIES	The Giese series consists of very deep, very poorly drained soils in low lying areas on moraines. This soil formed in a loamy mantle over very firm dense glacial till. These soils have a densic contact at depths of 40 to 80 inches. Permeability is moderate in the upper mantle and very slow in the dense till. Slopes range from 0 to 1 percent. Giese soils have plane or concave slopes in depressions or on broad flats on moraines. Slopes are 0 to 1 percent. This soil formed in a loamy mantle over very firm dense glacial till. The till is from the Superior Lobe of the Late Wisconsinan glaciation. Very poorly drained. Surface runoff is very low or ponded. Permeability is moderate in the upper loamy material and very slow in the dense till. Ponding is occasional or frequent. Depth to perched seasonal high saturation is at the surface for some time from January to December during most years. Most areas have a native vegetation of lowland hardwoods and aspen or have a cover of sedges and willows. Some are in pasture. Diagnostic horizons and features recognized in this pedon include: ochric epipedon - the zone from the surface to 13 inches (Ap and E horizons); albic horizon - the zone from 9 to 13 inches (E horizon); glossic horizon - the zone from 13 to 17 inches (B/E horizon); argillic horizon - the zone from about 13 to 43 inches (B/E, Bt1, and Bt2 horizons); densic contact - the zone beginning at 43 inches (BCd horizon); oxyaquic feature - redoximorphic accumulations and saturation within 40 inches. Aquic condition based on a presumed positive reaction with alpha-alpha dipyridyl at some time during normal years. This red parent material does not produce reduced soil colors typical of other parent materials. Base saturation above 60 percent in all parts of argillic horizon. The dense till has repetitive fracturing that affects water movement and root penetration. This soil was previously classified as a coarse-loamy, mixed, superactive, frigid Typic Hapludalfs. Field investigations has shown a predominance of a glossic horizon in this soil.

Aitkin County Land Department
Table 8. NRCS Descriptions of Soil Series - Lakeside Management Unit.

Soil Series	Descriptions
LUPTON SERIES	The Lupton series consists of very deep, very poorly drained soils formed in organic deposits more than 51 inches thick within depressions on lake plains, moraines and outwash plains. Permeability of these soils is moderately slow to moderately rapid. Slopes typically are from 0 to 2 percent, but may range to 15 percent. Mean annual precipitation is about 29 inches. Lupton soils are in depressions within lake plains, till plains, outwash plains, and moraines. These depressions vary from small enclosed ones to those of several thousand acres in extent. Lupton soils have normally been influenced by ground water passing through surrounding mineral soil materials that are high in minerals. Slopes typically range from 0 to 2 percent, but range to 15 percent. Minor deposits above 2 percent are on foot slopes as the upland soils break sharply into depressional or flood plain areas. These minor deposits are typically associated with groundwater discharge or seep areas. Very poorly drained. The representative depth to wet soil moisture status is at the surface to 1 foot below the surface at some time throughout the year. The representative depth of ponding is from .2 to 1.0 foot at some time throughout the year. Surface runoff is negligible to high, dependent on slope. Permeability is moderately slow to moderately rapid. A large part of these soils is in woodland, cut-over woodland, or brush. Some areas are cleared and used for permanent pasture or hay production. Major forest vegetation includes alder, balsam fir, black ash, black spruce, American elm, red maple, tamarack, white birch, white cedar, willow, and yellow birch. Diagnostic horizons and features recognized in this pedon are: Sapric and typic features; well decomposed organic material from the surface to a depth of 65 inches; Euic feature; reaction greater than 4.5 in 0.01M CaCl2 throughout.

Aitkin County Land Department
Table 8. NRCS Descriptions of Soil Series - Lakeside Management Unit.

Soil Series	Descriptions
MILACA SERIES	The Milaca series consists of very deep, moderately well drained soils that formed in loamy till on drumlins and moraines. These soils have a densic contact at 40 to 60 inches. Slopes ranges from 2 to 45 percent. These soils are on drumlins and moraines. Slope ranges from 2 to 45 percent. Milaca soils formed in noncalcareous, Superior lobe dense loamy till of Late Wisconsinan Age. Moderately well drained. Surface runoff is low to high. Saturated hydraulic conductivity is 4.23 to 42.34 micrometers per second (.6 to 6 inches per hour) in the upper part and .01 to .42 micrometers per second (.0015 to .06 inches per hour) in the dense till. This soil has perched season high saturation at depths as high as 1.5 feet during April to June in normal years. Approximately half of this soil is cultivated. Crops commonly grown are corn, oats, and hay. The remaining areas are pastured or forested. Native vegetation is mixed deciduous forest or mixed deciduous-coniferous forest. Diagnostic horizons and features recognized in this pedon include: ochric epipedon - the zone from the surface to 13 inches (Ap and E horizons); albic horizon - the zone from 9 to 13 inches (E horizon); glossic horizon - the zone from 13 to 17 inches (B/E horizon); argillic horizon - the zone from about 13 to 43 inches (B/E, Bt1, and Bt2 horizons); densic contact - the zone beginning at 43 inches (BCd horizon); oxyaquic feature - redoximorphic accumulations and saturation within 40 inches. Aquic condition based on a presumed positive reaction with alpha-alpha dipyridyl at some time during normal years. This red parent material does not produce reduced soil colors typical of other parent materials. Base saturation above 60 percent in all parts of argillic horizon. The dense till has repetitive fracturing that affects water movement and root penetration. This soil was previously classified as a coarse-loamy, mixed, superactive, frigid Typic Hapludalfs. Field investigations has shown a predominance of a glossic horizon in this soil.
MILLWARD SERIES	The Millward series consists of very deep, well drained soils formed in water modified sediments and the underlying loamy glacial till on moraines. This soil has moderate permeability. Millward soils have plane or convex slopes on crests or sideslopes of moraines. These soils formed in loamy glacial till and water worked sediments. Slope ranges from 2 to 15 percent. Well drained. Surface runoff is moderately low to high. Permeability is moderate. Most areas are forested. Dominant trees are aspen, red oak and sugar maple. Native vegetation is mixed deciduous and coniferous trees. Diagnostic horizons and features recognized in this pedon include: ochric epipedon -from the surface to 4 inches (Oe and E horizons); albic horizon - from 1 to 4 inches (E horizon); argillic horizon - the zone from 34 to 46 inches (3Bt1 and 3Bt2 horizon).

Aitkin County Land Department
Table 8. NRCS Descriptions of Soil Series - Lakeside Management Unit.

Soil Series	Descriptions
MORA SERIES	The Mora series consists of very deep, somewhat poorly drained soils that formed in loamy till on drumlins and moraines. These soils have a densic contact at 40 to 60 inches. Slope ranges from 0 to 6 percent. These soils are on nearly level to gently sloping drumlins or moraines. Slope ranges from 0 to 6 percent. Mora soils formed in noncalcareous, Superior lobe dense loamy till of Late Wisconsinan Age. Somewhat poorly drained. Surface runoff is negligible to medium. Saturated hydraulic conductivity is 4.23 to 42.34 micrometers per second (.6 to 6 inches per hour) in the upper part and .01 to .42 micrometers per second (.0015 to .06 inches per hour) in the dense till. This soil has perched season high saturation at depths as high as 0.5 foot during April through May in years of normal precipitation. About one-half of these soil areas are forested. The remaining areas are cleared and used for pasture or are cropped to corn, oats, and hay. Native vegetation is mixed deciduous forest or mixed deciduous-coniferous forest. Diagnostic horizons and features recognized in this pedon include: ochric epipedon - the zone from the surface to 12 inches (A and E horizons); albic horizon - the zone from 8 to 12 inches (E horizon); glossic horizon - the zone from 12 to 17 inches (B/E horizon); argillic horizon - the zone from 12 to 36 inches (B/E, Bt1, and Bt2 horizons); densic contact - the zone beginning at 46 inches (BCd horizon); aquic subgroup - low chroma redoximorphic features in upper 10 inches of the argillic horizon. Aquic condition based on a presumed positive reaction with alpha-alpha dipyridyl at some time during the year in 6 out of 10 years. This red parent material does not produce reduced soil colors typical of other parent materials. Base saturation above 60 percent in all parts of the argillic horizon. The dense till has repetitive fracturing that affects water movement and root penetration. This soil was previously classified as a coarse-loamy, mixed, superactive, frigid Aquic Hapludalfs. Field investigations have shown a predominance of a glossic horizon in this soil.
NEMADJI SERIES	The Nemadji series consists of deep somewhat poorly drained soils that formed in sandy glacial outwash or lacustrine sediments in glacial lake and outwash plains. These soils have rapid permeability. They have slopes of 0 to 3 percent. Mean annual precipitation is about 28 inches. These soils have plane or slightly convex slopes with gradient of less than 3 percent. They primarily are on nearly level lake plains or nearly level to gently undulating lacustrine and outwash plains. They formed in sandy, lacustrine or outwash sediments of the Superior Lobe of the Late Wisconsin Age. The sediments are dominated by fine or medium sand. The climate is humid continental with warm summers and cold winters. Most of this soil is forested. A small proportion is in pasture or is cropped to small grains or hay. Native vegetation is mixed deciduous-coniferous forest. Common species of trees include trembling aspen, paper birch, red pine, and white pine.

Aitkin County Land Department
Table 8. NRCS Descriptions of Soil Series - Lakeside Management Unit.

Soil Series	Descriptions
OMEGA SERIES	The Omega series consists of very deep, somewhat excessively drained soils that formed in sandy glacial outwash on outwash plains or valley trains. These soils have rapid permeability. Their slopes range from 0 to 25 percent. These soils have slightly concave to convex slopes with gradients of 0 to 25 percent on valley trains and outwash plains. They formed in thick sandy outwash sediments. These sediments are derived from the Superior or Rainy lobes of the Late Wisconsinan glaciation. Somewhat excessively drained. Surface runoff is very low to high. Permeability is rapid. Most of these soils are forested. A few areas are cleared and are cropped to forage crops or to special crops such as potatoes. Native vegetation primarily is coniferous forest. Jack pine and red pine were dominant. Diagnostic horizons and soil features recognized in this pedon are: ochric epipedon - the zone from 2 to 3 inches (E horizon); albic horizon - the zone from the 2 to 3 inches (E horizon); spodic horizon - the zone from 3 to 12 inches (Bhs and Bs horizons. Note: the Soil Taxonomy Amendment Number 14 changed the criteria of spodic material. This soil now has a Bs or Bhs which meets the definition of spodic materials.)
RONNEBY SERIES	The Ronneby series consists of very deep, somewhat poorly drained soils that formed in loamy glacial till on drumlins and moraines. These soils have a densic contact at depths of 40 to 60 inches. The saturated hydraulic conductivity is moderate or moderately rapid in the upper part and very slow in the dense till. Slopes range from 0 to 2 percent. These soils have plane or slightly concave slopes on drumlins or moraines. Slope gradients range from 0 to 2 percent. Ronneby soils formed in noncalcareous, Superior lobe dense loamy glacial till of Late Wisconsinan Age. Somewhat poorly drained. Runoff is very low or low. Saturated hydraulic conductivity is moderate or moderately rapid in the upper part and very slow in the dense till. This soil has perched seasonal high saturation at a depth of 0.5 feet during April to June in years of normal precipitation. Approximately half of this soil is cultivated. Crops commonly grown are corn, soybeans, oats, and hay. The remaining areas are pastured or forested. Native vegetation is mixed deciduous forest or mixed deciduous-coniferous forest. Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the surface to 11 inches (Ap and E horizon); albic horizon - the zone from 8 to 11 inches (E horizon); argillic horizon - the zone from 11 to 33 inches (B/E and Bt horizons); glossic horizon-zone from 11 to 17 inches (B/E horizon); base saturation is above 60 percent in some part of the argillic horizon; aquic conditions- based on presumed positive reaction with alpha alpha dipyridyl at sometime during the year in most years. This parent material does not reduce soil colors typical of other parent material; densic contact- the zone beginning at 45 inches (BCd horizon). This soil was formerly classified as coarse-loamy, mixed, superactive, frigid, Udollic Epiaqualfs. Classification changed to reflect predomenance of a glossic horizon.

Aitkin County Land Department
Table 8. NRCS Descriptions of Soil Series - Lakeside Management Unit.

Soil Series	Descriptions
SEELYEVILLE SERIES	The Seelyeville series consists of very deep, very poorly drained soils that formed in organic materials more than 51 inches thick. These soils are on glacial outwash plains, valley trains, flood plains, glacial lake plains and glacial moraines. They have moderately rapid to moderately slow permeability. Slopes are 0 to 15 percent. The Seelyeville soils are in depressions and large basins on nearly level slopes on outwash plains, flood plains, valley trains, glacial lake plains, and glacial moraines. Slope gradients typically are less than 0.5 percent but range to 15 percent in areas with hillside seeps. These soils are formed in highly decomposed organic soil materials that are more than 51 inches thick and that primarily are derived from herbaceous plants. Very poorly drained. Surface runoff is negligible. Permeability is moderately slow to moderately rapid. Depth to an apparent water table is as high as plus 1 to .5 feet at some time from October through June for the Seelyeville, Seelyeville flooded, and Seelyeville calcareous phases, 0 to 2 feet for Seelyeville sloping, and plus 3 to 0 feet at some time from October through June for Seelyeville ponded. Native vegetation primarily is sedges and grasses. Some areas have scattered alders, willow, tamarack, and bog birch. Diagnostic horizons and features recognized in this pedon are: sapric soil materials (muck) dominate the surface, subsurface and bottom tiers in the 51-inch control section.
TWIG SERIES	The Twig series consists of very deep, very poorly drained soils on moraines and drumlins. It formed in a mantle of organic material and underlying loamy material and underlying till that becomes very firm with depth. A densic contact occurs at depths of 102 to 203 cm. Slopes range from 0 to 1 percent. Twig soils have plane or concave slopes in shallow depressions or drainageways on moraines or in swales between drumlins. They formed in a mantle of organic material and underlying loamy material and underlying till that becomes very firm with depth. Slopes range from 0 to 1 percent. The till is from the Superior Lobe of the Late Wisconsinan glaciation. Very poorly drained. Surface runoff is negligible. The saturated hydraulic conductivity is 42.34 to 141.14 micrometers per second (6 to 20.0 inches) in the organic material; 4.23 to 14.11 micrometers per second (.6 to 2.0 inches per hour) in the next layer and .01 to .42 micrometers per second (.0015 to .06 inches per hour) in the dense till. Perched seasonal high saturation occurs at the surface in spring and fall in normal years. Ponding is also common during periods of snowmelt and heavy rains. Most areas have a native vegetation of lowland hardwoods and aspen or have a cover of sedges and willows. Some are in pasture. Diagnostic horizons and features recognized in this pedon are: histic epipedon - the zone from the surface to a depth of 30 cm (Oa1, Oa2, Oe horizons); aquic moisture regime - based on soil saturation to the surface; cambic horizon - the zone from 66 to 122 cm (2Btg and 2Bt horizons); densic contact at 122 cm (2BCd). The Bt and 2Bt horizons due not meet the requirement for an argillic horizon. The designation of the 2BCd horizon is based on fractures and platy structure in the densic material. Clay and silt translocation can be seen between the horizontal plates when broken apart. This reddish colored parent material often does not reduce to 2 chroma or less in either the matrix or as redox features when saturated. Studies are ongoing to try and explain this situation.

APPENDIX 3 - FIGURES

APPENDIX 3 - FIGURES

Figure 1: Location of Aitkin County Land Department Management (ACLD) Units and the Ecological Classification System (ECS) - Provinces of Minnesota. The following ECS descriptions are taken verbatim from MN DNR (2003) and http://www.dnr.state.mn.us/ecs/index.html. ACLD Management Units of Blind Lake, Lakeside, Rice Lake, Libby Lowlands and Wagner occur within the Laurentian Mixed Forest Province, West Superior Uplands Section, Mille Lacs Uplands Subsection; and Minnesota Drift and Lake Plains Section, St. Louis Moraines Subsection and the Tamarack Lowlands Subsection:

Laurentian Mixed Forest Province (MN DNR 2003)
The LMF Province traverses northern Minnesota, Wisconsin, and Michigan, southern Ontario, and the less mountainous portions of New England. In Minnesota, the LMF Province covers a little more than 23 million acres (9.3 million ha) of the northeastern part of the state. In Minnesota, the Province is characterized by broad areas of conifer forest, mixed hardwood and conifer forests, and conifer bogs and swamps. The landscape ranges from rugged lake-dotted terrain with thin glacial deposits over bedrock, to hummocky or undulating plains with deep glacial drift, to large, flat, poorly drained peatlands. Precipitation ranges from about 21 inches (53 cm) annually along the western border of the Province to about 32 inches (81 cm) at its eastern edge in Minnesota. Normal annual temperatures are about 34°F (1°C) along the northern part of the Province in Minnesota, rising to 40°F (4°C) at its southern extreme. Under influence of climate, the overall pattern of vegetation change across the Province in Minnesota is from warm and dry habitats in the southwest to cooler and moister ones in the northeast. Linked to climate are several other factors with southwest to northeast gradients that have important influence on vegetation and species ranges. Most notable are growing-degree days, evapotranspiration, and the depth and duration of snow cover.

Western Superior Uplands Section
The Western Superior Uplands Section (WSU) is a large region of non-calcareous till deposited by glacial ice that advanced southward from the Lake Superior Basin. Most of this till is deposited in level to undulating ground moraines or in drumlins. These landforms are coarse-textured near the southwestern edge of the WSU but become increasingly clayey to the northeast because of later, less extensive advances of glacial ice that incorporated clayey sediments from Glacial Lake Duluth with the glacial till. The areas of coarser drift are occupied by forests dominated by northern red oak, while areas of clayey till have forests of sugar maple, aspen, and birch. Sandy terraces along the St. Croix River and small sand plains in other parts of the Section have fire-dependent woodlands or forests of jack pine, bur oak, northern pin oak, and aspen. Fire-dependent pine, oak, and aspen forests are also present occasionally with mesic hardwood forests on coarse till and drumlins. Peatlands and other wetland communities are present mostly as inclusions within the broad areas of hardwood forest.

Mille Lacs Uplands Subsection
This subsection covers the large area of Superior Lobe ground moraines and end moraine in east-central Minnesota. Gently rolling till plains and drumlin fields are the dominant landforms in this ecoregion. The jewel of the region is Mille Lacs Lake, well known for walleye fishing. Brown and red till forms the parent material. In the southern portion, upland hardwood forests consisting of northern red oak, sugar maple, basswood, and aspen-birch were common before settlement. Presently, forestry, recreation, and some agriculture are the most common land uses.

Landform
This subsection consists primarily of Superior lobe ground moraine, and includes the Brainerd-Pierz and Automba Drumlin Fields (Dept. of Soil Science, Univ. of Minnesota 1977, 1980b, Hobbs and Goebel 1982). The depressions between drumlin ridges contain peatlands with shallow organic material. There are also small areas of Des Moines lobe ground moraine in the southeastern portion of the subsection (Hobbs and Goebel 1982). A large end moraine in the center of the subsection forms the dam that created Mille Lacs

APPENDIX 3 - FIGURES

Lake. In the northeast, there is another series of end moraines, which marked later advances and retreats of the Superior lobe.

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

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

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

Hydrology
Major rivers running through this subsection include the St. Croix, which forms part of the eastern boundary and the, Kettle, Snake, Rum, and Ripple rivers. The drainage network is young and undeveloped, with extensive areas of wetlands present. There are 100 lakes greater than 160 acres in size. Most occur on end moraines.

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

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

APPENDIX 3 - FIGURES

Natural disturbance
Both fire and windthrow were important in determining the vegetation of the subsection. Because dense basal till is present at depths of 20 to 40 inches throughout most of the subsection, rooting depths for trees are shallow and windthrow is common.

Northern Minnesota Drift and Lake Plains Section
The Northern Minnesota Drift and Lake Plains Section (MDL) covers the center of northern Minnesota. The MDL has complex surface geology, formed over many episodes of glaciation. It is characterized by deep (200-600ft [60-180m]) glacial deposits in outwash plains, lake plains, till plains, outwash channels, moraines, and drumlin fields. The patterns of vegetation in the MDL reflect the complex and patchy distribution of these glacial deposits. Mesic forests of sugar maple, basswood, paper birch, aspen, and northern red oak are widespread. They occur mostly on moraines or till plains characterized by rough topography, fine-textured parent material, or soils with subhorizons that perch snowmelt and rainfall. Historically, forests and woodlands of jack pine and red pine were very common. These fire-dependent communities occur on the sandy outwash plains formed by glacial meltwater. Sandy and gravelly deposits that cap many of the major moraines in the western part of the MDL provide habitat for mixed forests of pine and boreal hardwood species such as quaking aspen and paper birch. The eastern part of the MDL is formed of deposits from glacial lakes Upham and Aitkin. These lake plains have expansive areas of acid peatland communities such as black spruce bogs and poor swamp forests, along with rich swamp forests of white cedar and black ash. Sedge meadows and alder and willow swamps occur along the sluggish streams draining the flat lake plains and along the Mississippi and Leech Lake rivers.

St. Louis Moraines Subsection
Rolling to steep slopes characterize much of this subsection. End moraines are the dominant landform. The underlying topography was formed by the Rainy lobe. It was later overridden by the St. Louis sublobe of the last glaciation period. Northern hardwood forests were common in the southern portion of the region, south of Grand Rapids. North of Grand Rapids, white pine, sugar maple, basswood, and balsam fir were common tree species. Presently, forestry and tourism are the major landuses.

Landform
This subsection consists of distinct end moraines associated with the St. Louis and Koochiching Sublobes. and a pitted outwash plain (Hobbs and Goebel 1982). These sublobes overrode Rainy Lobe moraines, which formed the framework of landform characteristics. The cap of calcareous gray sediment varies from 1 to 10-plus feet in depth. Coarse loamy Rainy Lobe sediments underlie the cap. Portions of this unit, both north and south of Grand Rapids, have very steep topography. These areas are ice disintegration features. Topography on the rest is gently rolling to rolling.

Bedrock geology
The glacial drift in this subsection ranges from 100 to 200 feet in depth (0lsen and Mossler 1982). Lower Precambrian undivided granites, metavolcanics, and metasedimentary rocks underlie the glacial drift (Sims et al. 1970c).

Soils
Loamy calcareous soils make up about 75% of the soils in this subsection (Dept. of Soil Science, Univ. of Minnesota 110-1971). Excessively well-drained outwash sands account for another 10 to 15% and poorly drained soils account for about 3%. The soils are classified as Boralfs (well drained soils developed under forest vegetation), Aqualfs (wet soils developed under forest vegetation), Hemists (moderately decomposed organic soils), and Psamments (sandy, poorly developed well-drained soils), with Boralfs most common (Cummins and Grigal 1981).

APPENDIX 3 - FIGURES

Climate
Total annual precipitation ranges from 24 inches in the northwest to 27 inches in the southeast, with about 40% occurring during the growing season. Only 12 to 16% of the annual precipitation falls during winter months (based on Midwest Climate Center 1992). Growing season length varies from 111 to 131 days.

Hydrology
The Mississippi River cuts this subsection virtually in half. The river flows northwest to southeast close to the north-south midpoint of the subsection. Several small, relatively short rivers are present. They include the Prairie, Willow, Hill, and Moose rivers. The drainage network is poorly developed due to landform characteristics. Lakes are numerous. In fact, there are over 66 lakes that have a surface area greater than 160 acres; lakes account for over 10% of the surface area.

Presettlement vegetation
White pine-red pine forest covered large portions of the steep moraines and portions of the pitted outwash along the eastern edge of the subsection. South of Grand Rapids was an area of moraine dominated by northern hardwoods. Aspen-birch forests also grew on the moraines, but were more common on the outwash, which had excessively well drained sandy soils. Mixed hardwood-pine forest was locally present on the moraines, generally near large lakes. Conifer swamp and bogs were scattered throughout the subsection, occupying both kettles and linear depressions in the pitted outwash and moraines (Albert 1993).

Present vegetation and land use
The most important land uses in this subsection are forestry and recreation. This area is heavily forested and timber harvesting is extensive. Quaking aspen is the primary species harvested. Recreation is primarily associated with the subsection's lakes and the areas around them. Fishing, hunting, snowmobiling, and skiing are popular.

Natural disturbance
Fire and windthrow were the most common natural disturbances. Fire was an important agent in maintaining fairly pure red and white pine stands.

Tamarack Lowlands Subsection
The boundaries of this subsection coincide with the boundaries of the Glacial Lake Upham Plain and the Aurora Till Plain. This is a unique area topographically and climatically. The till plain is included because it forms a relatively flat plain ecologically similar to the adjacent lacustrine plain. Level to gently rolling topography are characteristic of this region. The largest landform is a lake plain. Around the edges of the old glacial lake is a till plain (Aurora Till Plain) formed in Superior lobe sediments. There is also a small piece of end moraine north of Sandy Lake that is related to the St. Louis moraines. Lowland hardwoods and conifers were the most common forest communities. Northern hardwood and aspen-birch forests were common on the other portions of this region. Presently, much of the land is in public ownership. Forestry and tourism, along with some agriculture are the most common land uses.

Landform
Glacial lacustrine (lake deposited) sediments occupy much of the subsection. Beach ridges are not well defined. The lake was probably not present at one level long enough to form distinct beach ridges (as are found in the Glacial Lake Agassiz basin, to the west). There is a ground moraine along the northern and southern borders of the Glacial Lake Upham basin. Low drumlin ridges. are present locally.

APPENDIX 3 - FIGURES

Bedrock geology
Glacial drift within the lake beds ranges from 100 to 300 feet thick, with some of the thickest sediments at the northern edge of the Glacial Lake Upham basin, where it meets the Mesabi Range (0lsen and Mosslet, 1982). The bedrock beneath Lake Upham is Middle Precambrian (Early Proterozoic) argillite, siltstone, quartzite, or graywacke, weakly metamorphosed (Morey 1976, Morey et al. 198~). There is also Cretaceous shale, sandstone, and clay near the southwest end of the basin and along the border with the Mesabi Range.

Soils
Soils include extensive areas of histosols (peats) over both fine-textured (silt and clay-rich) and sandy lacustrine deposits. Other soil orders present are entisols and alfisols. Soils are classified by Grigal and Anderson (1984) as primarily Ochrepts, Hemists, Aquents, and Boralfs. Alluvial soils are present along major rivers.

Climate
Total annual precipitation ranges from 24 inches in the northwest to 27 inches in the east, with about 40% occurring during the growing season. The growing season is short, from 92 to 115 days, as the low-lying subsection forms a frost pocket with late spring frosts and early fall frosts.

Hydrology
Several major rivers flow through this subsection. These include the Mississippi, St. Louis, Whiteface, East Swan, Savannah, and Willow rivers. Rivers and streams meander extensively across the subsection due to the predominately level landscape. There are few lakes present in the lake plain. The largest lake is Sandy Lake, which is a reservoir created by a dam on the Savannah River.

Presettlement vegetation
Vegetation in the lowlands was dominated by lowland conifers (black spruce, tamarack, and white cedar) and lowland hardwoods (black ash). Sedge meadows were also extensive. Uplands supported aspen-birch and upland conifer forest. White pine-red pine forests were located on the ground moraine at the edges of the lake plain, but were not extensive.

Present vegetation and land use
Forestry is the most important land use within the Tamarack Lowlands. There are some areas in the lake plain where agriculture is important, although most of the subsection is marginal for agriculture. Locally, tourism is important around Sandy Lake in Aitkin County.

Natural disturbance
Fire was probably important, both on the hardwood-conifer dominated uplands and in wetlands. Windthrow was probably important in the conifer swamps. In this type of flat, lacustrine setting, natural water-level fluctuations and flooding behind beaver dams often causes extensive tree mortality (Albert 1993).

Figure 2: Legend Surficial Geology
GIS Layer: Land Management Information Center, Minnesota Planning, and Minnesota Geological Survey.
Title: Geologic Map of Minnesota: Quaternary Geology, from MGS (Map S-1), 1982 (Digital Version).
Abstract This layer describes the general distribution of surficial sediments in Minnesota, as delineated and

APPENDIX 3 - FIGURES

classified by the Minnesota Geological Survey. It is a digital version of the Minnesota Geological Survey State Map Series Map S-1 (Geologic Map of Minnesota: Quaternary Geology), 1982, by H.C. Hobbs and J.E. Goebel. (1:500,000). The digital file was created by scanning the 1:500,000-scale paper map and then converting the scanned image into an Arc/INFO polygon coverage. The Arc coverage was also converted to an EPPL 40-acre grid cell file, and then later updated for incorporation into the EPPL MGC100 data set.

Figure 3: Locations of ACLM Management Units - Surficial Geology

GLACIAL HISTORY AND SURFICIAL GEOLOGY
The following is a summary of glaciers, and their aftermath, that have influenced the ecology of the Lakeside Unit.

The Quaternary - 2,000,000 Years Before Present (YBP) to the Present
The Quaternary Period is divided into the Pleistocene Epoch (ice age) and the Holocene Epoch, which represents the last 10,000 years. During the Ice Age, the earth was subjected to at least 20 glacial and interglacial cycles, of which there is evidence of at least four major glaciations in Minnesota. The last glacial event was known as the Wisconsin Glaciation (Delcourt and Delcourt 1993).

The Wisconsin Glaciation - 75,000 to 12,000 YBP
During the Wisconsin Glaciation, the Laurentide Ice Sheet covered much of North America, from which several large ice lobes advanced and retreated many times. Sediments deposited by these lobes and their aftermath predominantly influence the modern landscape of Minnesota. As glacial ice advanced, debris was scraped, lifted, carried and deposited some distance from its origin. This debris – which is called glacial till – is an unsorted mix of clay, silt, sand, pebbles and rocks. Often there are large boulders, called erratics, that have been transported a long way from their original source of bedrock. Till from each lobe forms a distinct stratum or parent soil, depending upon the origin of the debris (Lusardi 1997). Stratigraphically, the debris of earlier advances of ice are covered by debris of later ice lobes.

Glaciers are not always completely frozen. Meltwater can flow on top of the ice, in channels through or beneath the ice. Glacial streams transport silt, sand and gravel that are deposited in various distinct landformations. Along the ice margins, meltwater was impounded to form large glacial lakes that reworked the glacial till to produce sorted bands of sediments, whose size varies according to the wave energy at the time.

Northern Minnesota is covered by three general types of glacial drift originating from separate ice lobes emanating from the Wisconsin Glacier at different times (Ojakangas and Matsch 1982). These drifts are comprised of debris originating from the bedrock type over which the glaciers passed. The source material and the mode of deposition of the drift contributes to important differences in soil texture and nutrients that ultimately affect vegetative growth (McAndrews 1966). Drift from the Wadena and Des Moines Lobes are derived from regions underlain by Paleozoic limestone and dolomite. Soils derived from these drifts are calcareous. In addition, drift from some regions of the Des Moines Lobe is derived in part from Cretaceous shale, which adds silt and clay to the resulting soils. In contrast, the Superior-Rainy Lobes passed over the Canadian Shield. Their drifts are comprised of granitic and metamorphic rocks producing soils that are coarse-textured and noncalcareous.

Superior and Rainy Lobes - Middle Wisconsin Glaciation 30,000 to 20,000 YBP
Sublobes of the joined Rainy and Superior Lobes probably merged with the retreating Wadena Lobe to form a contiguous ice sheet across northern Minnesota. Deposits from the Superior and Rainy Lobes vary considerably. In general, they are a bouldery, coarse-textured glacial till comprised of granite, gabbro, basalt, red sandstone, iron-formations, slate and greenstone. The till has a reddish-brown to dark-brown or gray-black color depending upon composition.

APPENDIX 3 - FIGURES

The moraines surrounding Mille Lacs Lake were formed by a re-advancement of the Superior Lobe. Melt water formed from the retreating Superior Lobe to create vast glacial lakes that have since become today's remnant lakes while the former lake plains have become vast peatlands.

Des Moines Lobe - Late Wisconsin Glaciation 16,000 to 12,000 YBP
The Des Moines Lobe scoured what is now called the Red River Valley, before expanding southward to its maximum extent in Iowa, about 14,000 YBP. The St. Louis Sublobe separated from the main lobe in northwest Minnesota and expanded east, southeast across Aitkin County and the surrounding region. The Des Moines Lobe carried debris eroded from the limestone and dolomite of the Winnipeg lowlands. It formed the moraine immediately south of Lower Red Lake, and later the long peninsula between Upper and Lower Red Lakes (Wright 1992). Deposits from the Des Moines lobe are generally buff-colored to yellow-brown. Till from the Des Moines Lobe is rich in limestone and shale with a large quantity of granite. And typically has a loam or clay loam texture created from a fine-textured glacial till rich in limestone and granite with limited amounts of shale. The Des Moines lobe contains a higher percentage of shale fragments with few boulders and is thought to have originated from a more northwesterly source area than were deposits from the Wadena Lobe (Anderson).

Figure 4: ACLD Lakeside Unit - USGS Topographic Map & Waypoint Sample Locations. A total of 168 waypoints were sampled for vegetation; in addition, soil pits were dug to record soil data in 36 plots. It was important to collect data throughout ACLD Management Units surveyed in 2011 and to capture the range of variation expressed by each NPC cover type. Soil samples were collected from pits dug to 1.5 m depth. Soil properties were entered into an ACCESS database along with general observations, floristic lists and species' cover abundance. Waypoint samples were uploaded as a GIS shapefile and served as reference points for photo-interpreting, rectified air photos. Vegetation data included species lists with cover abundance values. By associating vegetation with soil and topographic characteristics, it is easier to understand how native plant communities (NPC) are distributed across the landscape within the study area. Understanding these relationships, facilitates the delineation of NPC map units over vegetation patterns visible on the air photographs while using NRCS soil map units and USGS topographic contour lines.

Figure 5: ACLD Lakeside Unit - NRCS-USDA Soil Polygons Classified by Soil Moisture Categories. ACLD Management Units includes 78 different soil map units and complexes delineated as soil polygons by the Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture (USDA) (Table 2). The soils map for ACLD Lakeside Unit is a subset of NRCS soils surveys from Aitkin County (SSURGO 2.2). ARCGIS shapefiles of the Becker county soil survey were clipped according to the ACLD Unit boundary and combined into a separate GIS cover. Table 2 is an index to NRCS soil map units within the Unit. It shows soil unit names, map number, soil properties, soil drainage and soil taxonomic hierarchy.

The soil moisture map in Figure 4 illustrates NRCS soil polygons in a manner more useful for recognizing and delineating boundaries of native plant communities. These moisture regime categories include: 1 = Dry Sand, 2 = Dry-Mesic Sand, 3 = Dry-Mesic Loam or Silt, 4 = Mesic Sand, 5 = Mesic Loam or Silt, 6 = Wet-Mesic Sand, 7 = Wet-Mesic Loam or Silt, 8 = Wet Sand, 9 = Wet Loam or Silt, 10 = Peat and 11 or "w" = Water. Several soil characteristics influence a substrate's ability to retain moisture or perch standing water above the prevailing water table. These soil characteristics were combined into larger, more-meaningful ecological categories that were useful fo explaining plant occurrence. These soil properties are described in higher soil taxonomic levels for NRCS units, especially the categories of Order, Suborder and Great Group (see Table 2). By combining 78 separate soil units into 10 categories (Fig 5) based upon soil moisture regime, we make a complex, obtusely-abstract relationship more discernable between soil types and native plant types. Arranging plant communities (ordination) along a soil-moisture gradation (continuum) is a fundamental principle of plant ecology (Curtis 1959).

Figure 6: ACLD Lakeside Unit - Native Plant Community (NPC) Polygons on Color Infra-Red (CIR) Aerial Photographs.

APPENDIX 3 - FIGURES

Figures 7: Legend - Native Plant Community (NPC) & Non-Natural Cover Types. Attribute Codes for Native Plant Community Floristic Regions, Classes and Types. The names of the NPC classes and types are based on floristic region, soil moisture or nutrient regimes, and vegetation or habitat features (see ECS Definitions and Hierarchy in Appendix 3; MN DNR 2005a). For wooded communities, NPC Type names are based on dominate tree species, sometimes qualified with understory species or minor canopy species that help separate that particular type from other types in the same NPC Class. If the NPC Type within a class have distinct geographic ranges or substrate affinities, these are often indicated in the name as well. NPC Class codes include five digits (e.g., FDc24, MHc26, WFn55). The first two capitalized letters indicate the NPC System (e.g., FDc24 = FD, Fire Dependent System). The third digit is a lower case letter indicating the Floristic Region within the NPC System (e.g, FDc24 = c, Central Floristic Region). The fourth digit is a number on a scale of "0" to "9" indicating the moisture gradient position from "0" being the driest, and "9" being the wettest (e.g., FDc24 = 2, Dry). The fifth digit is a number on a scale of "0" to "9" indicating the nutrient scale position from "0" being the poorest, to "9" being the richest (e.g., FDc24 = 4, Rich). Non-Natural cover types were assigned a "Potential Class" code indicating the polygon area's potential for NPC restoration and management based on soil properties, geologic landformation and other natural characteristics. NPC Type codes include all the previous five digits of the NPC Class, including a sixth digit comprised of a lower case letter (e.g, FDc24a = "Jack Pine - (Bush honeysuckle) Woodland" Type of the NPC Class, "Central Rich Dry Pine Woodland". Non-Natural codes have no distinct protocol and simply serve to identify the extant status of the existing vegetation or describe current landuse within the area circumscribed by the polygon.

Figures 8: ACLD Lakeside Unit - Native Plant Community Polygons Classified by NPC Type and Non-Natural Cover Types. A cover map of existing vegetation was created using ARCVIEW v9.3 for ACLD Lakeside Management Unit. Polygons of native plant community (NPC) types were delineated over patterns visible on rectified images of air photo mosaics. GPS locations of 168 sample waypoints were uploaded into ARCVIEW and used as bench marks during air photo interpretation of the vegetation cover. Map units of native vegetation were classified according to Native Plant Community (NPC) types developed by the Minnesota Department of Natural Resources (MN DNR 2003, 2005a, 2005b). Non-natural and other natural cover types, such as roads, utility corridors and various categories of open water, were developed by MN DNR Parks. NPC types for ACLD Lakeside Unit were determined from analysis and evaluation by Scott Zager of vegetation data collected at 168 waypoint sample locations (Table 5). These data helped interpret vegetation patterns seen on air photos. Vegetation patterns were also compared with GIS digitized soil map units classified according their soil moisture regime (Figure 5) and by using contour lines of digitized USGS 7.5 minute topographical maps. NPC polygons were delineated on the basis of multiple factors: dominant plant cover, soil type, topographic slope position and aspect, and recorded vegetation data. The recorded vegetation data associated with GIS points were derived from standardized vegetation plots (relevés), species lists and other ecological observations. The existing vegetation cover map (Fig. 8) for ACLD Lakeside Unit is comprised of polygons classified according NPC types and other non-natural cover types, including old fields, roads and various categories of open water. Tables 1 provides statistics for each NPC map unit.

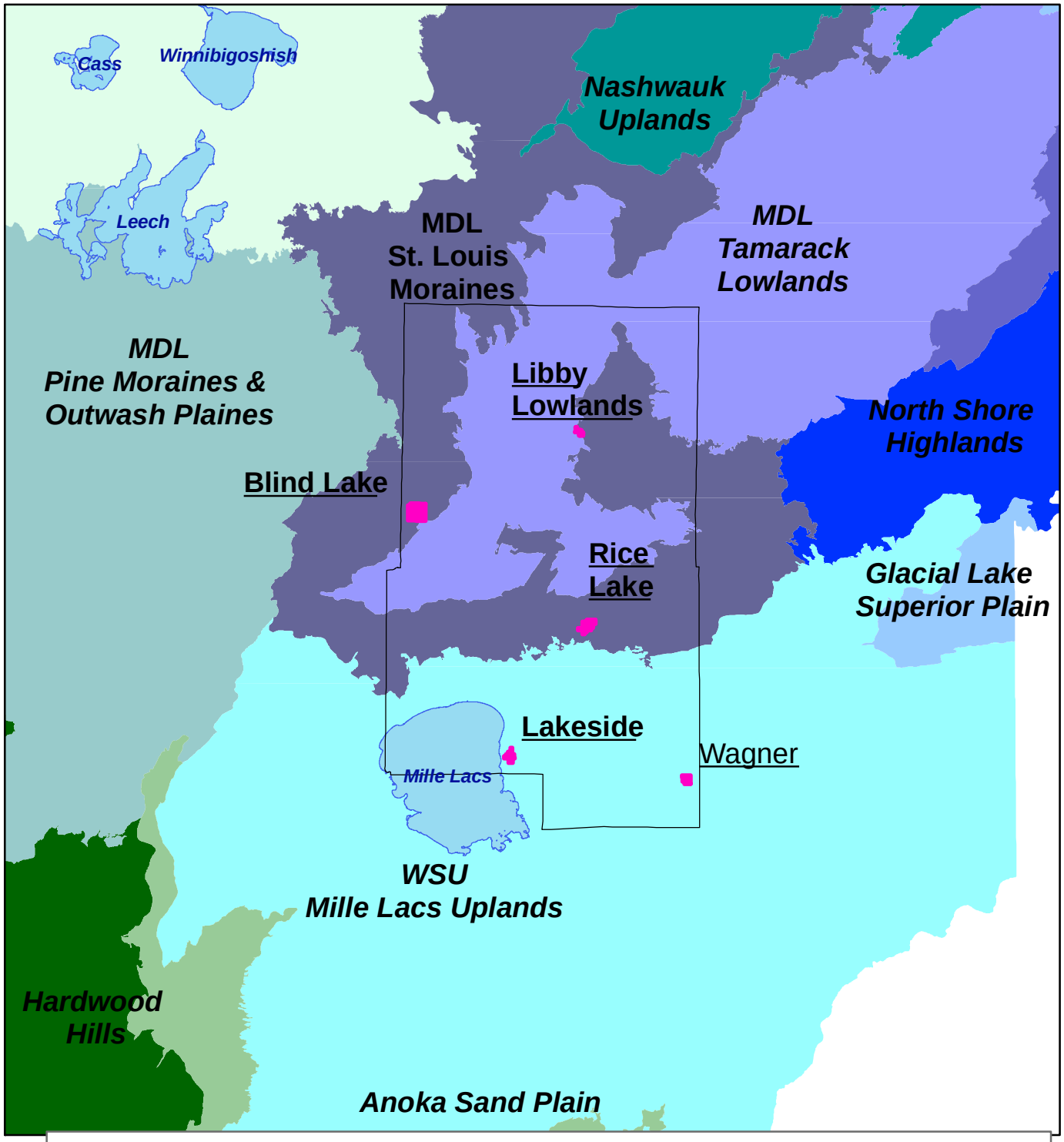
Figures 9: ACLD Lakeside Unit - Native Plant Community Polygons Classified by Potential NPC Class. In order to illustrate potential outcomes of management decisions (Desired Future Conditions) polygons of the existing vegetation map were re-labeled by their potential NPC Class codes within the GIS attribute table. For example, ACLD desires to promote red oak. The Potential Vegetation Map in Figures 9 & 10 (Appendix 3) depict this priority. For example, Existing Vegetation Maps can show areas currently in a non-natural state, or with native vegetation in an undesirable seral stage, such as young deciduous forest (2.6a). In contrast, the Potential Vegetation Map shows that these same areas could be managed for Red Oak - Basswood Forests (MHc36) because they have the prerequisite soils and geomorphic land formation (see Figs. 5 & 9, Appendix 3). Furthermore, NPC polygons were also labeled in the GIS attribute table by an area's "Potential ECS System". Non-natural vegetation types were identified by the ECS system that best expresses the prevailing ecological processes governing vegetation. The areas in Figure 10 (Appendix 3), depict NPC polygons that would be best managed as "Mesic Hardwood" communities. These are areas that also show potential for red oak management. These examples demonstrate how management outcomes described in Aitkin County's Strategic Plan can be illustrated using NPC polygons produced from this study. The potential vegetation map can also be used to identify habitats for plants and animals. For example, the state threatened plant, False Mermaid (*Floerkea proserpinacoide*s) inhabits wet hardwood forests perched on upland

moraines (see Table 7, Appendix 2). Three NPC types are considered prime potential habitats (MHn46a, MHn46b & WFn55b). Combined, these NPC potential classes provide over 63 acres (10%) of the unit as potential habitat for this rare species.

Figure 10. Native Plant Community (NPC) Polygons Classified by Their Potential ECS System. Polygons of the existing vegetation map were re-labeled by their potential NPC System codes within the GIS attribute table, in order to illustrate potential outcomes of management decisions (Desired Future Conditions). For example, given that both state (MN DNR 2006) and national (USFWS 2010) conservation priorities prescribe the reduction of aspen dominated woodlands in order to promote mixed pine woodlands and especially jack pine barrens. The Potential Vegetation Map in Figures 9 & 10 depict this priority. Furthermore, NPC polygons were also labeled in the GIS attribute table by an areas Potential ECS System. Non-natural vegetation types were identified by the ECS system that best expresses the prevailing ecological processes governing vegetation. The areas in Figure 5, depict NPC polygons that would be best managed as "Mesic Hardwood" communities.

Aitkin County Land Dept.

Minnesota Ecological Classification System
Subsections of Laurentian Mixed Forest Province
Location of ACLD Management Areas



Wildlands Ecological Services

Aitkin Co. Project Area

Subsections of the Laurentian Mixed Forest Province

Scale
1:1,079,302

Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

Aitkin County Land Dept.

Land Management Units and Surficial Geology
Origin of Glacial Till, Land Formations of
Various Lobes of the Wisconsin Glaciation

Legend

Wildlands Ecological Services

Aitkin Co. Project Area

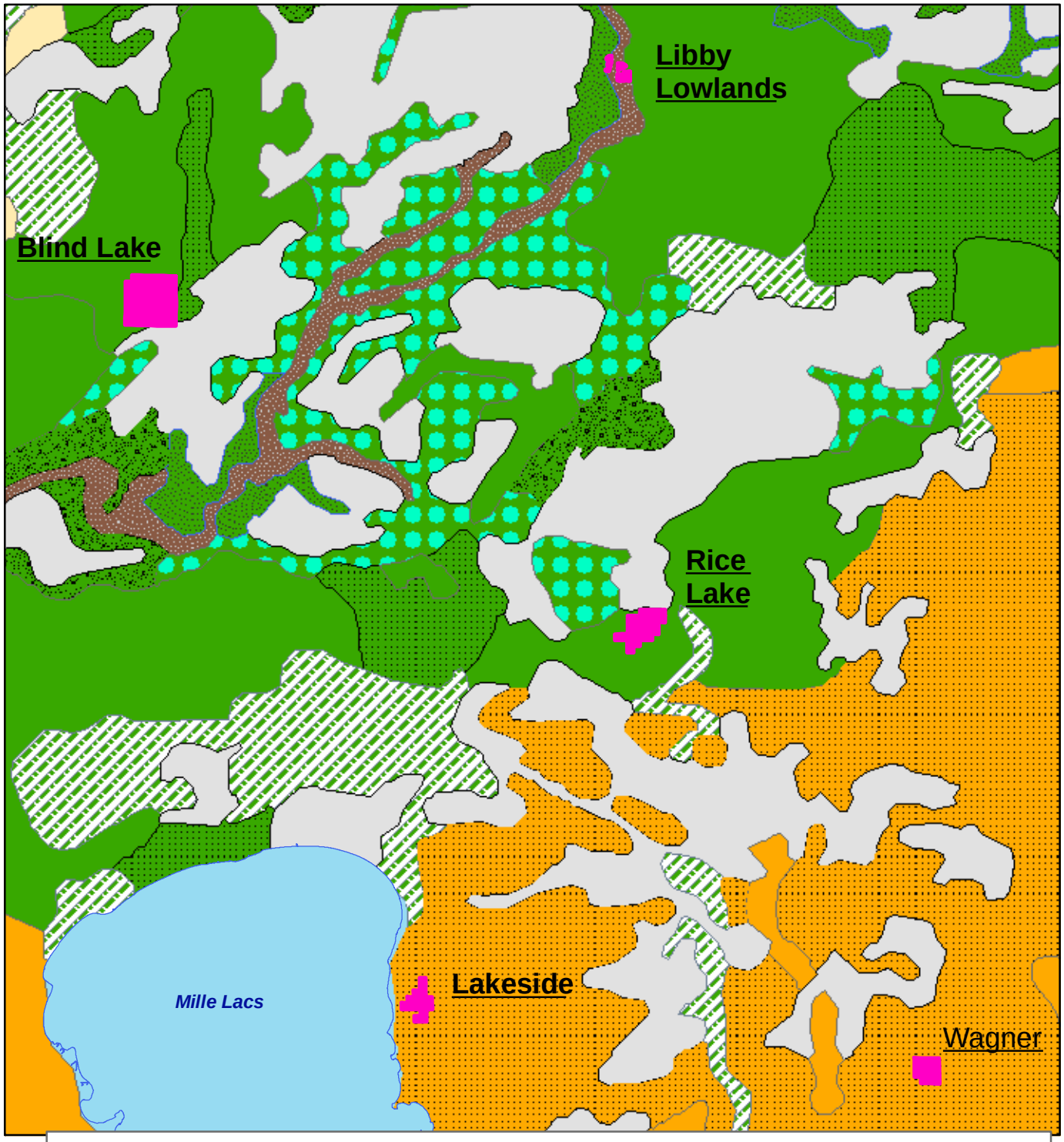
Quaternary Geology of Minnesota - MGS 1982 State Map Series

Scale
1:375,818

Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

Aitkin County Land Dept.

Land Management Units and Surficial Geology
Origin of Glacial Till, Land Formations of
Various Lobes of the Wisconsin Glaciation



Wildlands Ecological Services

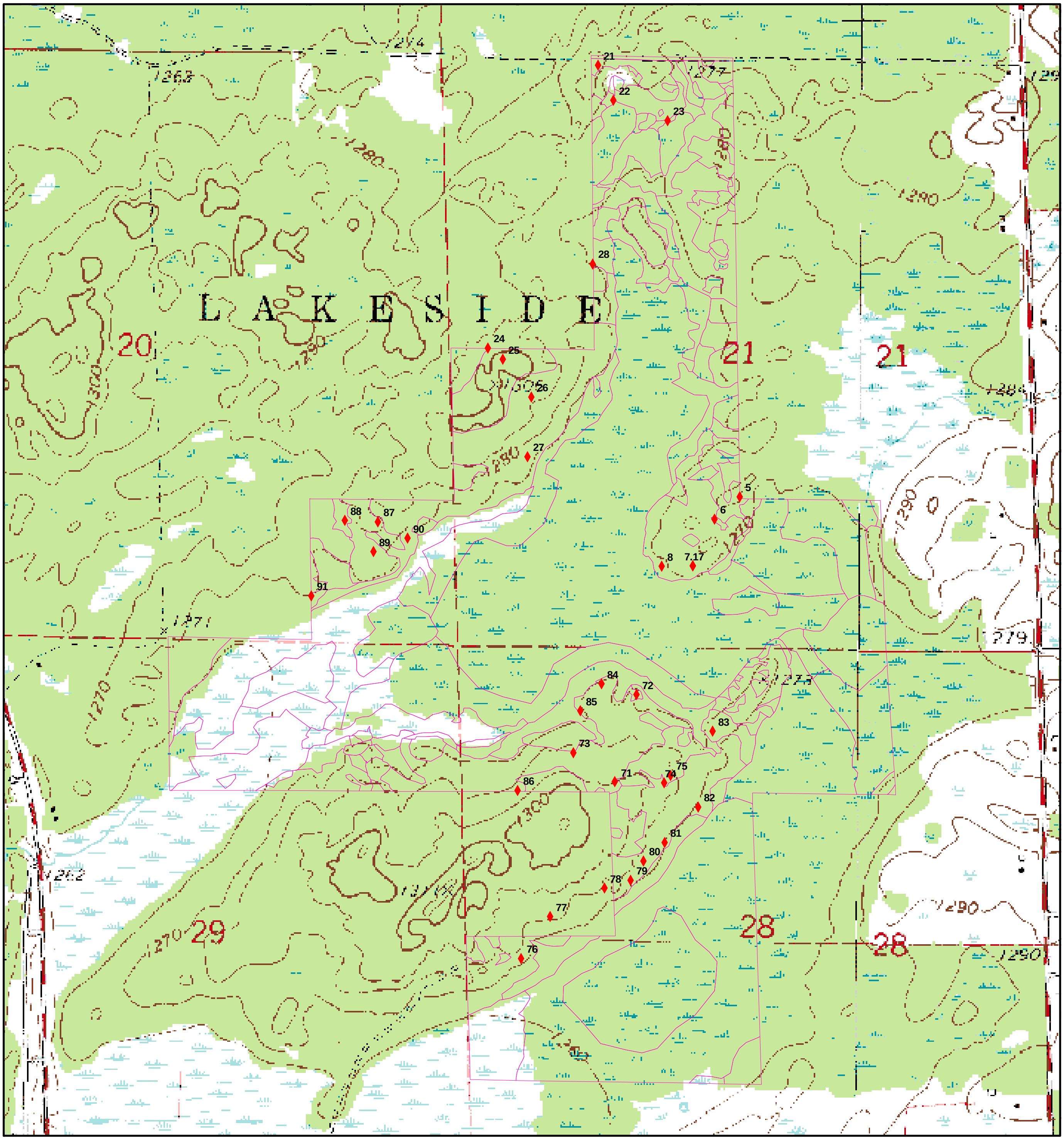
Aitkin Co. Project Area

Scale
1:375,106

Quaternary Geology of Minnesota - MGS 1982 State Map Series
Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

Aitkin County Land Dept.

Lakeside Management Unit
USGS Topographic Map
Native Plant Community Boundaries



Legend

Native Plant Community Type Boundaries

Aitkin ECS Waypoint Samples

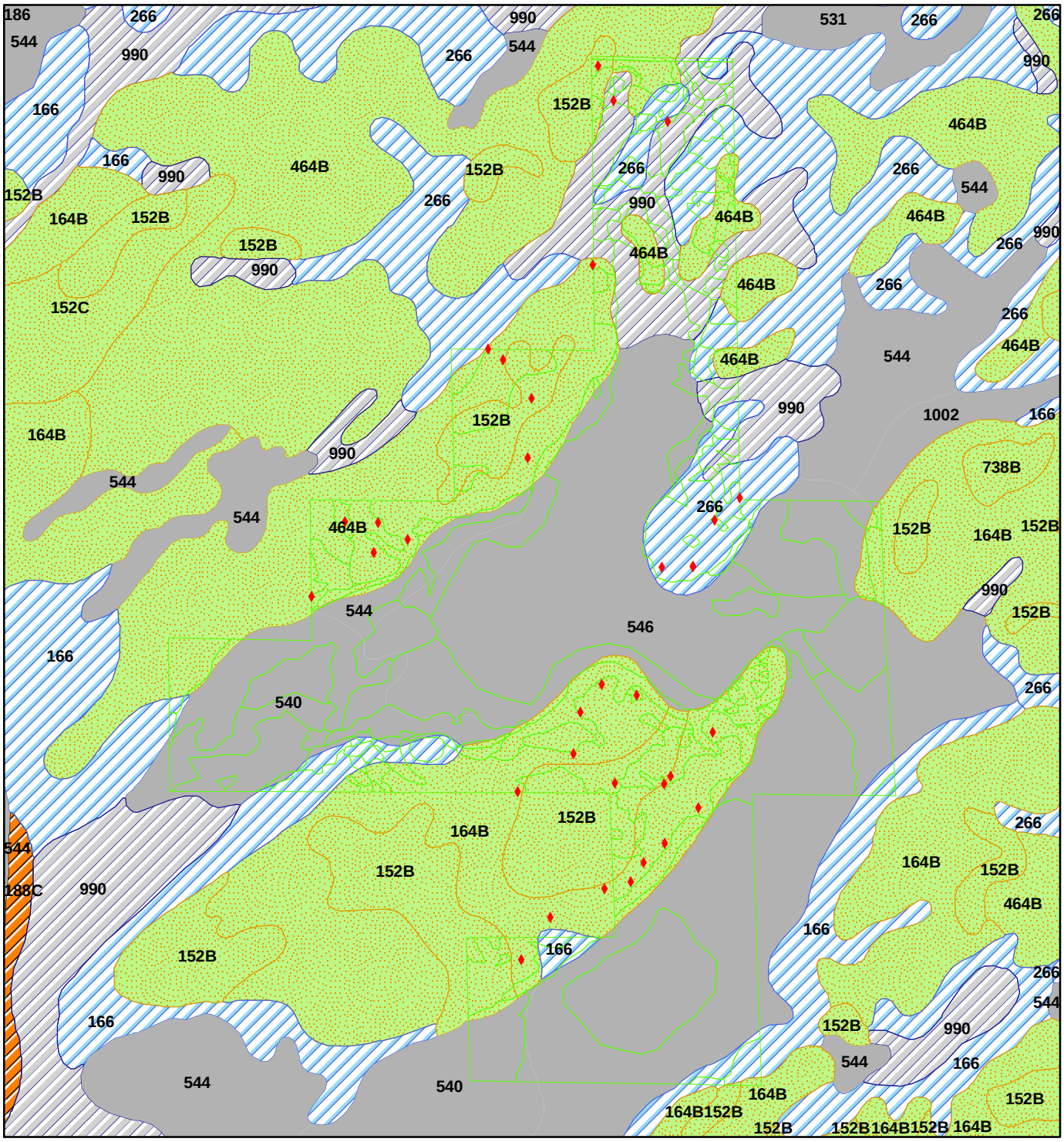
Wildlands Ecological Services

Scale
1:16,075

Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

Aitkin County Land Dept.

Lakeside Management Unit
USDA-NRCS Soil Unit Polygons
Reclassified by Soil Moisture-Texture



Wildlands Ecological Services

Scale
1:16,105

Legend

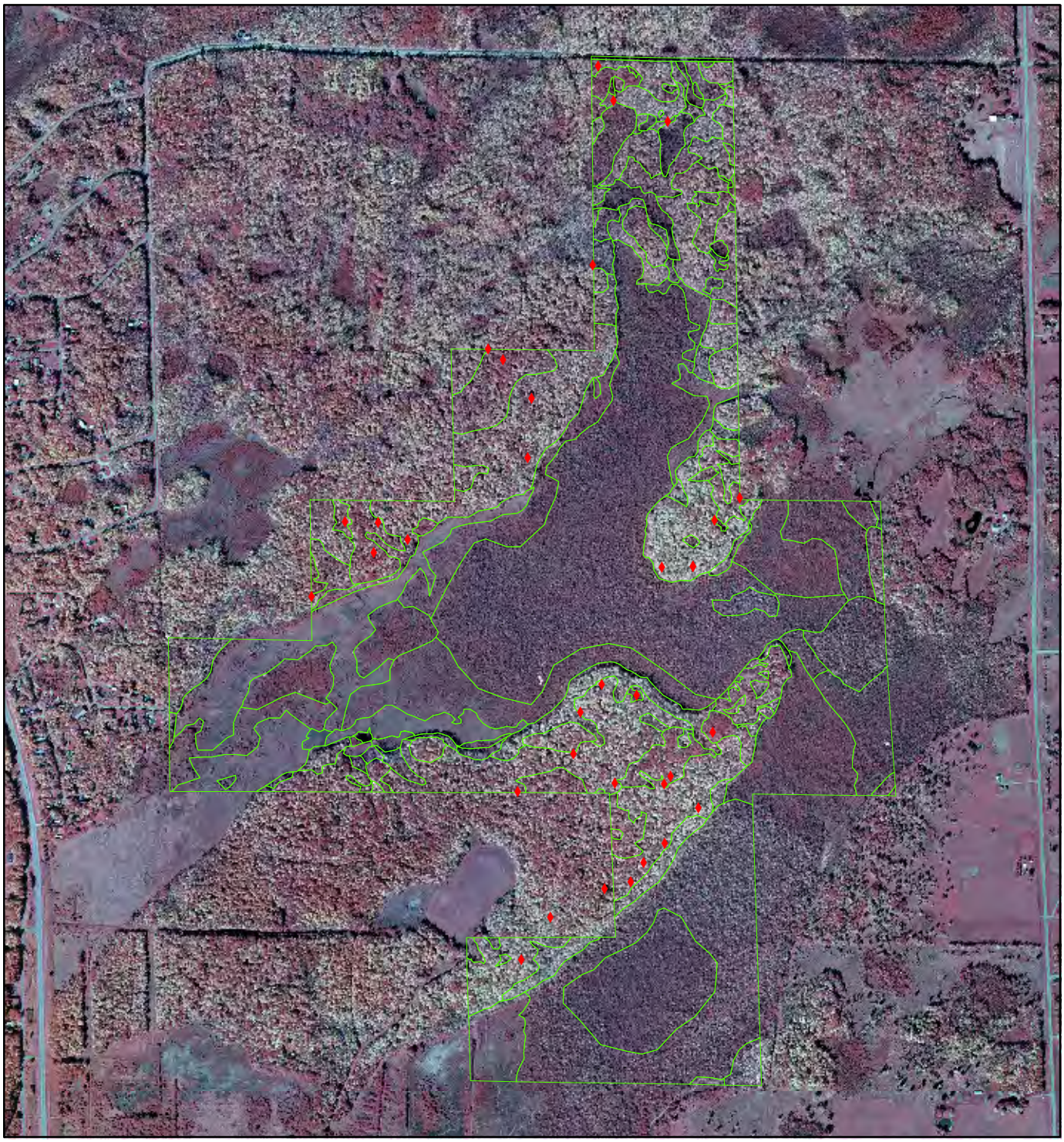
Soil Moisture-Texture

- 02 = Dry-Mesic Sand
- 03 = Dry-Mesic Loam
- 04 = Mesic Sand
- 05 = Mesic Loam
- 06 = Wet-Mesic Sand
- 07 = Wet-Mesic Loam
- 08 = Wet Sand
- 09 = Wet Loam
- 10 = Peat
- 10 = Peat / Water
- 11 = Water
- Aitkin ECS Waypoint Samples
- Aitkin Co. Project Area

Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

Aitkin County Land Dept.

Lakeside Management Unit
Color-Infrared Aerial Photographs
Native Plant Community Boundaries



Wildlands Ecological Services

Legend

Native Plant Community Type Boundaries

Aitkin ECS Waypoint Samples

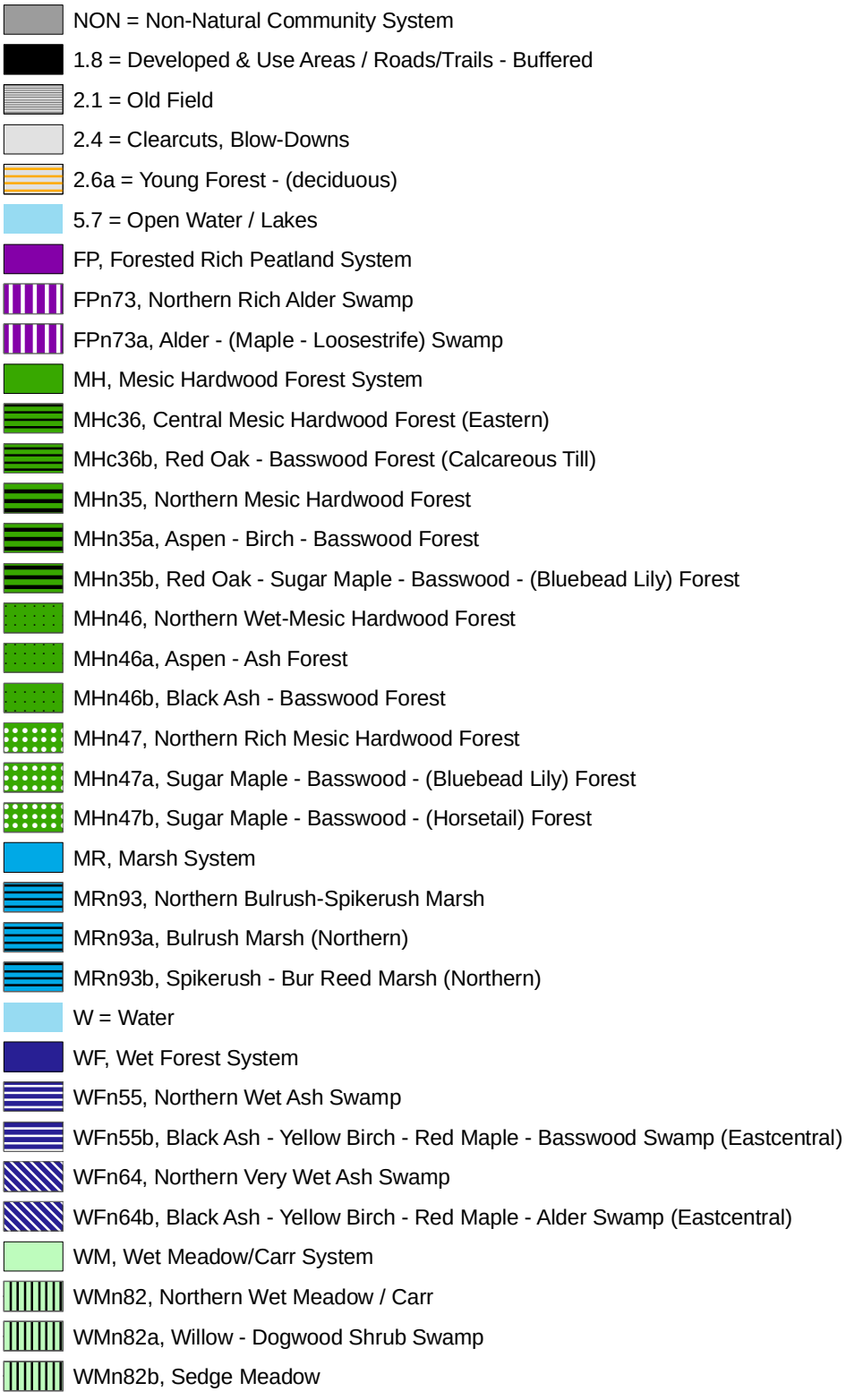
Scale
1:16,105

Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

Aitkin County Land Dept.

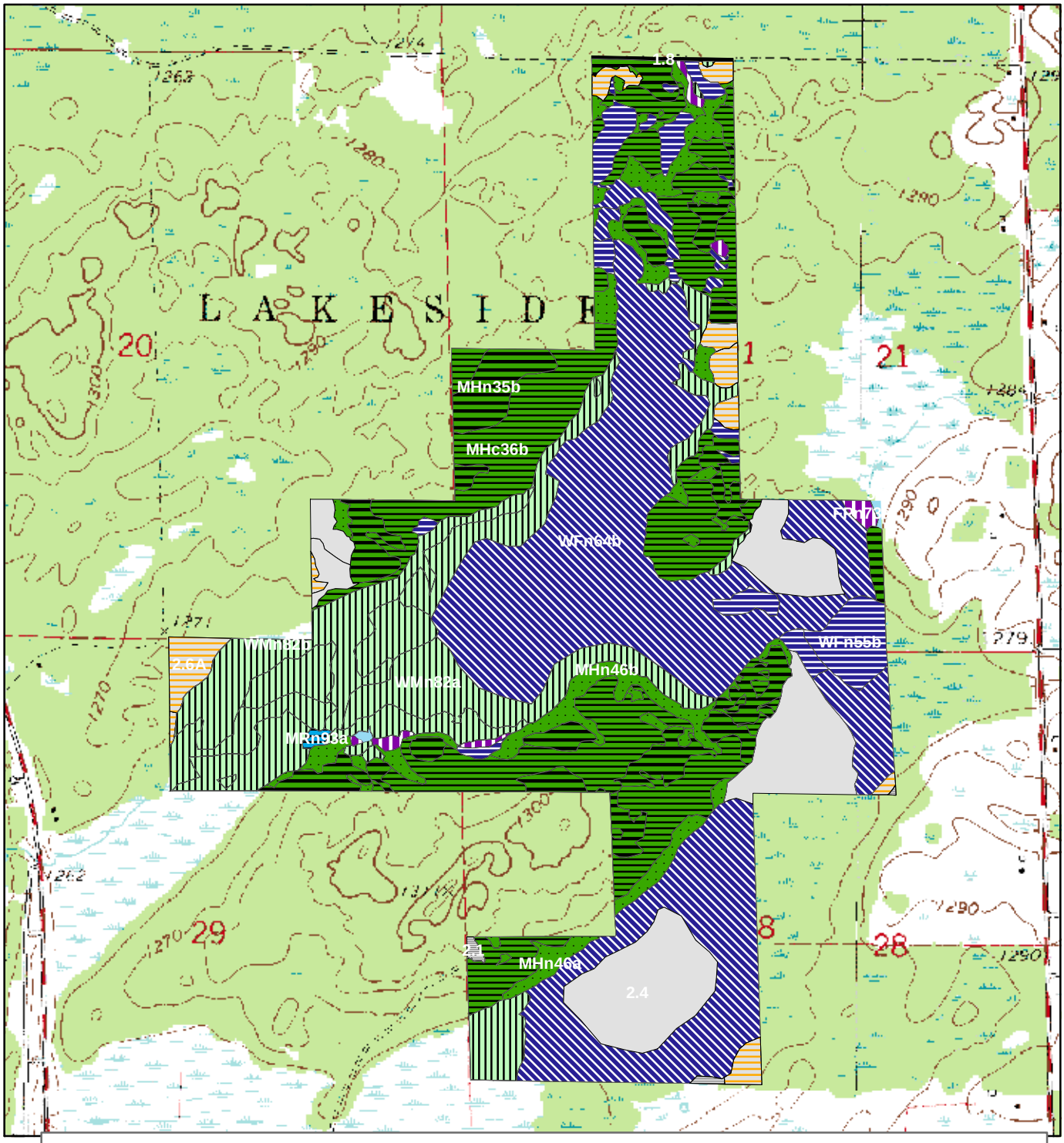
Lakeside Management Unit
Native Plant Community Boundaries
Extant NPC & Non-Natural Cover Types

Legend



Aitkin County Land Dept.

Lakeside Management Unit
Native Plant Community Boundaries
Extant NPC & Non-Natural Cover Types



Wildlands Ecological Services

Aitkin Co. Project Area

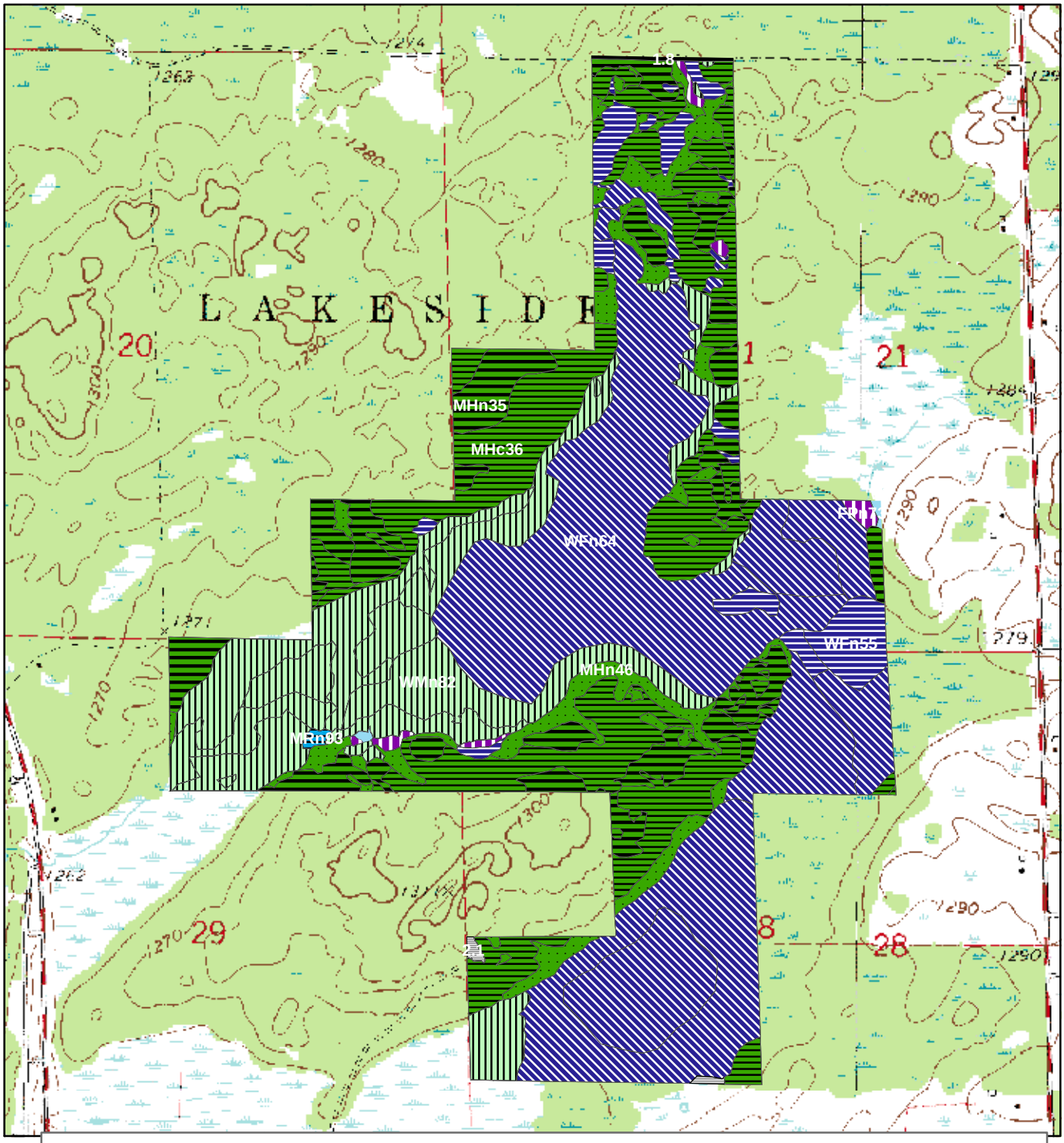
Native Plant Community Type Boundaries

Scale
1:16,058

Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

Aitkin County Land Dept.

Lakeside Management Unit
Native Plant Community Boundaries
Potential NPC Class (Desired Future State)



Wildlands Ecological Services

Aitkin Co. Project Area

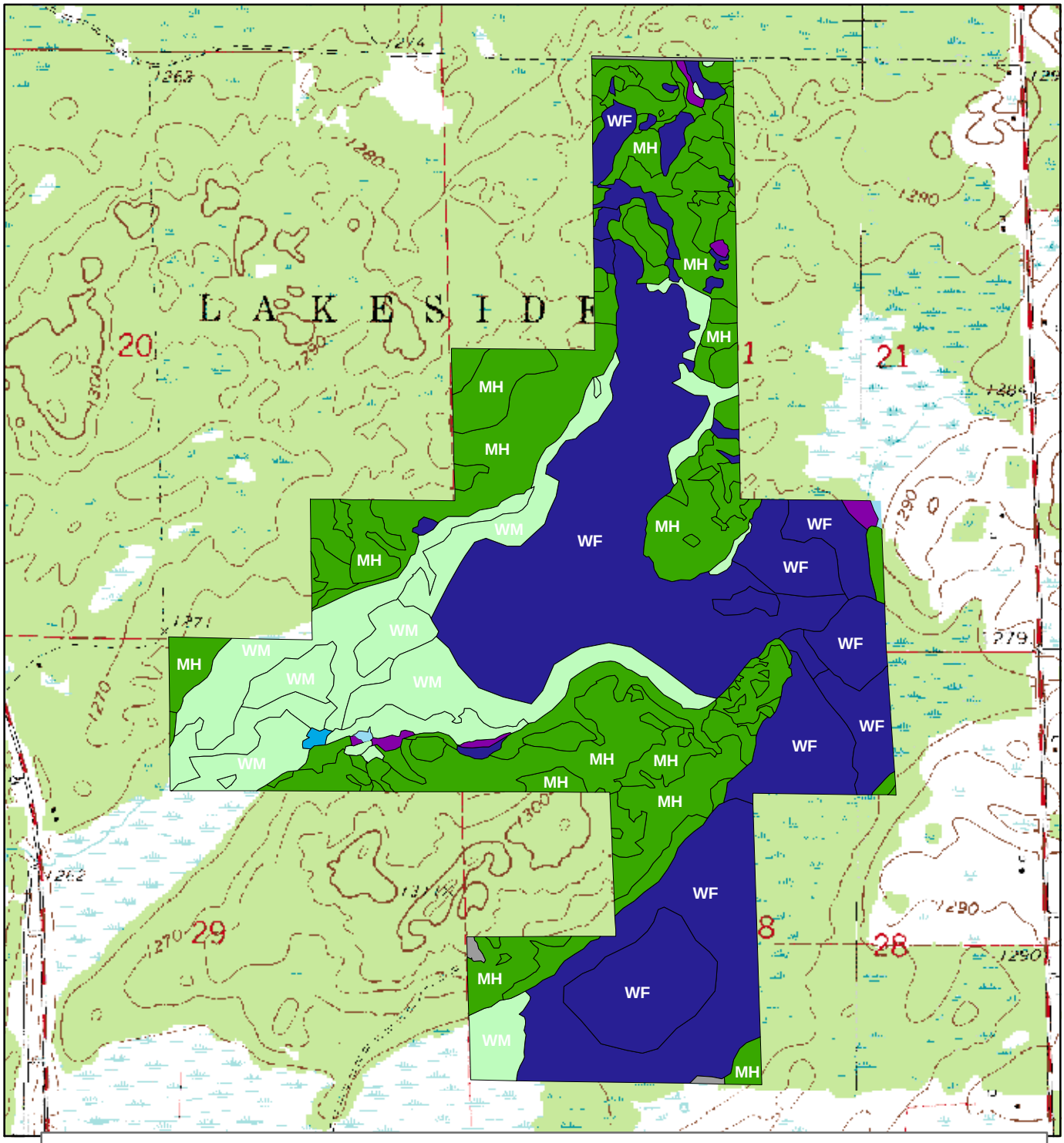
Native Plant Community Type Boundaries

Scale
1:16,058

Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

Aitkin County Land Dept.

Lakeside Management Unit
Native Plant Community Boundaries
NPC System (Desired Future State)



Wildlands Ecological Services

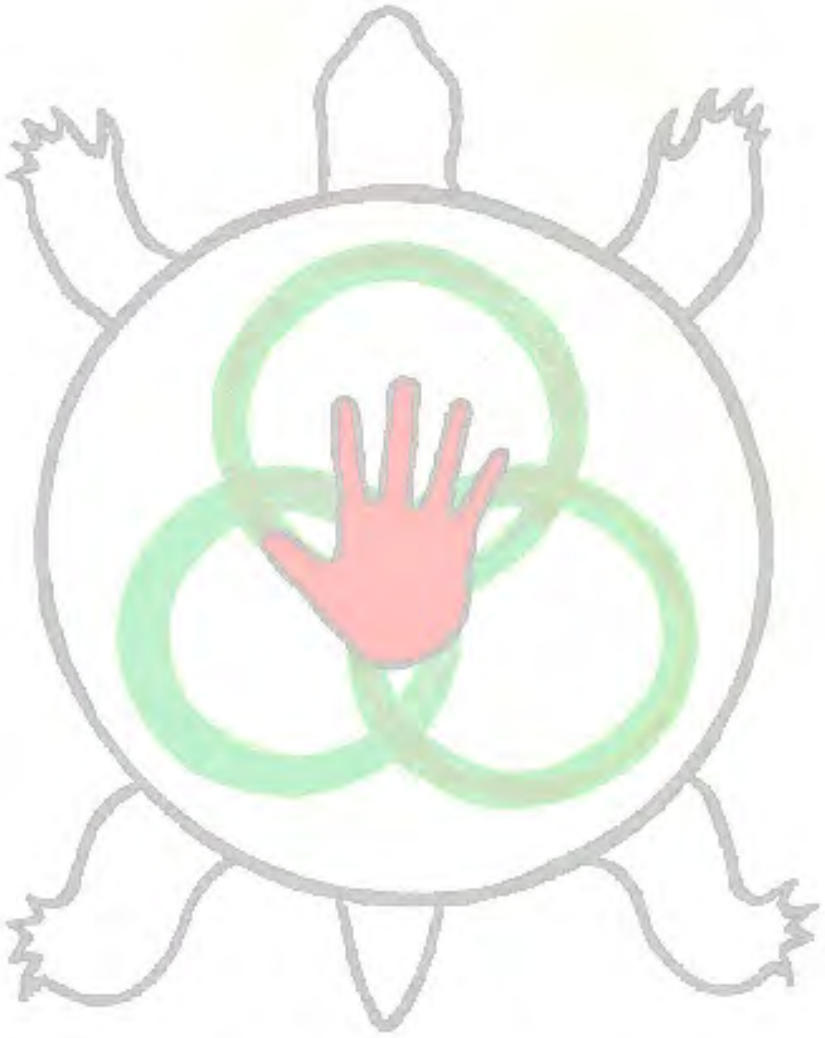
Aitkin Co. Project Area

Native Plant Community Type Boundaries

Scale
1:16,058

Map by Scott Zager, Wildlands Ecological Services - 01/31/2012

WILDLANDS



ECOLOGICAL SERVICES

Wildlands Ecological Services (WILDLANDS) is a small company that surveys vegetation and constructs ecological maps using a combination of techniques including Geographic Information System (GIS) software, remote sensing (air photo interpretation), and field investigation. Clients include federal, tribal, state and county agencies – as well as private engineering firms – requiring vegetation surveys and GIS maps of parks, wildlife management areas, ecologically-managed commercial forests, etc. WILDLANDS also conducts not-for-profit research in habitat conservation, plant taxonomy and floristics. Products include databases, electronic maps, ecological analysis and interpretive reports. As the name implies, WILDLANDS focuses on large natural areas often in remote wilderness settings. Our mission is to provide affordable data useful toward sustainable management of important ecosystems.

Scott Zager is the sole proprietor of WILDLANDS. Since receiving his master's degree in botany at the University of Northern Iowa, he has been a professional botanist and plant ecologist for over twenty-six years since beginning floristic studies as an Assistant Park Ranger for Iowa State Parks. Later as a natural resource technician for Black Hawk County, IA; he restored prairies, planted trees and managed natural areas on public and private lands. As a research assistant at the University of Northern Iowa, he researched native plant establishment and erosion control. For nearly twelve years he worked as a plant ecologist of for the Minnesota County Biological Survey (MCBS), where he mapped vegetation and searched for rare plants in nearly every type of plant community within the eastern half of Minnesota from border to border. As a private consultant for Wildlands Ecological Services, he has expanded his geographic range to include much of the Midwest. He was the principal ecologist in plant and vegetation surveys of the Red Lake Peatlands - the largest peatland complex in the contiguous United States. He mapped vegetation for Lake Itasca State Park and St. Croix State Park (Minnesota's largest state parks). He as also mapped vegetation in U.S. National Wildlife Refuges (Agassiz National Wildlife Refuge). Other projects have been completed in Iowa and Wisconsin. He has taught Plant Taxonomy at the University of Minnesota - Crookston. His academic research is focused on plant taxonomy and systematics. His graduate studies investigated a very difficult taxonomic group of sedges in the genus Carex. He is currently working with Dr. William Norris on an illustrated monograph of the genus Carex in Iowa.