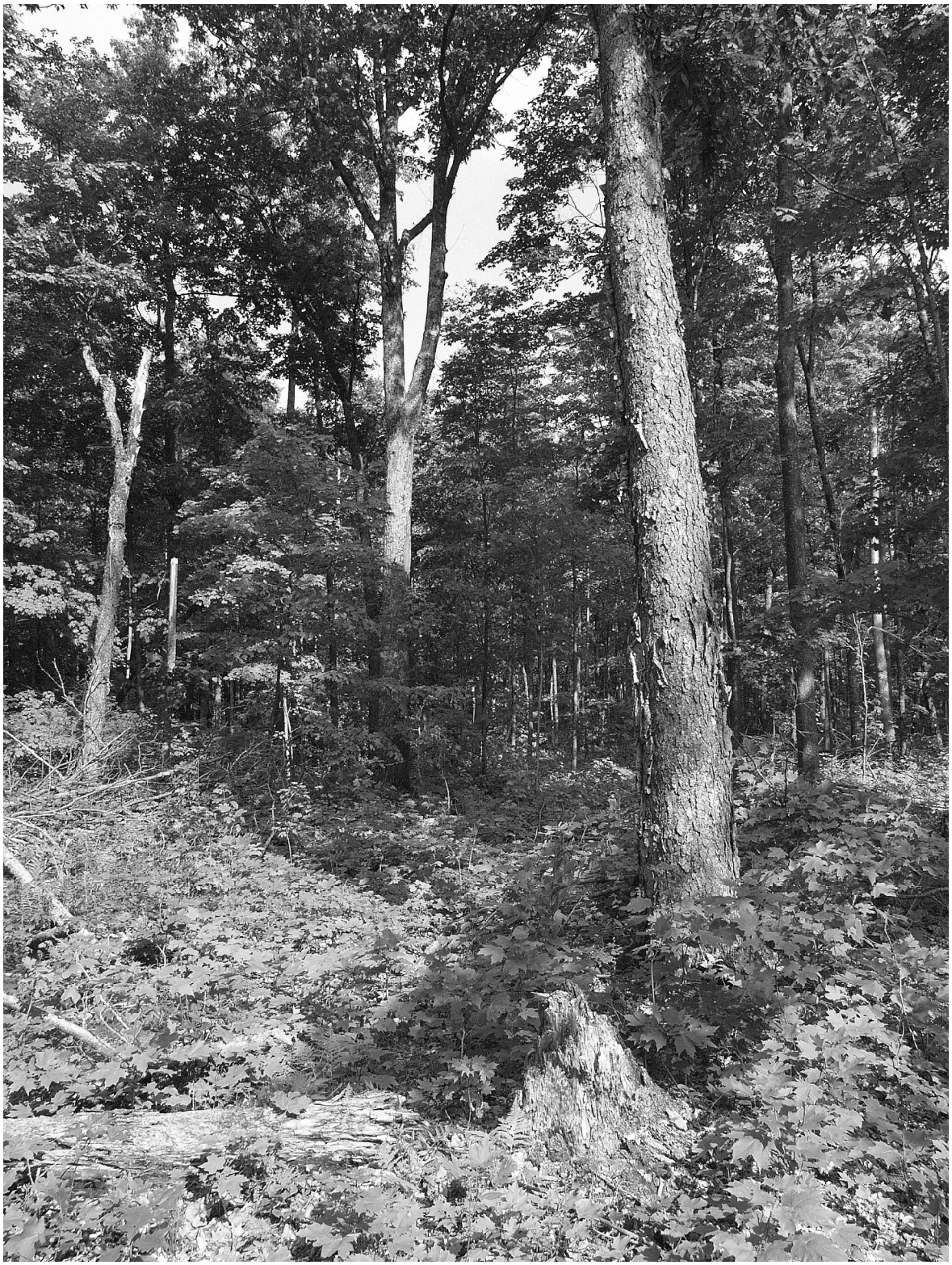
Ecological Evaluation and Assessment of the Cornish Area High Conservation Value Forest (HCVF), Land Department, Aitkin County, Minnesota

Scott Zager, Plant Ecologist, Wildlands Ecological Services



Ecological Evaluation and Assessment of the Cornish Area High Conservation Value Forest (HCVF), Land Department, Aitkin County, Minnesota

June 15, 2010

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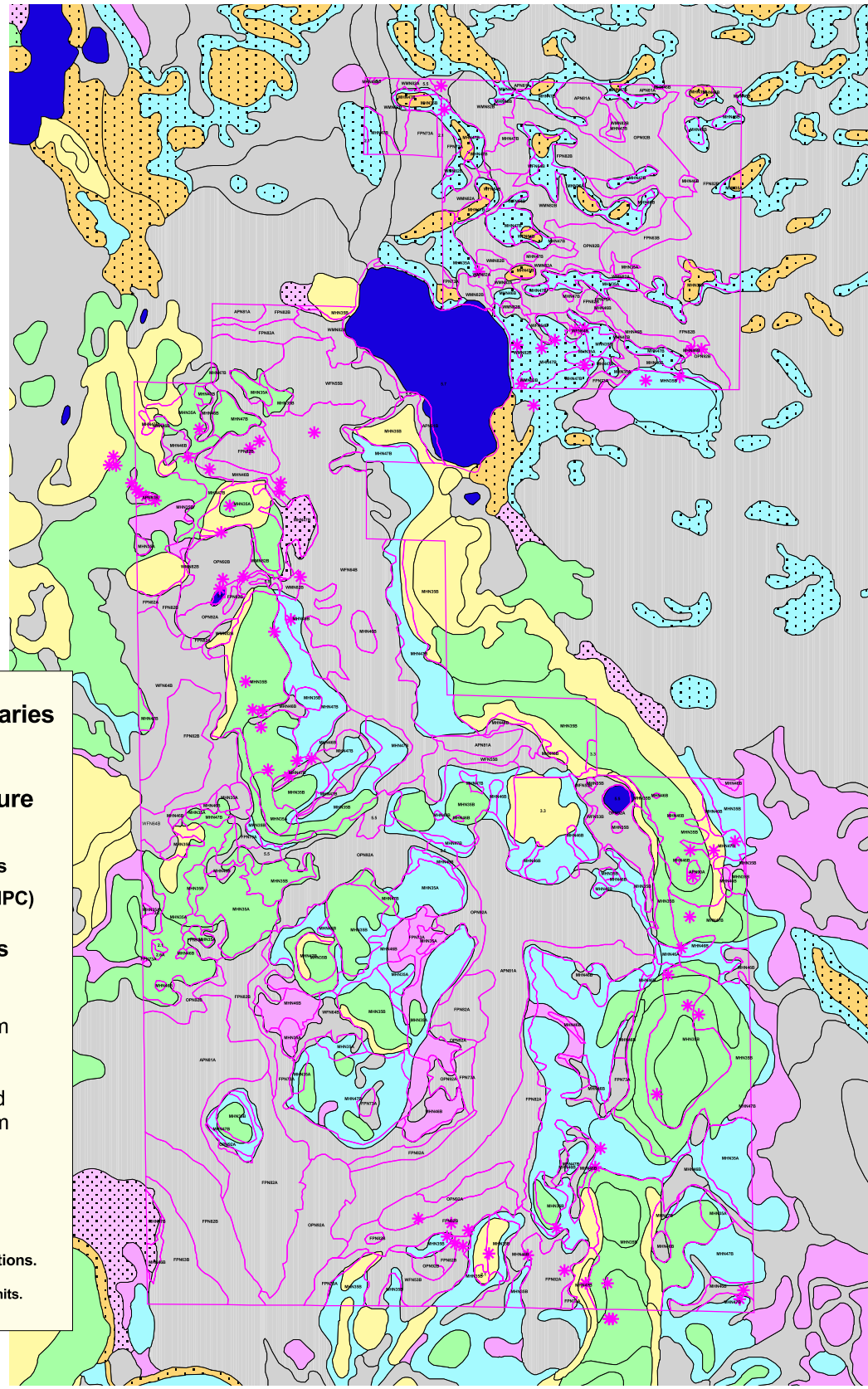
WILDLANDS
ECOLOGICAL SERVICES

NATIVE PLANT COMMUNITY TYPES (NPC)
Cornish Area - Aitkin County Land Department



Cornish Area NPC Boundaries overlying USDA Soil Map Units Classified by Soil Moisture

- Waypoint Sample Locations
- Native Plant Community (NPC) Boundaries

Soil Moisture Categories

- 01 = Dry Sand
- 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
- 11 = Water

See attached table for full NPC descriptions.

See table for description of USDA map units.

Map created by Scott Zager, Plant Ecologist, Wildlands Ecological Services

Final Map - January 29, 2009

NATIVE PLANT COMMUNITY TYPES (NPC)
Cornish Area - Aitkin County Land Department

Cornish Area NPC Types with CIR Air Photos

- 2.1
- 2.6A
- 3.2
- 3.3
- 5.5
- 5.7
- APN81A
- APN81B
- APN90A
- APN91B
- FPN46B
- FPN63B
- FPN73A
- FPN73B
- FPN82A
- FPN82B
- MHN35A
- MHN35B
- MHN46A
- MHN46B
- MHN47B
- OPN92A
- OPN92B
- WFN53B
- WFN55B
- WFN64B
- WMN82A
- WMN82B
- Waypoint Sample Locations

See attached table for full NPC descriptions.

Map created by Scott Zager, Plant Ecologist, Wildlands Ecological Services

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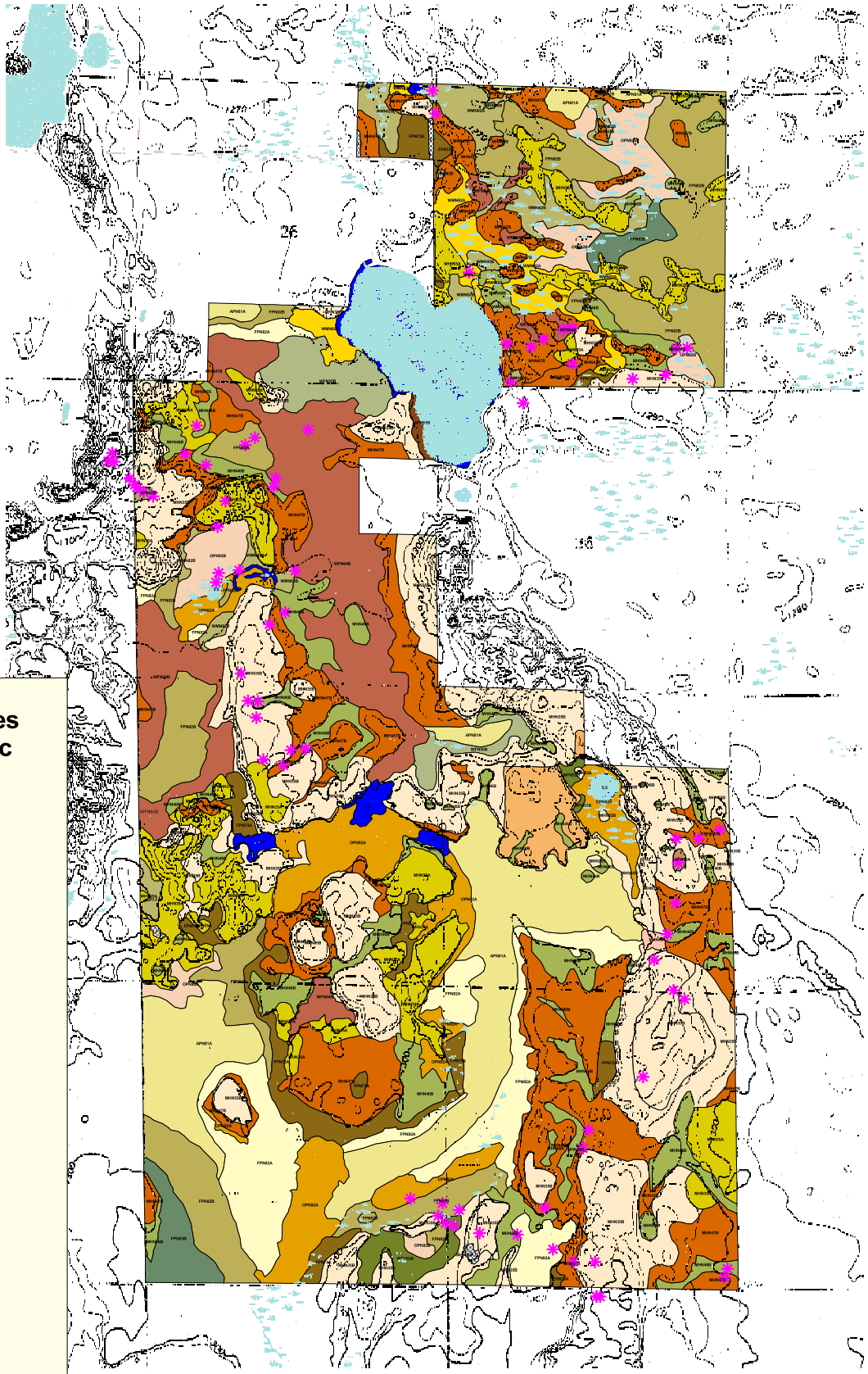
NATIVE PLANT COMMUNITY TYPES (NPC)
Cornish Area - Aitkin County Land Department



Cornish Area NPC Types with USGS Topographic Elevation Lines.

- 2.1
- 2.6A
- 3.2
- 3.3
- 5.5
- 5.7
- APN81A
- APN81B
- APN90A
- APN91B
- FPN63B
- FPN73A
- FPN82A
- FPN82B
- MHN35A
- MHN35B
- MHN46A
- MHN46B
- MHN47B
- OPN92A
- OPN92B
- WFN53B
- WFN55B
- WFN64B
- WMN82A
- WMN82B
- Waypoint Sample Locations

See attached table for full NPC descriptions.

Map created by Scott Zager, Plant Ecologist, Wildlands Ecological Services

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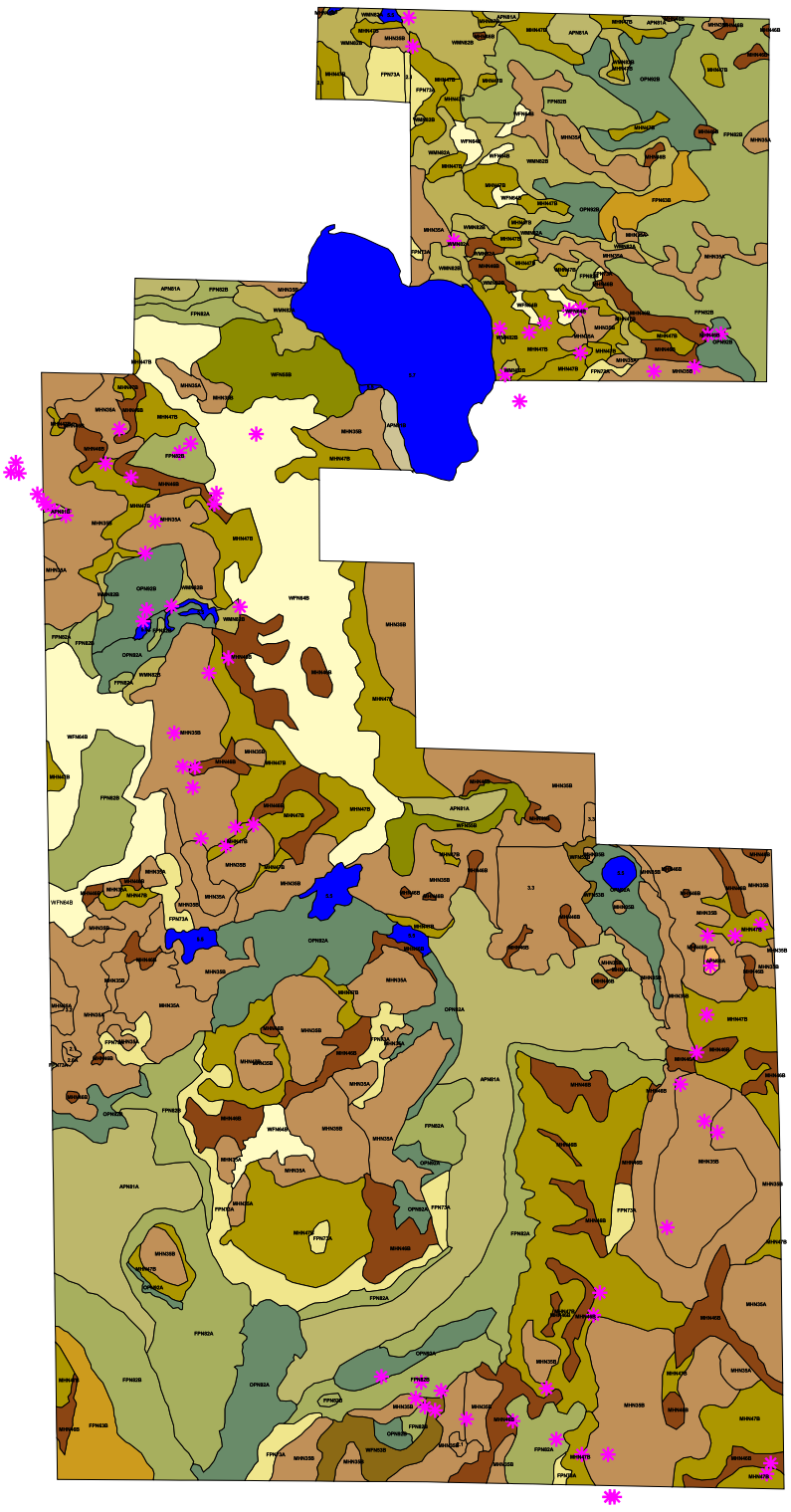
NATIVE PLANT COMMUNITY CLASS (NPC)
Cornish Area - Aitkin County Land Department



Cornish Area NPC Class

Cornish NPC Classes

- 5.5
- 5.7
- APN81
- APN90
- APN91
- FPN63
- FPN73
- FPN82
- MHN35
- MHN46
- MHN47
- OPN92
- WFN53
- WFN55
- WFN64
- WMN82

Waypoint Sample Locations

See attached table for full NPC descriptions.

Map created by Scott Zager, Plant Ecologist, Wildlands Ecological Services

Final Map - January 29, 2009

ACKNOWLEDGMENTS

I wish to thank the staff of the Aitkin County Land Department, specifically Beth Jacqmain and Dan Gordon for their assistance and advice.

Aitkin County Land Department:
Beth Jacqmain, Assistant Land Commissioner.
Dan Gordon – Bob Kangas: ACLD Foresters.
Minnesota Department of Natural Resources:
Gretchen Mehmel, Wildlife Manager, Red Lake WMA, MN DNR
John Almendinger – Dan Hanson, MN DNR Forestry.
Jason Johnson – Minnesota County Biological Survey, MN DNR

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

SUMMARY

The Aitkin County Land Department (ACLD) contracted Scott Zager, Plant Ecologist for Wildlands Ecological Services, to survey vegetation and soils on the Cornish Hardwoods Management Unit. This report, maps and supporting database are the result of that study conducted during the field season of 2008. 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 Cornish Hardwoods 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 Cornish 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 Goal of this survey was Not To Map 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 1 see Appendix II).

Two such HMZs are located in Cornish Township near Hay Lake, the subject of this report, which is managed jointly with the Minnesota Department of Natural Resources (MN DNR).

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 Cornish HCVF and vicinity. Later in 2001, MCBS herpetologists documented locations of a rare salamander near Cornish area in similar habitat as that found within the HCVF boundaries (Table 2 Appendix II).

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

MCBS has yet to publish data about the Native Plant Communities within Cornish HCVF. 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 representation of these ecological variables on a computer-generated ECS map (Figure 2) 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 Cornish HCVF 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 (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.

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 Cornish Hardwoods Management Unit (MU# 11) in the northeast quarter of the county. A brief summary of the ACLD management plan for MU# 11 and a location map is provided in Appendix I.

WILDLANDS was contracted by ACLD to conduct an ECS survey and map vegetation in parcels of seven PLS sections (~3.800 acres) within the Cornish Hardwoods Management Unit, which includes the Cornish HCVF. The Cornish Unit is managed jointly by ACLD and MN DNR. The unit encompasses 84,610 total acres total, of which 17,346 acres (21%) is owned by Aitkin County. The overall management goal is to maintain and expand large forest patches with a focus on shade-tolerant, long-lied 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 Cornish management unit (e.g., white pine, yellow birch, upland cedar, etc.).

GLACIAL HISTORY AND SURFICIAL GEOLOGY

The following is a summary of glaciers, and their aftermath, that have influenced the ecology of the Cornish HCVF.

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.

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).

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 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 2008. During the survey, I spent a day in the field with the Cornish area forester, Dan Gordan. Beth Jacqmain, Assistant Land Commissioner for the Aitkin County Land Department, was project manager for the study. Data were collected at a total of 81 waypoint locations within the various Native Plant Community (NPC) map units present (Table 3 Appendix II, Figures 2). 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). Selected reports for some waypoints are provided in the Appendix III. For each waypoint sample, a synopsis is given within the "General Description" field. Plant species composition was recorded at each site. At most sites, species' abundance values were recorded as well. Observations about the vegetation structure were

recorded. These describe the total percent cover, height range and typical diameter of trees for each different height strata of the vegetation (Canopy, Subcanopy, Shrub, Subshrub, Graminoid, Forb and Bare ground). At many sites, soil data were collected from pits dug up to 1 m depth. The depth of each soil horizon, when recorded, is measured to the bottom of the layer. A synopsis of the landscape and soils are provided, along with the NRCS soil map unit where the sample occurs. Within the database, a total of over 300 digital pictures are hyperlinked to their corresponding waypoint record.

Soils and NPC distributions

The Cornish and Seavey HCVF areas 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 4 Appendix II). The soils map for the Cornish Area is a subset of NRCS soils surveys from Aitkin County (NRCS 2008). ARCGIS shapefiles of the Aitkin county soil survey were clipped according to the Cornish HCVF boundary and combined into one cover. Table 4 (Appendix II) is an index to NRCS soil map units within Cornish HCVF. It shows soil unit names, map number, soil properties, soil drainage and soil taxonomic hierarchy.

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 Cornish HCVF 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 Cornish HCVF 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).

ARCGIS polygons of native vegetation for Cornish HCVF lands were delineated and classified according to their respective map units of Native Plant Community (NPC) classes and types (e.g., MHn35, MHn35b, etc.) (MN DNR 2005; see Table 3 - Appendix II - for a complete list of mapped NPC types). All the polygons of each NPC type were overlain upon the soil cover. Then soil map unit polygons were clipped according to the NPC polygons. 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 relative significance of a soil map unit for each NPC class, acreage values were transposed into a percentage of the total area covered by that particular soil unit within each NPC type. Table 5 (Appendix II) shows the results of this analysis sorted by NPC code (i.e., MHN47b) referenced to the full name of the NPC class in Table 3 - Appendix II - (i.e., MHn47b = Mesic Hardwood Forest System / Northern Rich Mesic Hardwood Forest / Sugar Maple - Basswood - (Horsetail) Forest).

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.

Major 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 5 (Appendix II) 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. Table 5 (Appendix II) and its accompanying soils map could be invaluable tool in predicting potential outcomes to prescribed management practices.

General Descriptions of Soil Moisture Types

The mineral soil in much of the Cornish HCVF 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 Cornish HCVF were compiled in Appendix IV and summarized within the most relevant NPC descriptions (NRCS 2008).

Existing Vegetation Map of Native Plant Community (NPC) Units

A cover map of existing vegetation was created using ARCVIEW v3.3/9.3 for the Cornish HCVF area.

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). 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 Cornish HCVF were determined from analysis and evaluation by Scott Zager of vegetation data collected at 81 waypoint sample locations (Table 6 Appendix II; Sample Data, Appendix III). 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 1) 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 (Figure 2) for Cornish HCVF is comprised of 302 polygons classified according to 20 different NPC types and 6 other cover types, including old fields, young (disturbed) forests and various categories of open water. Table 3 (Appendix II) provides statistics for each NPC map unit. For example, the study area contains 9 separate polygons classified as seasonal ponds or potholes (5.5) with at total area of 25.6 acres. Sugar Maple - Basswood Forest (MHn47b) was a common NPC type with 53 polygons and a total area of 547.4 acres.

Each polygon attempts to define a homogeneous unit of vegetation with a well-define 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.

ARCVIEW GIS shapefiles of the NPC cover for Agassiz NWR are available from the Aitkin County Land Department (see address on inside cover). Also NPC data of vegetation and soils collected in 2008 are available in MS ACCESS 2002/2003/2007. Data are linked with specific GPS waypoints and associated with over 300 digital photographs taken from the NPC plots.

NPC Description and Commentary

This section is the legend for the NPC vegetation cover map prepared for Agassiz NWR. The following map unit descriptions were written primarily from data collected within the refuge using the MN DNR (2003) classification as a template. The NPC descriptions given in this report relies only on data collected within Cornish HCVF. 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).

General Recommendations for the Cornish 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 Cornish HCVF 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 Cornish HCVF. At such levels there is some browsing of preferred plant species, but standing crop and productivity is controlled by the ecosystem. The deer populations is maintained at its biological potential resulting in sustainable hunting yields at low impact to the ecosystem.

A Suggested Goal for Incorporating Ecological Silviculture Techniques.

One potential management goal for the Cornish Area would be to promote marketable products from Cornish HCVF 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-conifer stand 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 (MHn35 and MHn47). 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).

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 Cornish Area.

8) Manage deer population levels occurring within Cornish HCVF 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 Potential 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 Cornish 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 Cornish 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 biodiverstiy. 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).

Ecological Classification System (ECS) Hierarchy of the Cornish HCVF

ECS is a hierarchal, nested approach of land classification that begins with large units of sub-continental sized areas of generalized common features (e.g., tall grass prairie) to ever smaller units. At each subsequently-smaller level, there is an increasing degree of homogeneity of ecological features (terrain, soils, vegetation). The following narrative uses this system to place the forested lands of Aitkin County – and Cornish HCVF – into their overall ecological context.

Laurentian Mixed Forest Province[1]

The Cornish HCVF is located within the Laurentian Mixed Forest Province. At the time of settlement this region consisted of extensive conifer, conifer-hardwood mix, or hardwood forest. The topography is variable with landforms ranging from lake plains and outwash plains, to ground and end moraines. Extensive peatlands also occupy much of this area. All of Aitkin County lies in this province.

Northern Minnesota Drift and Lake Plains Section[2]

The Laurentian Mixed Fores Province is divided into ECS sections. The Cornish HCVF is within the Northern Minnesota Drift and Lake Plains (MDL). This ECS section is comprised of extremely variable deposits of deep glacial drift, with numerous lakes and wetlands, and forest types that broadly include deciduous forests, coniferous forests, mixtures of these two types, and large areas of conifer swamp forests. The surface water patterns and forest types are correlated with glacial landforms including: outwash plains, lake plains, till plains, narrow outwash channels, moraine ridges, and drumlin fields.

MDL section is divided into ECS subsections.

Portions of the Cornish HCVF is within two of these ECS subsections: St. Louis Moraines and Tamarack Lowlands.

The St. Louis Moraines are characterized by rolling hills with steep slopes. End or stagnation moraines are the dominant geomorphic landformation. The underlying topography was formed by glacial till from the Rainy Lobe of the Wisconsin Glacier. This older till was later overridden by St. Louis Sublobe (Des Moines Lobe of the Late Wisconsin Glacial period. Northern hardwood-conifer forests were common in the southern portion of the region, south of Grand Rapids. North of Grand Rapids were northern hardwood-conifer forests, dominated by white pine, sugar maple, basswood, and balsam fir trees.

The boundaries of the Tamarack Lowlands subsection coincide with the landform boundaries of Glacial Lake Upham 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 related to the St. Louis moraines. Lowland hardwoods and conifers were the most common forest communities. Northern hardwoods and aspen-birch were common on the other portions of this region. Presently, much of the land is in public ownership.

St. Louis Moraines Subsection

Landform - **St. Louis Moraines**

This subsection consists of distinct end moraines and a pitted outwash plain associated with the St. Louis and Koochiching Sublobes of the Des Moines Lobe of the Wisconsin Glacier. These sublobes covered till laid by the earlier Rainy Lobe moraines. 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.

[1] The descriptions for these provinces comes from the MDNR's web site [www.dnr.mn.us/ebm/ecs]; 1999.

[2] " Ecological Land Classification Handbook for the Northern Minnesota Drift & Lake Plains and the Chippewa National Forest", draft, John C. Almendinger and Dan S. Hanson, MN DNR, June 1998.

Bedrock Geology - **St. Louis Moraines**
The glacial drift in this subsection ranges from 100 to 200 feet in depth. Lower Precambrian undivided granites, metavolcanics, and metasedimentary rocks underlie the glacial drift.

Soils - **St. Louis Moraines**
Loamy calcareous soils make up about 75 percent of the soils in this subsection Excessively well drained outwash sands account for another 10 to 15 percent and poorly drained soils account for about 3 percent. Important soils, as classified by Suborders are: Boralfs (Alfisols with well drained soils that developed under forest vegetation), Aqualfs (wet soils developed under forest vegetation), Hemists (moderately decomposed organic soils), and Psamments (sandy, poorly developed well drained soils). Boralfs most common.

Climate - **St. Louis Moraines**
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 12-16% of the annual precipitation falls during winter months. Growing season length varies from 111 to 131 days.

Hydrology - **St. Louis Moraines**
The Mississippi River cuts this subsection in half. It flows northwest to southeast close to the midpoint north-south. There are some small, relatively short rivers that 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 percent of the surface area.

Presettlement Vegetation - **St. Louis Moraines**
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, there was an area of the 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 found 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.

Present Vegetation & Land Use - **St. Louis Moraines**
The most important land uses in this subsection are forestry and recreation. This area is heavily forested and timber harvesting is extensive. Aspen is the primary species harvested. Recreation is primarily associated with the unit's lakes and the areas around them.

Natural Disturbance - **St. Louis Moraines**
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

Landform - **Tamarack Lowlands**
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 Glacial Lake Agassiz, to the west). There is a ground moraine along the northern and southern borders of Glacial Lake Upham. Low drumlin ridges. are present locally.

Bedrock Geology - **Tamarack Lowlands**
Glacial drift within the lake beds ranges from 100 to 300 feet thick, with some of the thickest sediments at the northern edge of Glacial Lake Upham, where it meets the Mesabi Range. The bedrock beneath Lake Upham is Middle (Early Proterozoic) argillite, siltstone, quartzite, or graywacke, weakly metamorphosed. There is also Cretaceous shale, sandstone, and clay near the southwest end of the basin and along the border with the Mesabi Range.

Soils - **Tamarack Lowlands**
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. Important soils, as classified by Suborders are: Ochrepts, Hemists, Aquents, and Boralfs. Alluvial soils are present along major rivers.

Climate - **Tamarack Lowlands**
Total annual precipitation ranges from 24 inches in the northwest ot 27 inches in the east, with about 40% occurring during the growing season. The

growing season is short, from 92 to 115 day, as the low-lying subsection forms a frost pocket with late spring frosts and early fall frosts.

Hydrology - **Tamarack Lowlands**
Several major rivers flow through this subsection. These include the Mississippi, the St. Louis, the Whiteface, the East Swan, the Savannah, and the 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.

Presettlement Vegetation - **Tamarack Lowlands**
Vegetation in the lowlands were 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 - **Tamarack Lowlands**
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 this landuse. Locally, tourism is important around Sandy Lake in Aitkin County.

Natural Disturbance - **Tamarack Lowlands**
Fire was probably important, both on the hardwood-conifer dominated uplands and 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.

MHN35A

MHn35a = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Aspen - Birch Basswood Forest

Polygon Count: 29. Cornish Acres: 299.4. Cornish Percentage: 7.86%.

General Description:
Dry-Mesic to Mesic hardwood forests on well-drained loam, sandy loam and sandy soils – sometimes with a mantle of wind-blown silt. On upperslopes/crests of stagnation moraines, ground moraines and sandy/gravelly glacial outwash. MHn35a forests are frequently subjected to seasonal water stress.

The canopy is usually greater than 75% cover but not entirely closed due to frequent gaps and tree spacing on steep slopes. Typical canopy species include red oak, sugar maple, paper birch, red maple green ash, basswood, big-toothed aspen and aspen. Infrequently, red and white pine trees are present in the canopy.

The subcanopy varies in coverage, ideally it is low (25-50% cover) in high-quality mature stands; however, often the subcanopy is closed and densely shading the substrate (100% cover). Subcanopy dominants include sugar maple and ironwood. Other canopy-species are rare in the subcanopy (e.g., red oak, paper birch).

The shrub layer varies considerably: in high-quality stands, shrubs are sparse (5-25% cover within partial light) to infrequent (1-5% cover beneath darkly shading canopies); however, in stands where Sugar maple saplings are abundant, the shrub layer can be interrupted to densely thick (50-75% to 100% cover). Other canopy-species are infrequent to occasional as saplings or seedlings, especially in high-quality stands. These include paper birch, red oak, and basswood. Other subcanopy-species are frequent including ironwood and choke cherry. Species of true shrubs are diverse with beaked hazel being frequent is but seldom dominant. Other shrubs include juneberries, pagoda dogwood, gooseberries, etc. The subshrub layer is sparse (1-5% cover) with lowbush blueberry, blackberries and occasionally, wintergreen.

The forbs can be the most prominent species in the herb layer; ranging from 5-25% cover where Pensylvania sedge is infrequent, to 1-5% cover beneath dense canopies. The most common forbs, include wild sarsaparilla, bracken fern and Canada mayflower. Other indicator species for MHn35a are frequently encountered: spreading dogbane and pale vetchling. Forbs characteristic of MHn47b are infrequent to rare within MHn35a polygons. These observations where attributed to the complex landscape.

The grass and sedge layer (graminoid) dominates the substrate of some stands (25-50% cover) with Pensylvania sedge being predominant. Other typical dry-mesic forest graminoids include mountain rice grass.

Comments:
Ecological attributes that help recognize MHn35a forests:

1) Many of the herbaceous species are dry-mesic indicators characteristic of woodlands and open forests.
2) Thin duff layer – or even absent – of moder humus; a mor humus is more common. Shallow depth of A-horizon with grayish colors.
3) More likely to have loamy soils with pebbles over red-brown, very-fine sand (characteristic of till derived from the Superior Lobe).
4) More frequent occurrence of rocks and boulders at the soil surface.

Soil Description:
The most prominent soils underlying MHn35a polygons are provided in Table 5, Appendix II. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series for the Cornish Area are also provided in Appendix IV. The most characteristic USDA soil series for MHn35a are Itasca Series, Cushing Series, Mahtomedi Series, and Wawina Series. Other soil series are associated with MHn35a 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 the NPC polygons.

MHn35a occurs on a variety of landscape positions characterized by frequent seasonal water stress

either due to well drained soil types with rapid permeability, deep water tables, desiccating slope positions and aspects – such as upperslopes/crests on south to west aspects subject to winds and direct sunlight. Characteristically, MHn35a polygons are associated with sandy and sandy loam soils derived from the Superior Lobe. Characteristically, MHn35a polygons were mapped on Dry-Mesic, well-drained soils; however, Mesic and Wet-Mesic soils are sometimes included within MHn35a polygons due to the complexity of the landscape.

Itasca soils have convex slopes on undulating to steep moraines. They consist of very deep, well-drained soils that formed in a silty mantle over loamy till. Moisture availability is moderate throughout most of the growing season, except on steep south-to-west aspects on upper slopes, which tend to be droughty due to direct exposure to extreme weather.

The Cushing soils consists of very deep, well-drained soils formed in loamy calcareous till on ground moraines. These are often on low rolling hills with steep 20-35% slopes. The upper soil horizons are comprised of fine sandy loam with thin organic horizons (duff, litter). Water movement is moderately high and there is no water saturation throughout the growing season. These soils are less exposed to weather extremes, however by their sandy nature tend to suffer some water stress infrequently.

Wawina soils are found on terraces and island-like rises on lake plains and consist of sandy glaciolacustrine deposits. Wawina soils are well-drained, very fine sand and have moderately rapid water movement. They occupy low hills with gentle slopes, mostly within the Tamarack Lowlands. And even though Wawina soils are inclusions with large peatlands, they are dry for much of the growing season.

The Mahtomedi series is on moraines and consists of sandy and gravelly outwash. Mahtomedi soils are very deep, excessively drained soils with rapid water movement. Organic content is low.

Canopy Layer:

Northern red oak (C) (Quercus rubra)	>75-100%
Sugar maple (C) (Acer saccharum)	>50-75%
Paper birch (C) (Betula papyrifera)	>25-50%
Red maple (C) (Acer rubrum)	>5-25%
Green ash (C) (Fraxinus pennsylvanica)	>5-25%
Quaking aspen (C) (Populus tremuloides)	>5-25%
Basswood (C) (Tilia americana)	>5-25%

Big-toothed aspen (C) (Populus grandidentata)	1-5% (many >20)
White pine (C) (Pinus strobus)	Single (r)
Yellow birch (C) (Betula alleghaniensis)	PRESENT
Black ash (C) (Fraxinus nigra)	PRESENT
Red pine (C) (Pinus resinosa)	PRESENT

Subcanopy Layer:

Sugar maple (U) (Acer saccharum)	>75-100%
Ironwood (U) (Ostrya virginiana)	>25-50%
Paper birch (U) (Betula papyrifera)	<1% (few 2-20)
White spruce (U) (Picea glauca)	Single (r)
Northern red oak (U) (Quercus rubra)	Single (r)

Black ash (U) (Fraxinus nigra)	PRESENT
Basswood (U) (Tilia americana)	PRESENT

Shrub Layer:

Sugar maple (Acer saccharum)	>5-25%
Quaking aspen (Populus tremuloides)	>5-25%
Paper birch (Betula papyrifera)	1-5% (many >20)
Beaked hazelnut (Corylus cornuta)	1-5% (many >20)
Ironwood (Ostrya virginiana)	1-5% (many >20)
Northern red oak (Quercus rubra)	1-5% (many >20)
Basswood (Tilia americana)	1-5% (many >20)
Juneberry (shrub) (Amelanchier spp.)	<1% (few 2-20)
Juneberry (shrub) (Amelanchier spicata)	<1% (few 2-20)
Pagoda dogwood (Cornus alternifolia)	<1% (few 2-20)
Leatherwood (Dirca palustris)	<1% (few 2-20)
Green ash (Fraxinus pennsylvanica)	<1% (few 2-20)
Fly honeysuckle (Lonicera canadensis)	<1% (few 2-20)
Big-toothed aspen (Populus grandidentata)	<1% (few 2-20)
Chokecherry (Prunus virginiana)	<1% (few 2-20)
Round-leaved juneberry (Amelanchier sanguinea)	Single (r)
Hairy honeysuckle (Lonicera hirsuta)	Single (r)
Prickly gooseberry (Ribes cynosbati)	Single (r)

Sub-Shrub Layer:

Lowbush blueberry (Vaccinium angustifolium)	1-5% (many >20)
Wintergreen (Gaultheria procumbens)	<1% (few 2-20)
Blackberry or raspberry (Rubus sp.)	<1% (few 2-20)
Velvet-leaved blueberry (Vaccinium myrtilloides)	<1% (few 2-20)

Forb Layer:

Wild sarsaparilla (Aralia nudicaulis)	>5-25%
Canada mayflower (Maianthemum canadense)	>5-25%
Bracken (Pteridium aquilinum var. latiusculum)	>5-25%
Hog peanut (Amphicarpaea bracteata)	1-5% (many >20)
Wood anemone (Anemone quinquefolia)	1-5% (many >20)
Large-leaved aster (Aster macrophyllus)	1-5% (many >20)
Fringed false buckwheat (Polygonum cilinode)	1-5% (many >20)
Starflower (Trientalis borealis)	1-5% (many >20)
Pale bellwort (Uvularia sessilifolia)	1-5% (many >20)
Yellow violet (Viola pubescens)	1-5% (many >20)
Spreading dogbane (Apocynum androsaemifolium)	<1% (few 2-20)
Lady-fern (Athyrium angustum)	<1% (few 2-20)
Bluebead lily (Clintonia borealis)	<1% (few 2-20)
Spinulose shield fern (Dryopteris carthusiana)	<1% (few 2-20)
Meadow horsetail (Equisetum pratense)	<1% (few 2-20)
Bedstraw; Cleavers (Galium)	<1% (few 2-20)
Pale vetchling (Lathyrus ochroleucus)	<1% (few 2-20)
Groundpine (Lycopodium dendroideum)	<1% (few 2-20)
Racemose false Solomon's-seal (Smilacina racemosa)	<1% (few 2-20)
Partridgeberry (Mitchella repens)	<1% (few 2-20)
One-sided pyrola (Pyrola secunda)	<1% (few 2-20)
Interrupted fern (Osmunda claytoniana)	<1% (few 2-20)
White rattlesnakeroot (Prenanthes alba)	<1% (few 2-20)
Green-flowered pyrola (Pyrola chlorantha)	<1% (few 2-20)
Rose twistedstalk (Streptopus roseus)	<1% (few 2-20)
Nodding trillium (Trillium cernuum)	<1% (few 2-20)
Large-flowered bellwort (Uvularia grandiflora)	<1% (few 2-20)

Yellow violet (Viola pubescens var. eriocarpa)	<1% (few 2-20)
Blue cohosh (Caulophyllum thalictroides)	Single (r)
Clayton's sweet cicely (Osmorhiza claytonii)	Single (r)
Round-leaved pyrola (Pyrola rotundifolia var.americana)	Single (r)
Zigzag goldenrod (Solidago flexicaulis)	Single (r)
Southern groundcedar (Lycopodium digitatum)	PRESENT
Shining firmoss (Lycopodium lucidulum)	PRESENT
Bristly clubmoss (Lycopodium annotinum)	PRESENT
Red clover (Trifolium pratense)	PRESENT

Graminoid Layer:

Sun-loving sedge (Carex pensylvanica)	>5-25%
Moutain rice grass (Oryzopsis asperifolia)	1-5% (many >20)
Bearded shorthusk (Brachyelytrum erectum)	<1% (few 2-20)
Fine-nerved sedge (Carex leptonervia)	<1% (few 2-20)
Long-stalked sedge (Carex pedunculata)	<1% (few 2-20)
Drooping woodreed (Cinna latifolia)	<1% (few 2-20)
Nodding fescue (Festuca obtusa = F. subverticellata)	Single (r)
Sedge (Carex sp.)	PRESENT
Drooping wood sedge (Carex arctata)	PRESENT

MHN35B

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

Polygon Count: 42. Cornish Acres: 740.2026. Cornish Percentage: 19.44%.

General Description:
Mesic to Dry-Mesic hardwood forests on moderately-well drained soils formed by silty wind deposits over loamy glacial till on moraines; especially on level crests pocked with depressions and swales, and middle to lower slopes with east-to-north aspects. Typically, there is a deep silty/fine sand mantle (~40-60 inches thick) beneath MHn35b forests mapped within Cornish Area. Like MHn47, there is often a water-restricting clay layer in the subsoil of MHn35b forests. However, this "Bt" horizon is usually deeper in MHn35b polygons (~25") than beneath polygons of MHn47 (~6" - 18").

The diverse canopy layer is interrupted to nearly closed (50-100% cover). Canopy gaps are due to steep slopes and/or disturbances. The canopy is often dominated by sugar maple (50-75% cover); however other species are common to abundant in high-quality stands, including paper birch, quaking aspen, basswood, red oak, red maple and big-toothed aspen. Other canopy species are infrequent: balsam fir, green ash and occasionally, yellow birch and white spruce.

The subcanopy is partial (25-50% cover) to interrupted-closed (50-75% cover), largely depending on the closure of the canopy layer. Sugar maple and ironwood dominate most stands in the MHn35b subcanopy. However, quaking aspen, red maple, basswood, paper birch and even black ash can be locally common to abundant. Red oak is rare in MHn35b understory layers.

The diverse shrub layer varies considerably (1-100% cover) regardless of overstory shading. Often, the shrub layer is dominated by saplings of sugar maple; with some other tree species locally common: red maple, green ash and ironwood. Many saplings of other canopy species are notably infrequent: quaking aspen, red oak and American elm. MHn35b shrub layers are richly diverse, with true shrub species frequent throughout the polygons. These include pagoda dogwood, leatherwood, choke cherry, nannyberry and juneberry. The subshrub layer can be prominent (1-50% cover) with several species frequently occurring throughout: bush honeysuckle, various honeysuckles, various gooseberries, red raspberry, lowland blueberry and velvet-leaved blueberry.

Forb cover ranges from partial cover (5-25%) to interrupted cover (50-75%). Since MHn35b occupies intermediate positions on the landscape; the herb layer reflects this diversity with several forbs shared with the drier MHn35a, and the moister MHn47b. Blue cohosh – an indicator species for MHn47b – occurs infrequently in MHn35b polygons, but is never abundant. Due to the complex terrain of stagnation moraines, MHn35b polygons frequently have wet-mesic and wet inclusions within depressions, swales and drainageways. Correspondingly, sometimes forbs – characteristic of wet-mesic/wet forests – are infrequently present within MHn35b polygons. A diverse array of upland forest herbs are prominent in MHn35b herbaceous layers. The most abundant species are wild sarsparilla and Canada mayflower. But many mesic indicator species are occasional throughout MHn35b polygons: Solomon's seal, American spikenard and rattlesnake fern. Other mesic species can be locally frequent to common: Lady fern, bluebead lily, honewort, various ground-cedars (Lycopodium sp. sensu latu), large-leaved aster, sweet-scented bedstraw, ostrich fern, bloodroot, etc.

The grass and sedge layer (graminoid) layer is prominent in MHn35b polygons with Pensylvania sedge having a partial cover (25-50%) locally in some places. However, graminoid diversity in MHn35b is richer than the drier subtype (MHn35a); with several graminoid species frequent throughout MHn35b polygons: bearded shorthusk, drooping sedge, fringed brome, Dewey's sedge, long-stalked sedge, etc. Again many graminoid species are present to infrequent in MHn35b, but are frequent to common in MHn47b.

Comments:
Many of the species of the MHn35b flora underlie the fact that MHn35b occupies an intermediate position between the drier MHn35a and the consistently mesic MHn47b.

In contrast to the MHn35a type, MHn35b forests suffer less desiccation from direct sunlight or winds than MHn35a or otherwise enjoy more stable levels of soil moisture. MHn35b soils suffer less desiccation from direct sunlight or winds. MHn35b tends to occupy micro-habitats that consistently maintain a mesic soil moisture regime through the growing season (i.e., less likely to suffer frequent droughts) and are often near perched wetland forests or meadows. Being an intermediate NPC community, MHn35b has mostly mesic soils; however the community does contain both dry and wet-mesic soils as marginal inclusions.

In contrast to MHn47b, the moderately well-drained MHn35b occupies higher slope positions with steeper gradients than the moderately-to-somewhat poorly drained MHn47b, which supports many wet-mesic species as inclusions.

MHn35b shares many of the same ecological attributes as MHn47b, making the two classes/types difficult to distinguish; and subject to differing interpretations by ecologists. These shared characteristics are:

1) Both MHn35b and, especially MHn47b have a silt mantle comprised of eolian silt or silt loam layers. Both types have an organic duff layer comprised of moder humus of intermediate depth.
2) Both types are associated with many mesic inclusions or localized, micro-habitats on otherwise well drained landscapes and substrates.

Characteristics that help separate MHn35b from MHn47b:

1) MHn35b shares many indicator species with MHn47b; however, in MHn35b, these species occur infrequently in low abundances within small localities. But, MHn47b indicator species are not reliably (i.e., inconsistently) found at other similar inclusions within MHn35b.
2) The MHn35b has many of the dry indicator species (often lacking in MHn47b forests). These indicator species are more characteristic of MHn35a forests or dry woodlands.
3) The majority of plants, and their relative abundance, of the MHn35b flora are more characteristic of dry-mesic forests (Pennsylvanian sedge, bracken fern).
4) Wet-mesic and wet species (characteristic of MHn47) are inconsistently or seldom present, and never in abundance.
5) MHn35b occupies landscape positions and substrates more susceptible to periodic, seasonal drought.
6) MHn35b occupies upper slopes and crests subject to desiccation by wind and insolation by direct, full-spectrum sunlight.
7) In MHn35b, canopy gaps more likely to occur (more frequent) due to frequent wind damage and protracted dessication of the upper soil horizons.
8) MHn35b is less likely to have deep organic duff layers.
9) Modern oak forests on MHn35b had their probable origins beneath white pine canopy.

Other Ecologists may have mapped Upper Slopes and Crests within the Cornish Area as MHn47,because some indicator species for MHn47 present; there is a mantle of eolian silt (loess) over calcareous glacial till; and there is a moderately restrictive subhorizon (Bt layer), which maintains soil moisture in the upper horizons longer. I mapped these areas as MHn35b, because:

1) Moraine ridges not uniform. They are very heterogeneous resulting in a very complicated map.
2) Nearly all waypoint samples were collected in mesic micro-habitats such as perched depressions, swale-ravines, etc.
3) Ecological variation of species distribution are very difficult to separate. MN DNR's classification does not delimit community boundaries.

3a) I choose to define a narrow MHn47b

found on consistently moist landscape position with a strong contingent of wet-mesic species.

4a) Indictor species separating MHn35b and MHn47b essentially share the same niche except for differences in relative abundance of species populations between the NPC types (compare American spikenard with Blue Cohosh). Species keys in the back of the NPC book are very similar among both NPC types.

4b) MHn35b is less likely to have wet or wet-mesic species in abundance.

4c) In MHn35b, mesic indicator species are more likely to occur because of high organic content of soil, which would be lost with earthworms resulting in drier forest substrate.

4d) In MHn35b, yellow birch is present in canopy, but seedlings are infrequently found on old stumps and downed trunks. In MHn47b, yellow birch is common in canopy and seedlings are frequent on deep humus covered soil.

5) I think it advantageous for forest management to delimit MHn35b on dry-mesic silt loam ridges that are subject to dessication, wind damage, etc.

6) I think these ridge crests were originally White Pine forests.

7) I give my clients (and critics) all the tools they need to make their own determinations (i.e. I don't just give my conclusions). With this data, they can make better silvicultural decisions based upon ecological principles.

8) Finally, when one attempts to distinguish MHn35b from MHn47b, this should be a guiding creed:

"The man who insists upon seeing with perfect clearness before he decides, never decides. Accept life, and you must accept regret." Henri-Frederic Amiel

Soil Description:

The most prominent soils underlying MHn35b polygons are provided in Table 5, Appendix II. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series for the Cornish Area are also provided in Appendix IV. The most characteristic USDA soil series for MHn35b are Hillcity Series and Duluth 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 the NPC polygons.

MHn35b occurs primarily on moraines, especially on level crests pocked with depressions and swales; and middle to lower slopes with east-to-north aspects. They tend to occupy landscape positions protected from extreme weather and long durations of intense, full-spectrum sunlight. The most characteristic soils for MHn35b are Hillcity, Branstad and Duluth Series.

The Hillcity soils are very deep, moderately-well drained soils formed by silty wind deposits over loamy glacial till on moraines. The deep silty/fine sand mantle is about 40-60 inches thick. There is a water-restricting clay layer in the subsoil. Water movement is moderate and there is a seasonal zone of saturation at about 40 inches in May. Organic layers of humus and litter are moderately thick.

The Branstad series consists of very deep, moderately well drained soils formed in loamy calcareous till on moraines. Permeability is moderate in the upper part of the solum (A & E soil horizons) and moderately slow or moderate in the lower part of the solum and in the substratum. Slopes range from 2 to 20 percent.

The Duluth soils are found on summits of linear to convex back slopes of moraine hills and till plains. The parent material consists of a mantle of loamy wind (eolian) or glaciofluvial deposits. There is an underlying layer of firm loamy till from the St. Louis Sublobe of the Des Moines Lobe deposited during the Late-Wisconsin Glaciation. Duluth soils are very deep, well-drained soils comprised of very fine, sandy loam. There is a moderately restrictive clay layer within 20 inches depth, therefore water movement is moderately low. Duluth soils are not ponded or flooded, however, they have a seasonal

zone of high water saturation in the Spring (13 inches in April). Organic content of the A horizon is moderate, however overlying duff layers are often absent.

Canopy Layer:

Sugar maple (C) (Acer saccharum)	>50-75%
Paper birch (C) (Betula papyrifera)	>50-75%
Quaking aspen (C) (Populus tremuloides)	>50-75%
Basswood (C) (Tilia americana)	>50-75%
Northern red oak (C) (Quercus rubra)	>25-50%
Red maple (C) (Acer rubrum)	>5-25%
Big-toothed aspen (C) (Populus grandidentata)	>5-25%
Balsam fir (C) (Abies balsamea)	1-5% (many >20)
Green ash (C) (Fraxinus pennsylvanica)	1-5% (many >20)
Yellow birch (C) (Betula alleghaniensis)	<1% (few 2-20)
Black ash (C) (Fraxinus nigra)	Outside Plot
White spruce (C) (Picea glauca)	PRESENT
White pine (C) (Pinus strobus)	PRESENT

Subcanopy Layer:

Sugar maple (U) (Acer saccharum)	>75-100%
Ironwood (U) (Ostrya virginiana)	>50-75%
Quaking aspen (U) (Populus tremuloides)	>50-75%
Red maple (U) (Acer rubrum)	>25-50%
Black ash (U) (Fraxinus nigra)	>5-25%
Basswood (U) (Tilia americana)	>5-25%
Balsam fir (U) (Abies balsamea)	<1% (few 2-20)
Big-toothed aspen (U) (Populus grandidentata)	<1% (few 2-20)
Northern red oak (U) (Quercus rubra)	Single (r)
White cedar (U) (Thuja occidentalis)	Outside Plot

Shrub Layer:

Sugar maple (Acer saccharum)	>75-100%
Beaked hazelnut (Corylus cornuta)	>25-50%
Red maple (Acer rubrum)	>5-25%
Green ash (Fraxinus pennsylvanica)	>5-25%
Ironwood (Ostrya virginiana)	>5-25%
Pagoda dogwood (Cornus alternifolia)	1-5% (many >20)
Leatherwood (Dirca palustris)	1-5% (many >20)
Winterberry (Ilex verticillata)	1-5% (many >20)
Quaking aspen (Populus tremuloides)	1-5% (many >20)
Chokecherry (Prunus virginiana)	1-5% (many >20)
Northern red oak (Quercus rubra)	1-5% (many >20)
Basswood (Tilia americana)	1-5% (many >20)
American elm (Ulmus americana)	1-5% (many >20)
Nannyberry (Viburnum lentago)	1-5% (many >20)
Balsam fir (Abies balsamea)	<1% (few 2-20)
Juneberry (shrub) (Amelanchier spp.)	<1% (few 2-20)
Juneberry (shrub) (Amelanchier spicata)	<1% (few 2-20)
Paper birch (Betula papyrifera)	<1% (few 2-20)

Bush honeysuckle (Diervilla lonicera)	<1% (few 2-20)
Black ash (Fraxinus nigra)	<1% (few 2-20)
Honeysuckle (Lonicera sp.)	<1% (few 2-20)
Fly honeysuckle (Lonicera canadensis)	<1% (few 2-20)
Mountain fly honeysuckle (Lonicera villosa)	<1% (few 2-20)
Big-toothed aspen (Populus grandidentata)	<1% (few 2-20)
Prickly gooseberry (Ribes cynosbati)	<1% (few 2-20)
Swamp gooseberry (Ribes hirtellum)	<1% (few 2-20)
Meadowsweet (Spiraea alba)	<1% (few 2-20)
Mountain maple (Acer spicatum)	Single (r)
Wild honeysuckle (Lonicera dioica)	Single (r)
Northern gooseberry (Ribes oxyacanthoides)	Single (r)
Yellow birch (Betula alleghaniensis)	Outside Plot
Hairy honeysuckle (Lonicera hirsuta)	PRESENT

Sub-Shrub Layer:

Red raspberry (Rubus idaeus)	1-5% (many >20)
Lowbush blueberry (Vaccinium angustifolium)	1-5% (many >20)
Velvet-leaved blueberry (Vaccinium myrtilloides)	<1% (few 2-20)

Forb Layer:

Wild sarsaparilla (Aralia nudicaulis)	>50-75%
Canada mayflower (Maianthemum canadense)	>5-25%
Hog peanut (Amphicarpaea bracteata)	1-5% (many >20)
Round-lobed hepatica (Anemone americana)	1-5% (many >20)
Lady-fern (Athyrium angustum)	1-5% (many >20)
Bluebead lily (Clintonia borealis)	1-5% (many >20)
Honewort (Cryptotaenia canadensis)	1-5% (many >20)
Southern groundcedar (Lycopodium digitatum)	1-5% (many >20)
Spinulose shield fern (Dryopteris carthusiana)	1-5% (many >20)
Large-leaved aster (Aster macrophyllus)	1-5% (many >20)
Common strawberry (Fragaria virginiana)	1-5% (many >20)
Sweet-scented bedstraw (Galium triflorum)	1-5% (many >20)
Pale vetchling (Lathyrus ochroleucus)	1-5% (many >20)
Groundpine (Lycopodium dendroideum)	1-5% (many >20)
Starflower (Trientalis borealis)	1-5% (many >20)
Ostrich-fern (Matteuccia struthiopteris var. pensylvanica)	1-5% (many >20)
Partridgeberry (Mitchella repens)	1-5% (many >20)
Sensitive fern (Onoclea sensibilis)	1-5% (many >20)
Clayton's sweet cicely (Osmorhiza claytonii)	1-5% (many >20)
Bracken (Pteridium aquilinum var. latiusculum)	1-5% (many >20)
Bloodroot (Sanguinaria canadensis)	1-5% (many >20)
Rose twistedstalk (Streptopus roseus)	1-5% (many >20)
Side-flowering aster (Aster lateriflorus)	1-5% (many >20)
Large-flowered bellwort (Uvularia grandiflora)	1-5% (many >20)
Pale bellwort (Uvularia sessilifolia)	1-5% (many >20)
Yellow violet (Viola pubescens)	1-5% (many >20)
Red baneberry (Actaea rubra)	<1% (few 2-20)
Maidenhair fern (Adiantum pedatum)	<1% (few 2-20)
Wood anemone (Anemone quinquefolia)	<1% (few 2-20)

American spikenard (Aralia racemosa)	<1% (few 2-20)
Jack-in-the-pulpit (Arisaema triphyllum)	<1% (few 2-20)
Wild ginger (Asarum canadense)	<1% (few 2-20)
Rattlesnake fern (Botrychium virginianum)	<1% (few 2-20)
Blue cohosh (Caulophyllum thalictroides)	<1% (few 2-20)
Alpine enchanter's nightshade (Circaea alpina)	<1% (few 2-20)
Canada thistle (Cirsium arvense)	<1% (few 2-20)
Horseweed (Conyza canadensis)	<1% (few 2-20)
Goldthread (Coptis trifolia var. groenlandica)	<1% (few 2-20)
Bunchberry (Cornus canadensis)	<1% (few 2-20)
Downy willow-herb (Epilobium strictum)	<1% (few 2-20)
Marsh horsetail (Equisetum palustre)	<1% (few 2-20)
Meadow horsetail (Equisetum pratense)	<1% (few 2-20)
Bedstraw; Cleavers (Galium)	<1% (few 2-20)
Common oak fern (Gymnocarpium dryopteris)	<1% (few 2-20)
Shining firmoss (Lycopodium lucidulum)	<1% (few 2-20)
Touch-me-not (Impatiens sp.)	<1% (few 2-20)
Running clubmoss (Lycopodium clavatum)	<1% (few 2-20)
Northern bugleweed (Lycopus uniflorus)	<1% (few 2-20)
Racemose false Solomon's-seal (Smilacina racemosa)	<1% (few 2-20)
Common mint (Mentha arvensis var. glabrata)	<1% (few 2-20)
Interrupted fern (Osmunda claytoniana)	<1% (few 2-20)
Palmate sweet coltsfoot (Petasites frigidus var. palmatus)	<1% (few 2-20)
Long beech-fern (Thelypteris phegopteris)	<1% (few 2-20)
Hairy Solomon's seal (Polygonatum pubescens)	<1% (few 2-20)
White rattlesnakeroot (Prenanthes alba)	<1% (few 2-20)
Pink shinleaf (Pyrola asarifolia)	<1% (few 2-20)
Dwarf raspberry (Rubus pubescens)	<1% (few 2-20)
Zigzag goldenrod (Solidago flexicaulis)	<1% (few 2-20)
Giant goldenrod (Solidago gigantea)	<1% (few 2-20)
Elm-leaved goldenrod (Solidago ulmifolia)	<1% (few 2-20)
Nodding trillium (Trillium cernuum)	<1% (few 2-20)
Stinging nettle (Urtica dioica ssp. gracilis)	<1% (few 2-20)
Violet species (Viola sp.)	<1% (few 2-20)
Rugulose violet (Viola canadensis var. rugulosa)	<1% (few 2-20)
Spreading dogbane (Apocynum androsaemifolium)	Single (r)
Leafy beggar-ticks (Bidens frondosa)	Single (r)
Dissected grapefern (Botrychium dissectum)	Single (r)
Field thistle (Cirsium discolor)	Single (r)
Dwarf scouring rush (Equisetum scirpoides)	Single (r)
Spotted Joe pye weed (Eupatorium maculatum)	Single (r)
Cleavers (Galium aparine)	Single (r)
wild lettuce species (Lactuca sp.)	Single (r)
Veiny pea (Lathyrus venosus var. intonsus)	Single (r)
Common plantain (Plantago major)	Single (r)
White vervain (Verbena urticifolia)	Single (r)
Blunt-lobed woodsia (Woodsia obtusa)	Single (r)
Woodmint (Blephilia hirsuta)	PRESENT
Striped coral-root (Corallorhiza striata)	PRESENT
Lesser rattlesnake-plantain (Goodyera repens var. ophioides)	PRESENT
Bristly clubmoss (Lycopodium annotinum)	PRESENT
One-sided pyrola (Pyrola secunda) PRESENT	PRESENT
Round-leaved pyrola (Pyrola rotundifolia var. americana)	PRESENT
Elliptic shinleaf (Pyrola elliptica)	PRESENT
Maryland black snakeroot (Sanicula marilandica)	PRESENT

Graminoid Layer:

Sun-loving sedge (Carex pensylvanica)	>25-50%
Moutain rice grass (Oryzopsis asperifolia)	>5-25%
Bearded shorthusk (Brachyelytrum erectum)	1-5% (many >20)
Drooping wood sedge (Carex arctata)	1-5% (many >20)
Bladder sedge (Carex intumescens)	1-5% (many >20)
Redtop (Agrostis stolonifera var. major)	<1% (few 2-20)
Twin bentgrass (Agrostis scabra)	<1% (few 2-20)
Fringed brome (Bromus ciliatus)	<1% (few 2-20)
Dewey's sedge (Carex deweyana)	<1% (few 2-20)
Graceful sedge (Carex gracillima)	<1% (few 2-20)
Long-stalked sedge (Carex pedunculata)	<1% (few 2-20)
Projecting sedge (Carex projecta)	<1% (few 2-20)

Drooping woodreed (Cinna latifolia)	<1% (few 2-20)
Nodding fescue (Festuca obtusa = F. subverticellata)	<1% (few 2-20)
Pointed woodrush (Luzula acuminata)	<1% (few 2-20)
Woodland millet grass (Milium effusum var. cisatlanticum)	<1% (few 2-20)
Fowl blue grass (Poa palustris)	<1% (few 2-20)
Bentgrass, Quackgrass etc. (Agropyron sp.)	Single (r)
Winter Bent (Agrostis hyemalis) Single (r)	Single (r)
Sedge (Carex sp.)	Single (r)
Poaceae (unknown grass)	Single (r)
Fringe sedge (Carex crinita)	PRESENT

MHN46A

MHn46a = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Aspen - Ash Forest

Polygon Count: 1. Cornish Acres: 2.8427. Cornish Percentage: 0.07%.

General Description:
Wet-mesic hardwood forests occurring within depressions, swales and drainageways on flat moraines and lake plains. The only mapped occurrence MHn46a in the Cornish Area is within a ravine on the lower slope of a moraine where soils are comprised of very deep, somewhat poorly drained soils formed in loamy, calcareous till. Water movement is moderately high, and there is no ponding or flooding; however the seasonal water table is relatively high (zone of water saturation to 12 inches in May). There is a clay loam subsoil at about 25 inches depth. Organic content is high. In contrast to MHn46b, groundwater discharge does not occur.

Please see the description for MHn46b.

Comments:
MHn46a appears to be a drier subtype than MHn46b, where it is often an inclusion around wet-mesic areas and ephemeral pools. The differences are best reflected in the MHn46a canopy where black ash trees occur in relatively equal proportion to sugar maple trees (relative abundance 50:50%).

As a NPC community subtype, MHn46a is very similar to MHn46b, being most likely separated only by canopy species. However, MHn46a tends to be drier with ponding periods of short duration leaving dry mud-flats for much of the growing season. Nonetheless see MHn46b discussion on soil characteristics, as this type is more prevalent within the Cornish Area.

Soil Description:
The most prominent soils underlying MHn46a polygons are provided in Table 5, Appendix II. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series for the Cornish Area are also provided in Appendix IV. The most characteristic USDA soil series for MHn46a are Alstad Series and Dusler Series. Other soil series are associated with MHn46a 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 the NPC polygons.

MHn46a occurs within depressions, swales and drainageways on flat moraines and lake plains. The only mapped occurrence MHn46a in the Cornish Area is within a ravine on the lower slope of a moraine.

Alstad soils are on upperslopes and crests with slopes less than 4%. They are comprised of very deep, somewhat poorly drained soils formed in loamy, calcareous till. Water movement is moderately high, and there is no ponding or flooding; however the seasonal water table is relatively high (zone of water saturation to 12 inches in May). There is a clay loam subsoil at about 25 inches depth. Organic content is high.

Dusler soils formed on loamy glacial till of lake plains and on moraines. Dusler soils have level to slightly convex slopes less than 3% on gently undulating to rolling terrains. The soils are primarily reddish brown loam or clay loam deposited by the Superior Lobe of the Wisconsin Glacier. Sometimes there is a thin mantle of eolian silt. Dusler soils are somewhat poorly drained and water movement in the most restrictive layer is moderately low. The soil is not flooded or ponded; however the seasonal zone of water saturation is at 6 inches during April. Organic content is moderate.

Canopy Layer:

Sugar maple (C) (Acer saccharum)	PRESENT
Paper birch (C) (Betula papyrifera)	PRESENT
Black ash (C) (Fraxinus nigra)	PRESENT
Quaking aspen (C) (Populus tremuloides)	PRESENT

Subcanopy Layer:

Sugar maple (U) (Acer saccharum)	PRESENT
Basswood (U) (Tilia americana)	PRESENT

Shrub Layer:

Sugar maple (Acer saccharum)	PRESENT	Quaking aspen (Populus tremuloides)	PRESENT
Beaked hazelnut (Corylus cornuta)	PRESENT		

Sub-Shrub Layer:

Forb Layer:

Jack-in-the-pulpit (Arisaema triphyllum)	PRESENT	Long beech-fern (Thelypteris phegopteris)	PRESENT
Lady-fern (Athyrium angustum)	PRESENT		
Common oak fern (Gymnocarpium dryopteris)	PRESENT		

Graminoid Layer:

Bearded shorthusk (Brachyelytrum erectum)	PRESENT	Woodland millet grass (Milium effusum var. cisatlanticum)	PRESENT
Sun-loving sedge (Carex pensylvanica)	PRESENT		

MHN46B

MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest

Polygon Count: 60. Cornish Acres: 242.8607. Cornish Percentage: 6.38%.

General Description:
Wet-mesic to wet hardwood forests within very poorly drained depressions, swales and drainageways on ground moraines, end moraines, lake plains, terraces and outwash plains. MHn46b is typically associated with groundwater discharge or a clayey subsoil that perches early Spring runoff. MHn46b occupy organic soils up to 50 inches deep over silt or clay loam. Water can be temporarily ponded up to a foot above the surface at least once a year (these pools are ephemeral, as many MHn46b forests were moist mud-flats when surveyed in the late summer of 2008.

The canopy is generally open: partial to interrupted, occasionally closed (25-100% cover). Black ash and basswood usually dominate the canopy; however, some wet forests are dominated by quaking aspen. Other common species in the canopy includes sugar maple, yellow birch, paper birch, and sometimes, white cedar. Many other tree species are often present to infrequent in the canopy is often at the margins or on slight rises: balsam fir, green ash, big-toothed aspen, white pine, etc.

The subcanopy can be partial, interrupted to densely closed (25-100% cover). The most frequent dominants of the subcanopy are immature black ash, basswood and balsam fir. Occasionally, sugar maple solely dominates the subcanopy. Other canopy trees are infrequent due to the proximity of upland forest and large swamps. These include red maple, ironwood, white cedar, red elm, yellow birch, American elm, black ash, etc.

The shrub layer is partial to closed (25-100% cover). Speckled alder and mountain maple are the most abundant shrubs. Poison ivy is common. Several shrub species are frequent throughout MHn46b polygons: dwarf alder, wild black currant and other gooseberry species, round-leaved juneberry; as are several seedlings of tree species, red elm, basswood, etc.

Forbs are extremely abundant, dominating up to 75% cover of the substrate. The most common species include lady fern, wild ginger, gold thread, woodland horsetail, ground-pine and ostrich fern. The forb layer is extremely diverse with a combination of mesic species of upland forests mixed with wet-mesic and wet species from swamps and wet hardwood forests.

The grass and sedge layer (graminoid) is likewise very diverse in species. Bluejoint is the most abundant graminoid. However, many mesic and wet-mesic graminoids is more characteristic of upland forests is are frequent in MHn46b polygons.

Comments:
As a NPC community subtype, MHn46b is very similar to MHn46a, being apparently separated only by canopy species. However, MHn46b tends to be slightly wetter with a longer ponding duration during the growing seasons. Perhaps soils for MHn46b and MHn46a should be combined as part of a moisture continuum from wet-mesic to wet.

Due to the complex landscape, mesic upland soils are often included within MHn46b polygons, especially around the margins (see soil descriptions for MHn46a).

MHn46b forests are recognized primarily by the following ecological attributes:

1) Wet-mesic to wet soils perched in spring and associated with uplands.
2) Inclusions within upland depressions, swale-ravines and footslopes.
3) Mixture of species typical of uplands and wet forests.
4) These species are either frequent throughout or locally common on small micro-habitats either on slight rises or depressions.

Soil Description:
The most prominent soils underlying MHn46b polygons are provided in Table 5, Appendix II. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series for the Cornish Area are also provided in Appendix IV. The most characteristic USDA soil series for MHn46b are Lupton Series, Mahtowa Series and Cathro 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 the NPC polygons.

MHn46b occurs within depressions, swales and drainageways on ground moraines, end moraines, lake plains, terraces and outwash plains (however, due to the complex landscape, upland soils are often within MHn46b polygons).

Lupton soils are within depressions that occur both as small upland inclusions and large areas. Often they are found on footslopes where upland soils break sharply into depressions or large plains. Here they are typically associated with groundwater discharge or seepage areas. The groundwater passes through mineral soil and has a high-dissolved mineral content. The Lupton series consists of very deep, very poorly drained soils formed in organic deposits more that 51 inches thick. Slopes are usually less than 2% but range up to 15%. The typical depth to saturated soil is at the surface to 1 foot depth at some point during the year. Ponding occurs at least once yearly to a depth between 0.2 and 1 foot.

Mahtowa soils are very poorly drained formed in loamy glacial till on moraines with concave slopes less than 1%. These soils are reddish brown, loam or clay loam formed from the Superior Lobe of the Wisconsin Glacier. Water movement is moderately high, but is frequently ponded. A seasonal zone of water saturation is at the surface during March through July and October. Organic matter at the surface horizon is very high.

Cathro soils are usually in small depressions on moraines and outwash plains. Slopes are less than 2%. The parent material consists of organic material over loamy till. Groundwater with dissolved minerals influences the surface layer. Cathro soils consists of very deep, poorly drained organic soils with a depth of 16 to 51 inches over loamy glacial till. They are frequently ponded throughout the year. Organic content of the surface layer is very high.

Canopy Layer:

Black ash (C) (Fraxinus nigra)	>75-100%
Quaking aspen (C) (Populus tremuloides)	>75-100%
Basswood (C) (Tilia americana)	>50-75%
Red maple (C) (Acer rubrum)	>25-50%
Sugar maple (C) (Acer saccharum)	>5-25%
Yellow birch (C) (Betula alleghaniensis)	>5-25%
Paper birch (C) (Betula papyrifera)	>5-25%
White cedar (C) (Thuja occidentalis)	>5-25%
Balsam fir (C) (Abies balsamea)	1-5% (many >20)

Green ash (C) (Fraxinus pennsylvanica)	1-5% (many >20)
Big-toothed aspen (C) (Populus grandidentata)	<1% (few 2-20)
Northern red oak (C) (Quercus rubra) Outside Plot	PRESENT
Black spruce (C) (Picea mariana)	PRESENT
White pine (C) (Pinus strobus)	PRESENT
Balsam poplar (C) (Populus balsamifera)	PRESENT

Subcanopy Layer:

Sugar maple (U) (Acer saccharum)	>75-100%
Black ash (U) (Fraxinus nigra)	>25-50%
Basswood (U) (Tilia americana)	>25-50%
Balsam fir (U) (Abies balsamea)	>5-25%

Ironwood (U) (Ostrya virginiana)	>5-25%
White cedar (U) (Thuja occidentalis)	>5-25%
Red elm (U) (Ulmus rubra)	>5-25%
Red maple (U) (Acer rubrum)	1-5% (many >20)

Yellow birch (U) (Betula alleghaniensis)	1-5% (many >20)
Tamarack (U) (Larix laricina)	1-5% (many >20)
Balsam poplar (U) (Populus balsamifera)	1-5% (many >20)
American elm (U) (Ulmus americana)	1-5% (many >20)

Paper birch (U) (Betula papyrifera)	Present
Northern red oak (U) (Quercus rubra)	Present

Shrub Layer:

Speckled alder (Alnus incana ssp rugosa)	>50-75%
Mountain maple (Acer spicatum)	>25-50%
Poison ivy (Rhus radicans var. rydbergii)	>25-50%
Beaked hazelnut (Corylus cornuta)	>5-25%
Black ash (Fraxinus nigra)	>5-25%
Sugar maple (Acer saccharum)	1-5% (many >20)
Red maple (Acer rubrum)	1-5% (many >20)
Bush honeysuckle (Diervilla lonicera)	1-5% (many >20)
Green ash (Fraxinus pennsylvanica)	1-5% (many >20)
Chokecherry (Prunus virginiana)	1-5% (many >20)
Northern red oak (Quercus rubra)	1-5% (many >20)
Dwarf alder (Rhamnus alnifolia)	1-5% (many >20)
Wild black currant (Ribes americanum)	1-5% (many >20)
Basswood (Tilia americana)	1-5% (many >20)
American elm (Ulmus americana)	1-5% (many >20)
Red elm (Ulmus rubra)	1-5% (many >20)
Balsam fir (Abies balsamea)	<1% (few 2-20)
Round-leaved juneberry (Amelanchier sanguinea)	<1% (few 2-20)

Yellow birch (Betula alleghaniensis)	<1% (few 2-20)
Paper birch (Betula papyrifera)	<1% (few 2-20)
Pagoda dogwood (Cornus alternifolia)	<1% (few 2-20)
Red-osier dogwood (Cornus sericea)	<1% (few 2-20)
Winterberry (Ilex verticillata)	<1% (few 2-20)
Hairy honeysuckle (Lonicera hirsuta)	<1% (few 2-20)
Ironwood (Ostrya virginiana)	<1% (few 2-20)
Quaking aspen (Populus tremuloides)	<1% (few 2-20)
Skunk currant (Ribes glandulosum)	<1% (few 2-20)
Swamp gooseberry (Ribes hirtellum)	<1% (few 2-20)
Swamp red currant (Ribes triste)	<1% (few 2-20)
Fly honeysuckle (Lonicera canadensis)	Single (r)
Bur oak (Quercus macrocarpa)	Single (r)
White spruce (Picea glauca)	Present
Wild current or gooseberry (Ribes sp.)	Present

Sub-Shrub Layer:

Red raspberry (Rubus idaeus)	1-5% (many >20)
Velvet-leaved blueberry (Vaccinium myrtilloides)	1-5% (many >20)
Five-leaved Virginia creeper (Parthenocissus inserta)	<1% (few 2-20)

Labrador tea (Ledum groenlandicum)	Present
Red raspberry (Rubus strigosus)	Present

Forb Layer:

Lady-fern (Athyrium angustum)	>25-50%
Wild ginger (Asarum canadense)	>5-25%
Goldthread (Coptis trifolia var. groenlandica)	>5-25%
Woodland horsetail (Equisetum sylvaticum)	>5-25%
Large-leaved aster (Aster macrophyllus)	>5-25%
Groundpine (Lycopodium dendroideum)	>5-25%
Ostrich-fern (Matteuccia struthiopteris var. pensylvanica)	>5-25%
Dwarf raspberry (Rubus pubescens)	>5-25%
Wood anemone (Anemone quinquefolia)	1-5% (many >20)
Wild sarsaparilla (Aralia nudicaulis)	1-5% (many >20)
Jack-in-the-pulpit (Arisaema triphyllum)	1-5% (many >20)
Rattlesnake fern (Botrychium virginianum)	1-5% (many >20)
Spotted water hemlock (Cicuta maculata)	1-5% (many >20)
Alpine enchanter's nightshade (Circaea alpina)	1-5% (many >20)
Common enchanter's nightshade (Circaea lutetiana)	1-5% (many >20)
Bluebead lily (Clintonia borealis)	1-5% (many >20)
Bunchberry (Cornus canadensis)	1-5% (many >20)
Spinulose shield fern (Dryopteris carthusiana)	1-5% (many >20)
Willow-herb species (Epilobium sp.)	1-5% (many >20)
Field horsetail (Equisetum arvense)	1-5% (many >20)
Spotted Joe pye weed (Eupatorium maculatum)	1-5% (many >20)
Common strawberry (Fragaria virginiana)	1-5% (many >20)
Bedstraw; Cleavers (Galium)	1-5% (many >20)
White avens (Geum canadense)	1-5% (many >20)
Common oak fern (Gymnocarpium dryopteris)	1-5% (many >20)
Touch-me-not (Impatiens sp.)	1-5% (many >20)
Bristly clubmoss (Lycopodium annotinum)	1-5% (many >20)
Starflower (Trientalis borealis)	1-5% (many >20)
Canada mayflower (Maianthemum canadense)	1-5% (many >20)
Naked miterwort (Mitella nuda)	1-5% (many >20)
Sensitive fern (Onoclea sensibilis)	1-5% (many >20)
Clayton's sweet cicely (Osmorhiza claytonii)	1-5% (many >20)
Cinnamon fern (Osmunda cinnamomea)	1-5% (many >20)
Interrupted fern (Osmunda claytoniana)	1-5% (many >20)
Palmate sweet coltsfoot (Petasites frigidus var. palmatus)	1-5% (many >20)
Bracken (Pteridium aquilinum var. latiusculum)	1-5% (many >20)
Maryland black snakeroot (Sanicula marilandica)	1-5% (many >20)
Rose twistedstalk (Streptopus roseus)	1-5% (many >20)
Side-flowering aster (Aster lateriflorus)	1-5% (many >20)
Early meadow-rue (Thalictrum dioicum)	1-5% (many >20)
Stinging nettle (Urtica dioica ssp. gracilis)	1-5% (many >20)
Pale bellwort (Uvularia sessilifolia)	1-5% (many >20)
Violet species (Viola sp.)	1-5% (many >20)
Yellow violet (Viola pubescens)	1-5% (many >20)
Kidney-leaved violet (Viola renifolia)	1-5% (many >20)
Round-lobed hepatica (Anemone americana)	<1% (few 2-20)
American spikenard (Aralia racemosa)	<1% (few 2-20)
Common marsh marigold (Caltha palustris)	<1% (few 2-20)
Crested fern (Dryopteris cristata)	<1% (few 2-20)
Meadow horsetail (Equisetum pratense)	<1% (few 2-20)
Sweet-scented bedstraw (Galium triflorum)	<1% (few 2-20)
Yellow avens (Geum aleppicum var. strictum)	<1% (few 2-20)
Shining firmoss (Lycopodium lucidulum)	<1% (few 2-20)
Northern blue flag (Iris versicolor)	<1% (few 2-20)
Michigan lily (Lilium michiganense)	<1% (few 2-20)
Fringed loosestrife (Lysimachia ciliata)	<1% (few 2-20)

Two-leaved miterwort (Mitella diphylla)	<1% (few 2-20)
Long beech-fern (Thelypteris phegopteris)	<1% (few 2-20)
Dwarf clearweed (Pilea pumila)	<1% (few 2-20)
Hairy Solomon's seal (Polygonatum pubescens)	<1% (few 2-20)
White rattlesnakeroot (Prenanthes alba)	<1% (few 2-20)
Heal-all (Prunella vulgaris)	<1% (few 2-20)
Kidney-leaved buttercup (Ranunculus abortivus)	<1% (few 2-20)
Hispid buttercup (Ranunculus hispidus)	<1% (few 2-20)
Hooked crowfoot (Ranunculus recurvatus)	<1% (few 2-20)
Zigzag goldenrod (Solidago flexicaulis)	<1% (few 2-20)
Giant goldenrod (Solidago gigantea)	<1% (few 2-20)
Smooth hedge-nettle (Stachys tenuifolia var. hispida)	<1% (few 2-20)
Lindley's aster (Aster ciliolatus)	<1% (few 2-20)
Red-stemmed aster (Aster puniceus)	<1% (few 2-20)
Nodding trillium (Trillium cernuum)	<1% (few 2-20)
Thistle species (Cirsium sp.)	Single (r)
Swamp thistle (Cirsium muticum)	Single (r)
Early coralroot (Corallorhiza trifida)	Single (r)
Cleavers (Galium aparine)	Single (r)
wild lettuce species (Lactuca sp.)	Single (r)
Pale vetchling (Lathyrus ochroleucus)	Single (r)

Red baneberry (Actaea rubra)	Present
Aster (Aster sp.)	Present
Leafy beggar-ticks (Bidens frondosa)	Present
Woodmint (Blephilia hirsuta)	Present
Wild calla (Calla palustris)	Present
Cuckoo-flower (Cardamine sp.)	Present
Honewort (Cryptotaenia canadensis)	Present
Lady's slipper (Cypripedium sp.)	Present
Flat-topped aster (Aster umbellatus)	Present
Marsh willow-herb (Epilobium palustre)	Present
Scouring-rush or horsetail species (Equisetum sp.)	Present
Northern bugleweed (Lycopus uniflorus)	Present
Three-leaved f. Solomon's-seal (Smilacina trifolia)	Present
Arrow-leaved tearthumb (Polygonum sagittatum)	Present
Mad dog skullcap (Scutellaria lateriflora)	Present
Eastern panicled aster (Aster lanceolatus)	Present
Crooked aster (Aster prenanthoides)	Present
Large-flowered bellwort (Uvularia grandiflora)	Present

Graminoid Layer:

Bluejoint (Calamagrostis canadensis)	>5-25%
Bladder sedge (Carex intumescens)	>5-25%
Bearded shorthusk (Brachyelytrum erectum)	1-5% (many >20)
Graceful sedge (Carex gracillima)	1-5% (many >20)
Projecting sedge (Carex projecta)	1-5% (many >20)
Drooping woodreed (Cinna latifolia)	1-5% (many >20)
Bottlebrush grass (Elymus hystrix)	1-5% (many >20)
Fowl manna grass (Glyceria striata)	1-5% (many >20)

Woodland millet grass (Milium effusum var. cisatlanticum)	1-5% (many >20)
Moutain rice grass (Oryzopsis asperifolia)	1-5% (many >20)
Autumn bentgrass (Agrostis perennans)	<1% (few 2-20)
Fringed brome (Bromus ciliatus)	<1% (few 2-20)
Sedge (Carex sp.)	<1% (few 2-20)
Drooping wood sedge (Carex arctata)	<1% (few 2-20)
Fine-nerved sedge (Carex leptonervia)	<1% (few 2-20)
Long-stalked sedge (Carex pedunculata)	<1% (few 2-20)
Carex radiata	<1% (few 2-20)

Stellate sedge (Carex rosea = C. radiata)	<1% (few 2-20)
Tussock sedge (Carex stricta)	<1% (few 2-20)
Nodding fescue (Festuca obtusa = F. subverticellata)	<1% (few 2-20)
Northern manna grass (Glyceria borealis)	<1% (few 2-20)
Fowl blue grass (Poa palustris)	<1% (few 2-20)
False melic grass (Schizachne purpurascens)	<1% (few 2-20)
Dewey's sedge (Carex deweyana)	Single (r)

Lake sedge (Carex lacustris)	Outside Plot
Bristle-stalked sedge (Carex leptalea)	Present
Awl-fruited sedge (Carex stipata)	Present
Sheathed sedge (Carex vaginata)	Present
Fowl bluegrass (Poa palustris)	Present

MHN47B

MHn47b = Mesic Hardwood Forest System / Northern Rich Mesic Hardwood Forest / Sugar Maple - Basswood - (Horsetail) Forest

Polygon Count: 53. Cornish Acres: 547.3745. Cornish Percentage: 14.38%.

General Description:
Mesic hardwood forests on moderately to somewhat poorly drained, rich soils formed on loamy, glacial till on moraines or glaciolacustrine outwash. The organic layers are thick, often with deep humus layers at all stages of decay (moder humus) over a thick, dark A horizon. Often there is a clayey loam subsoil at about 25 inches depth. In the Spring there is a zone of saturated soil at a depth from 6 to 25 inches below the surface. Organic content is high. MHn47b can be on crests and upper slopes near wet inclusions, such as water-retaining depressions, swales and drainageways, especially on east- to north-facing slopes that are level to slightly rolling. The most characteristic position for MHn47b is on lower slopes and terraces next to swamps, wet forests or within large ravines. Frequently, MHn47b polygons occupy landscape positions with surfaces a few inches above the adjacent swamps; such as depressions or swales with ground water seeps, or on footslopes or terraces.

The canopy layer in MHn47b is often closed (75-100% cover) with notable exceptions. Mhn47b polygons were mapped on landscape positions usually protected from high winds. Most of the naturally occurring canopy gaps observed in MHn47b forests were in mature stands with an interrupted canopy (50-75% cover) created by tree mortality or tipups attributed to saturated soil. MHn47b forests are heterogeneous, meaning the overall canopy is a patchwork of different dominant species, such as, sugar maple or black ash. However, some high quality MHn47b polygons have several codominants, especially in well-structured, older forests where several tree species coexist in equal proportions; including red oak, basswood, yellow birch and sometimes, white cedar. Many other tree species are common to frequent in the MHn47b canopy; including red maple, paper birch, green ash and quaking aspen. Tall white pine trees were infrequently to occasionally observed within MHn47b polygons.

The subcanopy layer varies considerably. In many mature stands, the subcanopy is partial to interrupted (25-75% cover). However, in young to immature stands the subcanopy layer is often closed (75-100% cover) or absent in immature stands. The subcanopy is most often dominated by sugar maple. (In one managed stand, the MHn47b canopy was gone and immature aspen dominated the MHN47b subcanopy layer.) In many MHn47b polygons, the subcanopy is a mixture of codominants with abundant ironwood, basswood, red maple, yellow birch and paper birch. Occasionally black ash, white cedar and red oak were found through the subcanopy of MHn47b forests.

The shrub layer varies considerably, ranging from sparse to closed (1-5% to 75-100% cover). The most abundant species were saplings/seedlings of sugar maple, mountain maple and bush honeysuckle. Interestingly, red oak saplings/seedlings were frequent; as were several other tree species: yellow birch, balsam fir, red maple, black ash, green ash, chokecherry, basswood and American elm. Several berry-producing shrubs were common; including juneberry, blue beech, pagoda dogwood, winterberry, wild black current and other gooseberries, snowberry, etc.

Forbs were extremely diverse and abundant in the herbaceous layer. In high-quality, rich stands, forbs covered 50-75% of the substrate. Other stands have considerably less forb diversity and species abundance due to 1) the complexity of the landscape, 2) the abundance of Pensylvania sedge and 3) density of the overstory (i.e., darkly shaded substrates). In one area bracken fern was prevalent. In other areas several mesic and wet-mesic ferns were abundant: lady fern, oak fern, long beech-fern is as were several species of moonwort species of Botrychium (B. multifidum, B. virginiana, B. matricarifolium and, B. oneidense). Several upland, mesic forbs are common: wild sarsparilla, bunchberry, large-leaved aster, pale bellwort, round-lobed hepatica, wood anemone, wild ginger, rose twisted stalk, red baneberry, etc. Blue cohosh was only noted once in plots; however, it occurred frequently throughout MHn47b forests. Many MHn47b polygons have frequent inclusions of wet-

mesic forbs due to their proximity to hardwood swamps, etc.

The grass and sedge layer (graminoid) varies considerably (1-5% to 50-75% cover). Graminoid relative abundance is usually inversely proportional to the coverage of forbs. On drier inclusions, Pensylvania sedge and mountain rice grass were dominant or abundant; on wet margins, bluejoint grass and drooping woodreed were prevalent. The high diversity of graminoids emphasizes the biological richness of MHn47b forests and its proximity to wet forests and swamps.

Comments:
See comments for MHn35b.

MHn47b polygons occupy intermediate positions on the landscape between MHn35b upslope and wet forest types, WFn55b or WFn64b, within small inclusions or on large swales or plains on lower slopes, terraces, swales or plains. MHn47b forests occupy positions on the landscape where soil moisture is stable throughout the growing season, but tend to be wet-mesic to wet at the margins. MHn47b polygons can be on crests and upper slopes with frequent wet inclusions, or within depressions and swales; most often with east to north facing slopes that are level to slightly rolling.

Blue beech (Carpinus) was noted on one rare occasion within the subcanopy and its presence emphasizes the biological diversity of MHn47b forests. It is also notable that yellow birch was frequently found in all strata of MHn47b forests; as opposed to MHn35b forests where yellow birch is infrequent in the canopy, never in the understory except for a few seedlings on very decayed logs.

MHn47b forests can be recognized by the following ecological attributes:

1) Lower slope positions or drainage ways on upperslopes and crests.
2) Consistently moist (mesic) soils with high water-table in subsoil.
3) Seldom adversely affected by drought.
4) Deep organic layer (moder humus) with all stages of decay and A horizons with dark silt.
5) Mesic and wet-mesic indicator species abundant and frequent throughout.
6) Wet species present at margins or within local depressions.
7) Yellow birch frequent within canopy, subcanopy and shrub layers. Seedlings frequent on thick organic layer on soil.

Soil Description:
The most prominent soils underlying MHn47b polygons are provided in Table 5, Appendix II. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series for the Cornish Area are also provided in Appendix IV. The most characteristic USDA soil series for MHn47b are Alstad Series, Dusler Series, the Cowhorn Series and Lupton Series. Other soil series are associated with MHn47b 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 the NPC polygons.

The most characteristic position for MHn47b is on lower slopes and terraces next to swamps, wet forests or large ravines. Frequently, MHn47b polygons include depressions or swales with ground water seeps; or on footslopes or terraces with surfaces a few inches above the adjacent swamps.

Alstad soils are on upperslopes and crests with slopes less than 4% gradient. They are comprised of very deep, somewhat poorly drained soils formed in loamy, calcareous till. Water movement is moderately high, and there is no ponding or flooding; however the seasonal water table is relatively high compared to MHn35b (zone of water saturation to 12 inches in May). There is a clay loam subsoil at about 25 inches depth. Organic content is high.

Dusler soils formed on loamy glacial till of lake plains and on moraines. Dusler soils have level to slightly convex slopes less than 3% gradient on gently undulating to rolling terrains. The soils are primarily reddish brown loam or clay loam deposited by the Superior Lobe of the Wisconsin Glacier. Sometimes there is a thin mantle of eolian silt. Dusler soils are somewhat poorly drained and water movement in the most restrictive layer is moderately low. The soil is not flooded or ponded; however the seasonal zone of water saturation is at

6 inches during April. Organic content is moderate.

Cowhorn soils are on level surfaces of lake plains, river terraces and deltas. Parent materials consists of sandy and silty glaciolacustrine deposits. Slopes are less than 3%. The glacial sediments are more than 40 inches thick. Cowhorn soils are somewhat poorly drained and water movement through the soils is high. The underlying water table is between 1.5 to 2.5 feet during April and June of most years. They are not flooded or pounded.

Lupton soils are within depressions that occur both as small upland inclusions and large areas. Often they are found on footslopes where upland soils break sharply into depressions or large plains. Here they are typically associated with groundwater discharge or seepage areas. The groundwater passes through mineral soil and has a high-dissolved mineral content. The Lupton series consists of very deep, very poorly drained soils formed in organic deposits more that 51 inches thick. Slopes are usually less than 2% by range up to 15%. The typical depth to saturated soil is at the surface to 1 foot depth at some point during the year. Ponding occurs at least once yearly to a depth between 0.2 and 1 foot.

Canopy Layer:

Sugar maple (C) (Acer saccharum)	>75-100%
Black ash (C) (Fraxinus nigra)	>75-100%
Basswood (C) (Tilia americana)	>50-75%
Yellow birch (C) (Betula alleghaniensis)	>25-50%
Northern red oak (C) (Quercus rubra)	>25-50%
White cedar (C) (Thuja occidentalis)	>25-50%
Red maple (C) (Acer rubrum)	>5-25%
Paper birch (C) (Betula papyrifera)	>5-25%

Green ash (C) (Fraxinus pennsylvanica)	1-5% (many >20)
White pine (C) (Pinus strobus)	1-5% (many >20)
Quaking aspen (C) (Populus tremuloides)	1-5% (many >20)
Balsam fir (C) (Abies balsamea)	Present
White spruce (C) (Picea glauca)	Present
Balsam poplar (C) (Populus balsamifera)	Present
American elm (C) (Ulmus americana)	Present

Subcanopy Layer:

Sugar maple (U) (Acer saccharum)	>75-100%
Quaking aspen (U) (Populus tremuloides)	>75-100%
Ironwood (U) (Ostrya virginiana)	>25-50%
Basswood (U) (Tilia americana)	>25-50%
Red maple (U) (Acer rubrum)	>5-25%
Yellow birch (U) (Betula alleghaniensis)	>5-25%
Paper birch (U) (Betula papyrifera)	>5-25%
Black ash (U) (Fraxinus nigra)	1-5% (many >20)
Northern red oak (U) (Quercus rubra)	1-5% (many >20)

White cedar (U) (Thuja occidentalis)	1-5% (many >20)
Blue beech (U) (Carpinus caroliniana ssp. virginiana)	<1% (few 2-20)
Green ash (U) (Fraxinus pennsylvanica)	<1% (few 2-20)
Balsam fir (U) (Abies balsamea)	Single (r)
White spruce (U) (Picea glauca)	Single (r)
Balsam poplar (U) (Populus balsamifera)	Outside Plot

Shrub Layer:

Sugar maple (Acer saccharum)	>50-75%
Mountain maple (Acer spicatum)	>50-75%
Quaking aspen (Populus tremuloides)	>50-75%
Bush honeysuckle (Diervilla lonicera)	>25-50%
Beaked hazelnut (Corylus cornuta)	>5-25%
Northern red oak (Quercus rubra)	>5-25%
Balsam fir (Abies balsamea)	1-5% (many >20)
Red maple (Acer rubrum)	1-5% (many >20)
Yellow birch (Betula alleghaniensis)	1-5% (many >20)
Black ash (Fraxinus nigra)	1-5% (many >20)
Green ash (Fraxinus pennsylvanica)	1-5% (many >20)
Ironwood (Ostrya virginiana)	1-5% (many >20)
Chokecherry (Prunus virginiana)	1-5% (many >20)
Basswood (Tilia americana)	1-5% (many >20)
American elm (Ulmus americana)	1-5% (many >20)
Juneberry (shrub) (Amelanchier spp.)	<1% (few 2-20)
Blue beech (Carpinus caroliniana ssp. virginiana)	<1% (few 2-20)
Pagoda dogwood (Cornus alternifolia)	<1% (few 2-20)
Leatherwood (Dirca palustris)	<1% (few 2-20)
Winterberry (Ilex verticillata)	<1% (few 2-20)

Fly honeysuckle (Lonicera canadensis)	<1% (few 2-20)
White spruce (Picea glauca)	<1% (few 2-20)
Wild black currant (Ribes americanum)	<1% (few 2-20)
Prickly gooseberry (Ribes cynosbati)	<1% (few 2-20)
Swamp red currant (Ribes triste)	<1% (few 2-20)
Bebb's willow (Salix bebbiana)	<1% (few 2-20)
Snowberry (Symphoricarpos albus)	<1% (few 2-20)
Downy arrowwood (Viburnum rafinesquianum)	<1% (few 2-20)
Hairy honeysuckle (Lonicera hirsuta)	Single (r)
White oak (Quercus alba)	Single (r)
Skunk currant (Ribes glandulosum)	Single (r)
Meadow willow (Salix petiolaris)	Single (r)
Red-berried elder (Sambucus racemosa)	Single (r)
Paper birch (Betula papyrifera)	Present
Red-osier dogwood (Cornus sericea)	Present
Wild current or gooseberry (Ribes sp.)	Present
Northern gooseberry (Ribes oxyacanthoides)	Present
Meadowsweet (Spiraea alba)	Present

Sub-Shrub Layer:

Red raspberry (Rubus idaeus)	>50-75%
Blackberry or raspberry (Rubus sp.)	1-5% (many >20)
Velvet-leaved blueberry (Vaccinium myrtilloides)	1-5% (many >20)
Five-leaved Virginia creeper (Parthenocissus inserta)	Present

High-bush blackberry (Rubus allegheniensis)	Present

Forb Layer:

Bracken (Pteridium aquilinum var. latiusculum)	>50-75%
Lady-fern (Athyrium angustum)	>25-50%
Common oak fern (Gymnocarpium dryopteris)	>25-50%

Long beech-fern (Thelypteris phegopteris)	>25-50%
Wild sarsaparilla (Aralia nudicaulis)	>5-25%
Bunchberry (Cornus canadensis)	>5-25%

Large-leaved aster (Aster macrophyllus)	>5-25%
Bristly clubmoss (Lycopodium annotinum)	>5-25%
Pale bellwort (Uvularia sessilifolia)	>5-25%
Hog peanut (Amphicarpaea bracteata)	1-5% (many >20)
Round-lobed hepatica (Anemone americana)	1-5% (many >20)
Wood anemone (Anemone quinquefolia)	1-5% (many >20)
American spikenard (Aralia racemosa)	1-5% (many >20)
Jack-in-the-pulpit (Arisaema triphyllum)	1-5% (many >20)
Wild ginger (Asarum canadense)	1-5% (many >20)
Bluebead lily (Clintonia borealis)	1-5% (many >20)
Goldthread (Coptis trifolia var. groenlandica)	1-5% (many >20)
Spinulose shield fern (Dryopteris carthusiana)	1-5% (many >20)
Field horsetail (Equisetum arvense)	1-5% (many >20)
Woodland horsetail (Equisetum sylvaticum)	1-5% (many >20)
Fringed false buckwheat (Polygonum cilinode)	1-5% (many >20)
Common strawberry (Fragaria virginiana)	1-5% (many >20)
Sweet-scented bedstraw (Galium triflorum)	1-5% (many >20)
Shining firmoss (Lycopodium lucidulum)	1-5% (many >20)
Touch-me-not (Impatiens sp.)	1-5% (many >20)
Pale vetchling (Lathyrus ochroleucus)	1-5% (many >20)
Running clubmoss (Lycopodium clavatum)	1-5% (many >20)
Groundpine (Lycopodium dendroideum)	1-5% (many >20)
Starflower (Trientalis borealis)	1-5% (many >20)
Canada mayflower (Maianthemum canadense)	1-5% (many >20)
Starry false Solomon's seal (Smilacina stellata)	1-5% (many >20)
Clayton's sweet cicely (Osmorhiza claytonii)	1-5% (many >20)
Interrupted fern (Osmunda claytoniana)	1-5% (many >20)
Dwarf raspberry (Rubus pubescens)	1-5% (many >20)
Maryland black snakeroot (Sanicula marilandica)	1-5% (many >20)
Giant goldenrod (Solidago gigantea)	1-5% (many >20)
Rose twistedstalk (Streptopus roseus)	1-5% (many >20)
Eastern panicled aster (Aster lanceolatus)	1-5% (many >20)
Side-flowering aster (Aster lateriflorus)	1-5% (many >20)
American vetch (Vicia americana)	1-5% (many >20)
Violet species (Viola sp.)	1-5% (many >20)
Yellow violet (Viola pubescens)	1-5% (many >20)
Red baneberry (Actaea rubra)	<1% (few 2-20)
Leathery grapefern (Botrychium multifidum)	<1% (few 2-20)
Blunt-lobed grapefern (Botrychium oneidense)	<1% (few 2-20)
Triangle moonwort (Botrychium lanceolatum)	Present
Matricary grapefern (Botrychium matricariifolium)	Present
Goblin fern (Botrychium mormo)	Present
Rattlesnake fern (Botrychium virginianum)	<1% (few 2-20)
Canada thistle (Cirsium arvense)	<1% (few 2-20)
American willow-herb (Epilobium ciliatum Raf.)	<1% (few 2-20)
Meadow horsetail (Equisetum pratense)	<1% (few 2-20)
Grass-leaved goldenrod (Euthamia graminifolia)	<1% (few 2-20)
Spotted Joe pye weed (Eupatorium maculatum)	<1% (few 2-20)
Rough avens (Geum laciniatum var. trichocarpum)	<1% (few 2-20)
Yellow avens (Geum aleppicum var. strictum)	<1% (few 2-20)
Racemose false Solomon's-seal (Smilacina racemosa)	<1% (few 2-20)
Ostrich-fern (Matteuccia struthiopteris var. pensylvanica)	<1% (few 2-20)
Partridgeberry (Mitchella repens)	<1% (few 2-20)
Sensitive fern (Onoclea sensibilis)	<1% (few 2-20)

Dwarf ginseng (Panax trifolium)	<1% (few 2-20)
Palmate sweet coltsfoot (Petasites frigidus var. palmatus)	<1% (few 2-20)
Hairy Solomon's seal (Polygonatum pubescens)	<1% (few 2-20)
White rattlesnakeroot (Prenanthes alba)	<1% (few 2-20)
Mad dog skullcap (Scutellaria lateriflora)	<1% (few 2-20)
Canada goldenrod (Solidago canadensis)	<1% (few 2-20)
Zigzag goldenrod (Solidago flexicaulis)	<1% (few 2-20)
Lindley's aster (Aster ciliolatus)	<1% (few 2-20)
Early meadow-rue (Thalictrum dioicum)	<1% (few 2-20)
Nodding trillium (Trillium cernuum)	<1% (few 2-20)
Large-flowered bellwort (Uvularia grandiflora)	<1% (few 2-20)
Marsh horsetail (Equisetum palustre)	Single (r)
Common boneset (Eupatorium perfoliatum)	Single (r)
Bloodroot (Sanguinaria canadensis)	Single (r)
Honewort (Cryptotaenia canadensis)	Outside Plot
Giant Solomon's-seal (Polygonatum commutatum)	Outside Plot
Maryland figwort (Scrophularia marilandica)	Outside Plot
Maidenhair fern (Adiantum pedatum)	Present
Columbine (Aquilegia canadensis)	Present
Common burdock (Arctium minus)	Present
Swamp milkweed (Asclepias incarnata)	Present
Matricary grapefern (Botrychium matricariifolium	Present
Common marsh marigold (Caltha palustris)	Present

Blue cohosh (Caulophyllum thalictroides)	Present
Alpine enchanter's nightshade (Circaea alpina)	Present
Common enchanter's nightshade (Circaea lutetiana)	Present
Field thistle (Cirsium discolor)	Present
Horseweed (Conyza canadensis)	Present
Flat-topped aster (Aster umbellatus)	Present
Crested fern (Dryopteris cristata)	Present
Pilewort (Erechtites hieracifolia)	Present
White avens (Geum canadense)	Present
Northern blue flag (Iris versicolor)	Present
Wood nettle (Laportea canadensis)	Present
Cut-leaved bugleweed (Lycopus americanus)	Present
Two-leaved miterwort (Mitella diphylla)	Present
Naked miterwort (Mitella nuda)	Present
Kidney-leaved buttercup (Ranunculus abortivus)	Present
Hooked crowfoot (Ranunculus recurvatus)	Present
Erect carrion-flower (Smilax ecirrata)	Present
Goldenrod Species (Solidago sp.)	Present
Red-stemmed aster (Aster puniceus)	Present
Rugulose violet (Viola canadensis var. rugulosa)	Present
Wild leak (Allium tricoccum)	Present

Graminoid Layer:

Sun-loving sedge (Carex pensylvanica)	>50-75%
Bluejoint (Calamagrostis canadensis)	>5-25%
Drooping woodreed (Cinna latifolia)	>5-25%

Moutain rice grass (Oryzopsis asperifolia)	>5-25%
Bearded shorthusk (Brachyelytrum erectum)	1-5% (many >20)
Drooping wood sedge (Carex arctata)	1-5% (many >20)

Dewey's sedge (Carex deweyana)	1-5% (many >20)
Nodding fescue (Festuca obtusa = F. subverticellata)	1-5% (many >20)
Pointed woodrush (Luzula acuminata)	1-5% (many >20)
Woodland millet grass (Milium effusum var. cisatlanticum)	1-5% (many >20)
Twin bentgrass (Agrostis scabra)	<1% (few 2-20)
Brownish sedge (Carex brunnescens var. sphaerostachya)	<1% (few 2-20)
Soft-leaved sedge (Carex disperma)	<1% (few 2-20)
Graceful sedge (Carex gracillima)	<1% (few 2-20)
Bladder sedge (Carex intumescens)	<1% (few 2-20)
Lake sedge (Carex lacustris)	<1% (few 2-20)
Long-stalked sedge (Carex pedunculata)	<1% (few 2-20)
Projecting sedge (Carex projecta)	<1% (few 2-20)
Bottlebrush grass (Elymus hystrix)	<1% (few 2-20)
Fowl blue grass (Poa palustris)	<1% (few 2-20)
Woolgrass (Scirpus cyperinus)	<1% (few 2-20)
Interior sedge (Carex interior)	Single (r)
Fine-nerved sedge (Carex leptonervia)	Outside Plot
Fringed brome (Bromus ciliatus)	Present
Peck's sedge (Carex peckii)	Present
Fowl manna grass (Glyceria striata)	Present
Reed canary grass (Phalaris arundinacea)	Present
Fowl bluegrass (Poa palustris)	Present

WFN55B

WFn55b = Wet Forest System / Northern Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Basswood Swamp (Eastcentral)

Polygon Count: 2. Cornish Acres: 61.3443. Cornish Percentage: 1.61%.

General Description:

Wet hardwood forests on mucky mineral soils with consistently high water tables or sapric peat fed by groundwater discharge. WFn55b occurs in shallow depressions and drainageways on lake plains, till plains, outwash plains and moraines. WFn55b is characterized by ephemeral pools that dry down by late summer (in contrast to WFn64b, which usually has pools throughout the growing season).

The WFn55b canopy is interrupted to closed (50-100% cover). Usually black ash is the predominant species, but it is also found in combination with other codominant tree species: sugar maple, quaking aspen, red maple, yellow birch, white spruce and frequently, white cedar. The subcanopy is patchy (25-50% cover) usually with black ash, but also with balsam fir, red maple, sugar maple, yellow birch, basswood, red oak, etc.

The shrub layer varies considerably. Black ash saplings are common with other tree species such as red maple, basswood, American elm, red elm, etc. Shrub species are diverse and often abundant. They include mountain maple, speckled alder, black chokecherry, various willows, meadowsweet, dwarf alder, etc.

The forb layer is diverse and abundant. Most species are characteristic of wet forests: palmate sweet coltsfoot, long-leaved chickweed, northern blue-flag iris, bur-marigold species, wild calla, water hemlock, marsh marigold, goldthread, etc. Due to the complex landscape and the inclusion of slight rises, many mesic and wet-mesic forest species are common: maidenhair fern American spikenard, jack-in-the-pulpit, bluebead lily, bunchberry, spinulose shield fern, etc.

The grass and sedge layer (graminoid) is likewise diverse and abundant with graminoids from both upland forests, wet forests and wet meadows: manna grass, graceful sedge, bearded shorthusk, bluejoint grass, lake sedge, etc.

Comments:

This study focused on upland forests, so few data points were collected in wet forest classes. This description is provided to aid understanding of the continuum of hardwood NPC classes mapped at Cornish.

Soil Description:

The most prominent soils underlying WFn55b polygons are provided in Table 5, Appendix II. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series for the Cornish Area are also provided in Appendix IV. The most characteristic USDA soil series for WFn55b are Northwood Series and Lupton 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 the NPC polygons.

WFn55b occurs on shallow depressions and drainageways on lake plains, till plains, outwash plains and moraines. Northwood soils consist of organic material over sandy and silty glaciolacustrine deposits. Slopes are less than 1%.

The Northwood series consists of very deep, very poorly drained soils that formed in herbaceous organic materials overlying stratified loamy and sandy lacustrine deposits underlain by loamy calcareous till or lacustrine sediments. They general have a thin organic layer over sandy and loamy strata. Water movement through the organic layer is moderate to moderately-rapid; water movement through the underlying till is rapid in the sand strata and moderate through the loamy strata. Surface runoff is very low or ponded. Depth to seasonal high saturation is normally at the surface from November through July. The soil is frequently ponded.

Lupton soils are within depressions that occur both as small upland inclusions and large areas. Often they are found on footslopes where upland soils break sharply into depressions or large plains. Here they are typically associated with groundwater discharge or seepage areas. The groundwater passes through mineral soil and has a high-dissolved mineral content. The Lupton series consists of very deep, very poorly drained soils formed in organic

deposits more that 51 inches thick. Slopes are usually less than 2% by range up to 15%. The typical depth to saturated soil is at the surface to 1 foot depth at some point during the year. Ponding occurs at least once yearly to a depth between 0.2 and 1 foot.

Canopy Layer:

Red maple (C) (Acer rubrum)	Present
Sugar maple (C) (Acer saccharum)	Present
Yellow birch (C) (Betula alleghaniensis)	Present
Black ash (C) (Fraxinus nigra)	Present
White spruce (C) (Picea glauca)	Present
Quaking aspen (C) (Populus tremuloides)	Present
White cedar (C) (Thuja occidentalis)	Present

Subcanopy Layer:

Balsam fir (U) (Abies balsamea)	Present
Red maple (U) (Acer rubrum)	Present
Sugar maple (U) (Acer saccharum)	Present
Yellow birch (U) (Betula alleghaniensis)	Present
Black ash (U) (Fraxinus nigra)	Present
Black spruce (U) (Picea mariana)	Present
Quaking aspen (U) (Populus tremuloides)	Present
Northern red oak (U) (Quercus rubra)	Present
Basswood (U) (Tilia americana)	Present
Red elm (U) (Ulmus rubra)	Present
American elm (U) (Ulmus americana)	<1% (few 2-20)

Shrub Layer:

Dwarf alder (Rhamnus alnifolia)	<1% (few 2-20)
Wild black currant (Ribes americanum)	<1% (few 2-20)
Swamp gooseberry (Ribes hirtellum)	<1% (few 2-20)
Swamp red currant (Ribes triste)	<1% (few 2-20)
Balsam fir (Abies balsamea)	Present
Red maple (Acer rubrum)	Present
Mountain maple (Acer spicatum)	Present
Speckled alder (Alnus incana ssp rugosa)	Present
Black chokeberry (Aronia melanocarpa)	Present
Yellow birch (Betula alleghaniensis)	Present
Beaked hazelnut (Corylus cornuta)	Present
Black ash (Fraxinus nigra)	Present
Winterberry (Ilex verticillata)	Present
Northern red oak (Quercus rubra)	Present
Skunk currant (Ribes glandulosum)	Present
Meadow willow (Salix petiolaris)	Present
Meadowsweet (Spiraea alba)	Present
Basswood (Tilia americana)	Present
American elm (Ulmus americana)	Present
Red elm (Ulmus rubra)	Present
Paper birch (Betula papyrifera)	Outside Plot
Quaking aspen (Populus tremuloides)	Outside Plot
Green ash (Fraxinus pennsylvanica)	Single (r)

Sub-Shrub Layer:

Five-leaved Virginia creeper (Parthenocissus inserta)	Present
Red raspberry (Rubus idaeus)	Present
Velvet-leaved blueberry (Vaccinium myrtilloides)	Present

Forb Layer:

Common strawberry (Fragaria virginiana)	1-5% (many >20)
Palmate sweet coltsfoot (Petasites frigidus var. palmatus)	1-5% (many >20)
Long-leaved chickweed (Stellaria longifolia)	1-5% (many >20)
Crested fern (Dryopteris cristata)	<1% (few 2-20)
Purple avens (Geum rivale)	<1% (few 2-20)
Northern blue flag (Iris versicolor)	<1% (few 2-20)
Kidney-leaved buttercup (Ranunculus abortivus)	<1% (few 2-20)
Maidenhair fern (Adiantum pedatum)	Present
Agrimonia species (Agrimonia sp.)	Present
Hog peanut (Amphicarpaea bracteata)	Present
American spikenard (Aralia racemosa)	Present
Jack-in-the-pulpit (Arisaema triphyllum)	Present
Lady-fern (Athyrium angustum)	Present
Bur-marigold; Beggar-ticks (Bidens)	Present
Nodding bur-marigold (Bidens cernua)	Present
Tufted begar-ticks (Bidens comosa)	Present
Wild calla (Calla palustris)	Present
Common marsh marigold (Caltha palustris)	Present
Bulb-bearing water hemlock (Cicuta bulbifera)	Present
Alpine enchanter's nightshade (Circaea alpina)	Present
Bluebead lily (Clintonia borealis)	Present
Goldthread (Coptis trifolia var. groenlandica)	Present
Bunchberry (Cornus canadensis)	Present
Spinulose shield fern (Dryopteris carthusiana)	Present
Willow-herb species (Epilobium sp.)	Present
American willow-herb (Epilobium ciliatum Raf.)	Present
Field horsetail (Equisetum arvense)	Present
Woodland horsetail (Equisetum sylvaticum)	Present
Obtuse bedstraw (Galium obtusum)	Present
Three-cleft bedstraw (Galium trifidum)	Present
Sweet-scented bedstraw (Galium triflorum)	Present
Yellow avens (Geum aleppicum var. strictum)	Present
Touch-me-not (Impatiens sp.)	Present
Spotted touch-me-not (Impatiens capensis)	Present
Wood nettle (Laportea canadensis)	Present
Michigan lily (Lilium michiganense)	Present
Bristly clubmoss (Lycopodium annotinum)	Present
Groundpine (Lycopodium dendroideum)	Present
Northern bugleweed (Lycopus uniflorus)	Present
Virginia bugleweed (Lycopus virginicus)	Present
Starflower (Trientalis borealis)	Present
Tufted loosestrife (Lysimachia thyrsiflora)	Present
Canada mayflower (Maianthemum canadense)	Present
Ostrich-fern (Matteuccia struthiopteris var. pensylvanica)	Present
Sensitive fern (Onoclea sensibilis)	Present
Cinnamon fern (Osmunda cinnamomea)	Present
Interrupted fern (Osmunda claytoniana)	Present
Halberd-leaved tearthumb (Polygonum arifolium var. pubescens)	Present

Dotted smartweed (Polygonum punctatum)	Present
Arrow-leaved tearthumb (Polygonum sagittatum)	Present
Long beech-fern (Thelypteris phegopteris)	Present
White rattlesnakeroot (Prenanthes alba)	Present
Dwarf raspberry (Rubus pubescens)	Present
Great water dock (Rumex orbiculatus)	Present
Marsh skullcap (Scutellaria galericulata)	Present
Mad dog skullcap (Scutellaria lateriflora)	Present

Water parsnip (Sium suave)	Present
Zigzag goldenrod (Solidago flexicaulis)	Present
Giant goldenrod (Solidago gigantea)	Present
Side-flowering aster (Aster lateriflorus)	Present
Red-stemmed aster (Aster puniceus)	Present
Violet species (Viola sp.)	Present
Yellow violet (Viola pubescens)	Present

Graminoid Layer:

Manna grass species (Glyceria sp.)	1-5% (many >20)
Reed canary grass (Phalaris arundinacea)	Single (r)
Graceful sedge (Carex gracillima)	<1% (few 2-20)
Autumn bentgrass (Agrostis perennans)	Present
Bearded shorthusk (Brachyelytrum erectum)	Present
Bluejoint (Calamagrostis canadensis)	Present
Soft-leaved sedge (Carex disperma)	Present
Bladder sedge (Carex intumescens)	Present
Lake sedge (Carex lacustris)	Present
Projecting sedge (Carex projecta)	Present

Awl-fruited sedge (Carex stipata)	Present
Tuckerman's sedge (Carex tuckermanii)	Present
Stout woodreed (Cinna arundinacea)	Present
Drooping woodreed (Cinna latifolia)	Present
Fowl manna grass (Glyceria striata)	Present
Rattlesnake grass (Glyceria canadensis)	Present
Tall manna grass (Glyceria grandis)	Present
Fowl bluegrass (Poa palustris)	Present
Maple species (Acer sp.)	Present

WFN64B

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

Polygon Count: 9. Cornish Acres: 277.9715. Cornish Percentage: 7.30%.

General Description:
Very wet hardwood forest (with some conifers) on peaty soils in small depressional inclusions on uplands, on the alluvial delta of large ravines and along the margins of large peatlands. Often they are found on footslopes where upland soils break sharply into depressions or large plains. WFn64b forests occupy positions on the landscape where soil saturation is stable throughout the growing season with normal years of frequent ponding with stable pools throughout the growing season. WFn64b is often associated with groundwater discharge. Soils consists of very deep, very poorly drained soils formed in organic deposits, sometimes more that 51 inches thick. Slopes are usually less than 2% by range up to 15%. The typical depth to saturated soil is at the surface to 1 foot depth at some point during the year.

The canopy is patchy to closed (25-100% cover), largely determine by the relative proportion of standing water. Black ash is the predominant species but other trees may be Present , including white cedar, balsam fir, yellow birch, red maple, white spruce, and infrequently, white pine.

The subcanopy is patchy (25-50% cover). Black ash is the most abundant tree species in the subcanopy.

The shrub layer varies considerably (5-100% cover). Speckled alder abundant is the most abundant species, but mountain maple is sometimes common. Winterberry is frequent.

The herbaceous layer is similar to WFn55b. However, the wet forest species is both forbs and graminoids is are more common.

Sedges and grasses typical of wet meadows predominate. These include bluejoint, lake sedge, TuckermanÆs sedge, drooping windreed, various species of manna grass, etc. Very few upland species are Present. Mostly on hummocks and slight rises on root masses.

Comments:
This study focused on upland forests, so few data points were collected in wet forest classes. This description is provided to aid understanding of the continuum of hardwood NPC classes mapped at Cornish. Also please note that WFn64b shares many of the same characteristics as WFn55b. However, WFn64b is considerably wetter and therefore more likely to be dominated by species indicative of wet forests with upland forest species restricted to small inclusions on slight rises, margins and on root masses of trees and shrubs (alder).

Soil Description:
The most prominent soils underlying WFn64b polygons are provided in Table 5, Appendix II. They are arranged in descending order by acreage. A compiled summary of the most important USDA soil series for the Cornish Area are also provided in Appendix IV. The most characteristic USDA soil series for WFn64b are Luton Series, Cathro Series and Rifle 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 the NPC polygons. WFn64b polygons occupy wet positions is especially with groundwater discharge is within small upland, depressional inclusions, large swales or drainageways, lower slopes, footslopes, terraces and, especially large former lake plains.

WFn64b occupy positions on the landscape where soil saturation is stable throughout the growing season with normal years of frequent ponding. WFn64b polygons can be on crests and upper slopes with frequent wet inclusions within depressions and swales; most often with east to north facing slopes that are level to slightly rolling. Frequently, WFn64b polygons include depressions or swales with ground water seeps. WFn64b are in swamps, bogs and depressional areas within ground moraines, end moraines, outwash plains and lake plains. The most characteristic position for WFn64b is on large lake plains or within large ravines.

Lupton soils are within depressions that occur both as small upland inclusions and large areas. Often they are found on footslopes where upland soils break sharply into depressions or large plains. Here

they are typically associated with groundwater discharge or seepage areas. The groundwater passes through mineral soil and has a high-dissolved mineral content. The Lupton series consists of very deep, very poorly drained soils formed in organic deposits more that 51 inches thick. Slopes are usually less than 2% by range up to 15%. The typical depth to saturated soil is at the surface to 1 foot depth at some point during the year. Ponding occurs at least once yearly to a depth between 0.2 and 1 foot.

Cathro soils are usually in small depressions on moraines and outwash plains. Slopes are less than 2%. The parent material consists of organic material over loamy till. Groundwater with dissolved minerals influences the surface layer. Cathro soils consists of very deep, poorly drained organic soils with a depth of 16 to 51 inches over loamy glacial till. They are frequently ponded throughout the year. Organic content of the surface layer is very high.

The Rifle series consists of very deep, very poorly drained soils formed in organic deposits more than 51 inches thick in swamps, bogs and depressional areas within ground moraines, end moraines, outwash plains and lake plains. Slope gradients are less than 2%. Drainage is very poorly drained. The seasonal high water table ranges from 1 foot above the surface to 1 foot below the surface frm November to June. Surface runoff is very slope. Water movement through the substrate is moderately rapid. It is frequently ponded throughout the growing season.

Canopy Layer:

Black ash (C) (Fraxinus nigra)	>25-50%
White pine (C) (Pinus strobus)	Present

Subcanopy Layer:

Black ash (U) (Fraxinus nigra)	Present

Shrub Layer:

Speckled alder (Alnus incana ssp rugosa)	
Winterberry (Ilex verticillata)	Present

Sub-Shrub Layer:

Forb Layer:

Jack-in-the-pulpit (Arisaema triphyllum)	Present
Nodding bur-marigold (Bidens cernua)	Present
Bulb-bearing water hemlock (Cicuta bulbifera)	Present
Spotted water hemlock (Cicuta maculata)	Present
Alpine enchanter's nightshade (Circaea alpina)	Present
Spinulose shield fern (Dryopteris carthusiana)	Present

Woodland horsetail (Equisetum sylvaticum)	Present
Bedstraw; Cleavers (Galium)	Present
Labrador bedstraw (Galium labradoricum)	Present
Touch-me-not (Impatiens sp.)	Present
Northern blue flag (Iris versicolor)	Present
Northern bugleweed (Lycopus uniflorus)	Present
Ostrich-fern (Matteuccia struthiopteris var. pensylvanica)	Present

Sensitive fern (Onoclea sensibilis)	Present
Halberd-leaved tearthumb (Polygonum arifolium var. pubescens)	Present
Arrow-leaved tearthumb (Polygonum sagittatum)	Present
Dwarf raspberry (Rubus pubescens)	Present

Water parsnip (Sium suave)	Present
Giant goldenrod (Solidago gigantea)	Present
Red-stemmed aster (Aster puniceus)	Present
Violet species (Viola sp.)	Present

Graminoid Layer:

Bluejoint (Calamagrostis canadensis)	>25-50%
Lake sedge (Carex lacustris)	>25-50%
Interior sedge (Carex interior)	Present
Retrorse sedge (Carex retrorsa)	Present
Tuckerman's sedge (Carex tuckermanii)	Present

Drooping woodreed (Cinna latifolia)	Present
Manna grass species (Glyceria sp.)	Present
Rattlesnake grass (Glyceria canadensis)	Present

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APPENDIX I

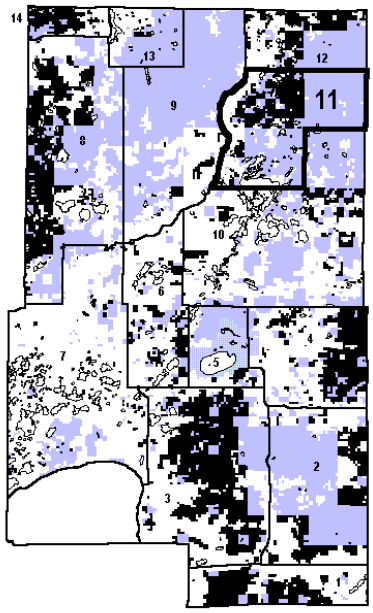
Aitkin County Land Department

Management Plan for the

Cornish Hardwoods Management Unit (MU #11)

Aitkin County Land Department **MU # 11**

Management Plan for the Cornish Hardwoods Management Unit



Ownership

Owner	Acres	%
County	17,346	21%
State	44,464	53%
Federal	0	0%
Private	22,800	27%
Total	84,610	100%

Patch Review

CType	Avg Size (ac)	Interior (tot. ac.)
Aspen/Bir/Fir	48.0	0
Aspen/Birch	196.6	1,407
No. Hdwds	95.0	604
Low. Conifer		475

Direction of change of average patch size:
Active Aggregation

Summary of Cover Type: 2000							
Cover Type	Aspen	No Hdwd	BlkSp/lo	Tamarack	Wh Cedar	Ash	Red Pine
Acres	4,464	4,218	933	778	622	579	355
Age Class	0-20	21-40	41-60	61-80	81-100	101-120	121+
Aspen	2,088	1,208	567	601			
Northern Hdwds	32	289	294	1,715	1,344	479	65

■ DESCRIPTION

This unit contains the Cornish Hardwoods Management Area (CHMA) which is a joint project of Aitkin County and the MnDNR.

■ LAND ADMINISTRATION

The County will retain its ownership within this unit. If the small amount of private land becomes available for acquisition, the County will pursue this through purchase or exchange.

■ MANAGEMENT OBJECTIVES

Increase the size of patches within the CHMA and consolidate patches in the surrounding "cluster zone".

Increase the extent of northern hardwood forest type through selective harvesting (uneven age) and conversion of other upland forest types.

Enhance wildlife habitat characteristics for species that prefer mature/old, closed canopy, upland deciduous forests, in large contiguous areas.

Produce high quality, large diameter hardwood saw timber for high value forest products.

Maintain or increase native tree species that are "rare" in the CHMA (e.g., white pine, yellow birch, upland cedar, etc.).

Areas outside of the CHMA will be managed according to County cover type and ecological system standards.

Dispersed recreation opportunities will be made available across the unit.

■ RECREATION

The County has the following facilities within this unit:

Boat accesses: Little Ball Bluff Lake; Rat House Lake; Cutaway Lake; Mississippi River

In addition, a portion of Savanna Portage State Park lies within the unit

■ WILDLIFE

One objective of Cornish Hardwoods Management Area is to ensure large contiguous tracts of interior northern hardwood forest. This type of forest, which is in relatively short supply, provides habitat for a variety of mammals and birds, especially neo-tropical migrants.

■ OTHER

The CHMA occupies most of the unit. It has a special management guide prepared for it. The most recent version follows the Management Unit narratives in this chapter.

APPENDIX II

Report Tables

Table 1: Criteria for scoring attributes of potential High Conservation Value Forests.

Table 2: Rare, Threatened, Endangered (RTE) Plants and Animals within Cornish HCVF Vicinity.

Table 3: Native Plant Community (NPC) Types with Acreage and Percent Cover - Cornish HCVF.

Table 4: Soil Moisture, Drainage and Soil Taxonomy for NRCS Soil Map Units - Cornish HCVF.

Table 5: NRCS Soil Types arranged by relative abundance within Native Plant Community Types.

Table 6: General Descriptions of data collected at various waypoints within Cornish HCVF.

Table 1. 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 2. Rare, threatened, endangered (RTE) plants and animals within the MN DNR Heritage Database Recorded Within the Cornish HCVF and Vicinity.

EOR NUM	ENAME	Common Name	MN STAT	Description
12181	BOTRYCHIUM LANCEOLATUM	TRIANGLE MOONWORT	THR	ABOUT SIX MILES SOUTHEAST OF THE TOWN OF JACOBSON, ON A FORESTED RIDGE SOUTH OF HAY LAKE CAMPGROUND. ON THE WEST SIDE OF THE HAY LAKE TO WOLF LAKE SNOWMOBILE TRAIL. AROUND A SMALL POOL IN A MAPLE-BASSWOOD FOREST. SEVERAL LARGE WHITE CEDAR AND YELLOW BIRCH IN THE HARDWOOD MIX. ASSOCIATED WITH ARALIA NUDICAULIS, MAIANTHEMUM CANADENSE, TRIENTALIS BOREALIS, BOTRYCHIUM
22664	BOTRYCHIUM LANCEOLATUM	TRIANGLE MOONWORT	THR	CORNISH TWP, APPROXIMATELY 7 MILES SW OF JACOBSON, MN. APPROX 0.9 MILES NORTH OF THE MULTI-USE TRAIL & HEDBOM FOREST RD JUNCTION (JUST EAST OF TRAIL). MAPLE- BASSWOOD FOREST WITH NUMEROUS SUGAR MAPLE SEEDLINGS, UVULARIA SESSIFOLIA & B. MATRICARIIFOLIUM. B. MORMO ALSO WITHIN 15M. APPROX 6 PLANTS OBSERVED. (VERIFIED BY W.H. WAGNER 10/97).
22665	BOTRYCHIUM LANCEOLATUM	TRIANGLE MOONWORT	THR	HAY LAKE AREA, APPROX 4.5 MILES SE OF JACOBSON, MN. APPROX 0.25 MILES SOUTH OF THE SW CORNER OF HAY LAKE. MAPLE-BASSWOOD FOREST WITH FRAXINUS PENSYLVANICA, ATHYRIUM ANGUSTUM, B. MULTIFIDUM & B. MATRICARIIFOLIUM. PLANTS PATCHY BUT NOT UNCOMMON IN FOREST. ADDITIONAL COLLECTION (#2274) MADE ON 7/31/1997. (VERIFIED BY W.H. WAGNER 10/97).
22666	BOTRYCHIUM LANCEOLATUM	TRIANGLE MOONWORT	THR	HAY LAKE AREA, APPROX 4.5 MILES SE OF JACOBSON, MN. JUST SOUTH OF THE SW CORNER OF HAY LAKE. MAPLE-BASSWOOD FOREST WITH BETULA ALLEGHANIENSIS, ARISAEMA TRIPHYLLUM, B. MATRICARIIFOLIUM & B. MULTIFIDUM. PLANTS PATCHY BUT SCATTERED THROUGH FOREST. (VERIFIED BY W.H. WAGNER 10/97).
22667	BOTRYCHIUM LANCEOLATUM	TRIANGLE MOONWORT	THR	HAY LAKE AREA, APPROX 4.5 MILES SE OF JACOBSON, MN & APPROX 0.35 MILES SE OF THE SE CORNER OF HAY LAKE. MAPLE-BASSWOOD FOREST WITH BETULA ALLEGHANIENSIS & ATHYRIUM ANGUSTUM. PLANTS PATCHY IN WOODS, OCCASIONALLY WITH B. MATRICARIIFOLIUM (VERIFIED BY W.H. WAGNER 10/97).
1630	BOTRYCHIUM MATRICARIIFOLIUM	MATRICARY GRAPEFERN	NON	LOCATED 1 MILE SOUTHEAST OF HAY LAKE. PLANTS OCCUR IN A DECIDUOUS FOREST DOMINATED BY ACER SACCHARUM AND TILIA AMERICANA. ASSOCIATED WITH ARALIA RACEMOSA, UVULARIA GRANDIFLORA, ARALIA NUDICAULIS, BOTRYCHIUM VIRGINIANUM, OSMUNDA CLAYTONIANA.

Table 2. Rare, threatened, endangered (RTE) plants and animals within the MN DNR Heritage Database Recorded Within the Cornish HCVF and Vicinity.

EOR NUM	ENAME	Common Name	MN STAT	Description
12180	BOTRYCHIUM MATRICARIIFOLIUM	MATRICARY GRAPEFERN	NON	LOCATED 3/4 MILE SOUTH OF HAY LAKE. OCCASIONAL. PLANTS OCCUR IN A DECIDUOUS FOREST DOMINATED BY ACER SACCHARUM & TILIA AMERICANA. ASSOCIATED WITH THUJA OCCIDENTALIS, ARALIA NUDICAULIS, BOTRYCHIUM VIRGINIANUM, UVULARIA GRANDIFLORA, ARALIA RACEMOSA. (PREV COLL: ENGELS, BOE & DAHLE
22325	BOTRYCHIUM MATRICARIIFOLIUM	MATRICARY GRAPEFERN	NON	APPROX 7 MI SW OF JACOBSON & APPROX 0.9 MI N OF MULTI-USE TRAIL & HEDBOM FOREST RD JCT, JUST E OF TRAIL. IN MAPLE-BASSWD FOREST W/ NUMEROUS ACER SACC SEEDLINGS, UVULARIA SESS & SEVERAL B. LANCEOLATUM VAR ANGUST. B. MORMO ALSO WITHIN 15M. (PREV COLL: BOE,J. (97073001), 518892 MIN. 7/30/97. 20 PLANTS OBS ON MAPLE-BASSWD RIDGE S OF HAY LAKE. ASSOC: SMILAX LASIO, OSMORHIZA CLAY, VIOLA PUB, VIOLA INCOG & ALLIUM TRI. PLANT LIST PL 97-09). SILHOUETTE VER
25267	BOTRYCHIUM MATRICARIIFOLIUM	MATRICARY GRAPEFERN	NON	LOCATED IN HAY LAKE AREA, APPROX 4.5 MILES SE OF JACOBSON, JUST SOUTH OF THE SW CORNER OF HAY LAKE. IN MAPLE-BASSWOOD FOREST WITH BETULA ALLEGHANIENSIS, ARISAEMA TRIPHYLLUM, B. LANCEOLATUM VAR. ANGUSTISEGMENTUM & B. MULTIFIDUM.
25268	BOTRYCHIUM MATRICARIIFOLIUM	MATRICARY GRAPEFERN	NON	HAY LAKE AREA, APPROX 4.5 MILES SE OF JACOBSON & APPROX 0.25 MILES SOUTH OF THE SW CORNER OF HAY LAKE. IN MAPLE-BASSWOOD FOREST WITH FRAXINUS PENNSYLVANICA, ATHYRIUM ANGUSTUM, B. LANCEOLATUM VAR. ANGUSTISEGMENTUM, ARALIA RACEMOSA, A. NUDICAULIS & THELYPTERIS PHEGOPTERIS. IN OLD TRAIL WITH BOTH VARIETIES OF B. DISSECTUM. (1 DUP #2279, 519546 MIN).
25269	BOTRYCHIUM MATRICARIIFOLIUM	MATRICARY GRAPEFERN	NON	HAY LAKE AREA. APPROX 4.5 MILES SE OF JACOBSON & APPROX 0.35 MILES SE OF THE SE CORNER OF HAY LAKE. IN MAPLE-BASSWOOD FOREST WITH BETULA ALLEGHANIENSIS & ATHYRIUM ANGUSTUM. IN WOODS, OCCASIONALLY WITH B. LANCEOLATUM VAR. ANGUSTISEGMENTUM.
25270	BOTRYCHIUM MATRICARIIFOLIUM	MATRICARY GRAPEFERN	NON	HAY LAKE AREA. APPROX 4.5 MILES SE OF JACOBSON, SOUTH OF HAY LAKE ALONG THE WESTERLY EDGE OF A MAPLE-BASSWOOD FOREST. LOCATED IN FOREST WITH BETULA ALLEGHANIENSIS, ARISAEMA TRIPHYLLUM, B. LANCEOLATUM VAR. ANGUSTISEGMENTUM & ASARUM CANADENSE.

Table 2. Rare, threatened, endangered (RTE) plants and animals within the MN DNR Heritage Database Recorded Within the Cornish HCVF and Vicinity.

EOR NUM	ENAME	Common Name	MN STAT	Description
12003	BOTRYCHIUM MORMO	GOBLIN FERN	SPC	MCBS SANDY LAKE STUDY AREA. SUGAR HILLS MORAINE. MAPLE-BASSWOOD RIDGE SOUTH OF HAY LAKE AROUND SMALL FOREST POOL IN CONCENTRATION OF WHITE CEDAR AND YELLOW BIRCH WITHIN MAPLE-BASSWOOD FOREST. BOTRYCHIUM LANCEOLATUM, B. MATRICARIIFOLIUM & B. ONEIDENSE ALSO FOUND AT SITE. IN RELEVE 96-27. THREE PLANTS OBSERVED IN PLOT. PLANTS FOUND AT BASE OF WHITE CEDAR WITH ARALIA NUDICAULIS, MAIANTHEMUM CANADENSE, ACER SACCHARUM, TRIENTALIS BOREALIS, AND CAREX
22326	BOTRYCHIUM MORMO	GOBLIN FERN	SPC	7 PLANTS OBSERVED ON MAPLE-BASSWOOD RIDGE SOUTH OF HAY LAKE. ASSOCIATED WITH CAULOPHYLLUM THALICTROIDES, ALLIUM TRICOCCUM, ACER SACCHARUM SEEDLINGS, SANGUINARIA CANADENSIS, ARISAEMA TRIPHYLLUM, BOTRYCHIUM VIRGINIANUM & BOTRYCHIUM MATRICARIIFOLIUM. SEE PLANT LIST PL 97-09 AND RELEVE #97-22. SILHOUETTE VERIFIED BY DR. W.H.
9636	BOTRYCHIUM ONEIDENSE	BLUNT-LOBED GRAPEFERN	END	ABOUT 6 MILES SOUTHEAST OF THE TOWN OF JACOBSON, ON A FORESTED RIDGE SOUTH OF HAY LAKE CAMPGROUND. ON THE WEST SIDE OF HAY LAKE TO WOLF LAKE SNOWMOBILE TRAIL. AROUND A SMALL POOL IN A MAPLE-BASSWOOD FOREST. SEVERAL LARGE WHITE CEDAR & YELLOW BIRCH IN THE HARDWOOD MIX. ASSOCIATED WITH ARALIA NUDICAULIS, MAIANTHEMUM CANADENSE, TRIENTALIS BOREALIS, BOTRYCHIUM MATRICARIIFOLIUM, B. MORMO. (VERIFIED BY W.H.
22660	BOTRYCHIUM ONEIDENSE	BLUNT-LOBED GRAPEFERN	END	HAY LAKE AREA, APPROXIMATELY 4.5 MILES SE OF JACOBSON, MN. APPROX 0.25 MILES SOUTH OF THE SW CORNER OF HAY LAKE. MAPLE-BASSWOOD FOREST WITH BETULA ALLEGHAN- IENSIS, THELYPTERIS PHEGHOPTERIS, ARALIA NUDICAULIS, ETC. PLANTS INTERMIXED IN A DENSE LOCALIZED PATCH OF CAREX CF. PENSYLVANICA. (VERIFIED BY
29278	BUTEO LINEATUS	RED-SHOULDERED HAWK	SPC	BREEDING SEASON OBSERVATION. ONE BIRD HEARD CALLING REPEATEDLY DURING POINT COUNT SURVEY. HABITAT WAS NORTHERN HARDWOOD FOREST DOMINATED BY RED OAK AND SUGAR MAPLE.
29293	HEMIDACTYLIUM SCUTATUM	FOUR-TOED SALAMANDER	SPC	ONE FEMALE FOUR-TOED SALAMANDER WAS LOCATED IN MOSS HUMMOCK ALONG EDGE OF TAMARACK/BLACK SPRUCE SWAMP. EGG CLUSTER NEAR FEMALE CONSISTED OF 50 EGGS.

Table 2. Rare, threatened, endangered (RTE) plants and animals within the MN DNR Heritage Database Recorded Within the Cornish HCVF and Vicinity.

EOR NUM	ENAME	Common Name	MN STAT	Description
29294	HEMIDACTYLIUM SCUTATUM	FOUR-TOED SALAMANDER	SPC	TWO FEMALE FOUR-TOED SALAMANDERS WERE LOCATED IN MOSS HUMMOCKS ALONG EDGE OF TAMARACK/BLACK SPRUCE SWAMP. ONE WAS NEAR EGG CLUSTER CONTAINING 35 EGGS, THE SECOND FEMALE ESCAPED. HER EGG CLUSTER WAS HALF SUBMERGED WITH APPROX 25 EGGS.
22320	MALAXIS MONOPHYLLOS VAR. BRACHYPODA	WHITE ADDER'S-MOUTH	SPC	ABOUT 6 MILES SE OF THE TOWN OF JACOBSON, ON A FORESTED RIDGE SOUTH OF HAY LAKE CAMPGROUND. ON W SIDE OF HAY LAKE TO WOLF LAKE SNOWMOBILE TRAIL. AT THE EDGE OF AN ASH SWAMP AT THE BASE OF A MAPLE-BASSWOOD RIDGE. SOME WHITE CEDAR MIXED WITH THE ASH AT THE EDGE & CONTINUING UP INTO HIGHER GROUND. PLANTS OCCUR AROUND THE EDGES OF POOLS AMONG THE ASH & CEDARS. ABOUT 20 PLANTS SEEN. ASSOC SPP: ARALIA NUD, PLATANTHERA HYPER, GOODYERA REP, MITELLA NUDA & CLINTONIA BOR.
14807	MYRIOPHYLLUM TENELLUM	LEAFLESS WATER MILFOIL	NON	LOCATED 1 MI EAST OF BALL BLUFF LAKE. PLANTS OCCUR ALONG THE NORTH BAY OF BLACKFACE LAKE. ASSOC WITH NYMPHAEA TUBEROSA, POTAMOGETON NATANS, UTRIVULARIA VULGARIS, CERATOPHYLLUM DEMERSUM.
10250	NORTHERN HARDWOOD FOREST (NORTHERN)	NORTHERN HARDWOOD FOREST (NORTHERN)		MATURE NORTHERN HARDWOOD FOREST DOM BY ACER SACCHARUM (35-60 CM DBH) W LESSER AMTS OF TILIA AMER. AND BETULA ALLEG (TO 78 CM). RATHER OPEN UNDERSTORY DOM BY ACER; SEEDLING AND SAPLING DENSITY QUITE VARIABLE. HUGE, OLD CUT PINE STUMPS; SOME OLD SMALL STUMPS ALSO PRESENT. NO CONIFERS SEEN IN BRIEF VISIT. ON ISLAND 3-5 M ABOVE SURROUNDING WETLAND. DEEP SILTY OR LOAMY SOILS IN SUGAR HILLS MORAINE GEOMORPHIC REGION. PHASE 2
10263	NORTHERN HARDWOOD FOREST (NORTHERN)	NORTHERN HARDWOOD FOREST (NORTHERN)		MATURE TO OLD-GROWTH N HARDWOOD FOR DOM BY ACER SACCHARUM(30-69 CM DBH), QUERCUS BOR (31-42 CM), TILIA & BETULA ALLEG (TO 117 CM). CANOPY: 20-24 M. A FEW THUJA ABIES, PICEA GL & PINUS ST PRESENT. SUBCANOPY COM BY ACER & OSTRYA. SHRUB LAYER DOM BY ACER, SOME DIRCA & CORNUS ALT. MANY CLR, STRAIGHT BOLES. MOD & VARIABLE AMTS COARSE WOODY DEBRIS. SCATTERED LRG CUT PINE STUMPS. SILTY OR LOAMY SOILS ON POSSIBLE ICE CONTACT MORAINE; SUGAR HILLS GEOM REGION. PHASE 2 STAND #7 NH56.

Table 3a. Cornish Unit - Native Plant Community (NPC) Types and Acreage

Code	NPC Legend	Poly Count	Acres	% Acres
2.1	2.1 = Non-Natural Community System / Open, Non-Developed / Old Field	4	4.1	0.11%
2.6A	2.6a = Non-Natural Community System / Open, Non-Developed / Young Forest / Young Forest - (deciduous)	1	0.6	0.02%
3.2	3.2 = Non-Natural Community System / Planted Stands of Trees / Planted (coniferous)	1	5.9	0.16%
3.3	3.3 = Non-Natural Community System / Planted Stands of Trees / Planted (mixed)	2	47.3	1.24%
5.5	5.5 = Other Natural Community System / Open Water / Ponds & Potholes	9	25.6	0.67%
5.7	5.7 = Other Natural Community System / Open Water / Lakes	1	128.1	3.36%
APN81A	APn81a = Acid Peatland System / Northern Poor Conifer Swamp / Poor Black Spruce Swamp	7	292.8	7.69%
APN81B	APn81b = Acid Peatland System / Northern Poor Conifer Swamp / Poor Tamarack - Black Spruce Swamp	1	1.4	0.04%
APN90A	APn90a = Acid Peatland System / Northern Open Bog / Low Shrub Bog	1	1.6	0.04%
APN91B	APn91b = Acid Peatland System / Northern Poor Fen / Graminoid Poor Fen (Basin)	1	5.6	0.15%
FPN63B	FPn63b = Forested Rich Peatland System / Northern Cedar Swamp / White Cedar Swamp (Northcentral)	2	46.6	1.22%
FPN73A	FPn73a = Forested Rich Peatland System / Northern Rich Alder Swamp / Alder - (Maple - Loosestrife) Swamp	15	99.8	2.62%
FPN82A	FPn82a = Forested Rich Peatland System / Northern Rich Tamarack Swamp (Western Basin) / Rich Tamarack - (Alder) Swamp	8	195.9	5.14%
FPN82B	FPn82b = Forested Rich Peatland System / Northern Rich Tamarack Swamp (Western Basin) / Extremely Rich Tamarack Swamp	14	332.1	8.72%
MHN35A	MHn35a = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Aspen - Birch - Basswood Forest	29	299.4	7.86%
MHN35B	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	42	740.2	19.44%
MHN46A	MHn46a = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Aspen - Ash Forest	1	2.8	0.07%
MHN46B	MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest	60	242.9	6.38%
MHN47B	MHn47b = Mesic Hardwood Forest System / Northern Rich Mesic Hardwood Forest / Sugar Maple - Basswood - (Horsetail) Forest	53	547.4	14.38%
OPN92A	OPn92a = Open Rich Peatland System / Northern Rich Fen (Basin) / Graminoid Rich Fen (Basin)	9	177.5	4.66%
OPN92B	OPn92b = Open Rich Peatland System / Northern Rich Fen (Basin) / Graminoid - Sphagnum Rich Fen (Basin)	6	97.7	2.57%
WFN53B	WFn53b = Wet Forest System / Northern Wet Cedar Forest / Lowland White Cedar Forest (Northern)	3	25.4	0.67%
WFN55B	WFn55b = Wet Forest System / Northern Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Basswood Swamp (Eastcentral)	2	61.3	1.61%

Table 3a. Cornish Unit - Native Plant Community (NPC) Types and Acreage

Code	NPC Legend	Poly Count	Acres	% Acres
WFN64B	WFn64b = Wet Forest System / Northern Very Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Alder Swamp (Eastcentral)	9	278.0	7.30%
WMN82A	WMn82a = Wet Meadow/Carr System / Northern Wet Meadow/Carr / Willow - Dogwood Shrub Swamp	7	59.2	1.55%
WMN82B	WMn82b = Wet Meadow/Carr System / Northern Wet Meadow/Carr / Sedge Meadow	14	88.2	2.32%
		302	3807.5	100.00%

Table 3b. Acreage and Percent Cover of Upland NPC Forest Types in the Cornish HCVF

NPC	NPC Name	Poly #	Acres	Total %
MHN35A	MHn35a = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Aspen - Birch - Basswood Forest	29	299.4	7.86%
MHN35B	MHn35b = Mesic Hardwood Forest System / Northern Mesic Hardwood Forest / Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	42	740.2	19.44%
MHN46A	MHn46a = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Aspen - Ash Forest	1	2.8	0.07%
MHN46B	MHn46b = Mesic Hardwood Forest System / Northern Wet-Mesic Hardwood Forest / Black Ash - Basswood Forest	60	242.9	6.38%
MHN47B	MHn47b = Mesic Hardwood Forest System / Northern Rich Mesic Hardwood Forest / Sugar Maple - Basswood - (Horsetail) Forest	53	547.4	14.38%
WFN55B	WFn55b = Wet Forest System / Northern Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Basswood Swamp (Eastcentral)	2	61.3	1.61%
WFN64B	WFn64b = Wet Forest System / Northern Very Wet Ash Swamp / Black Ash - Yellow Birch - Red Maple - Alder Swamp (Eastcentral)	9	278.0	7.30%
	Total for Upland NPC Types	196	2172.0	56.97%

Table 4. Soil Moisture Content Assigned to USDA Soil Map Units classified in Cornish and Seavey 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
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
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

Table 4. Soil Moisture Content Assigned to USDA Soil Map Units classified in Cornish and Seavey Areas in Aitkin County.

MAP UNIT	Drainage Code	Soil Moisture	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
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
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
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

Table 4. Soil Moisture Content Assigned to USDA Soil Map Units classified in Cornish and Seavey Areas in Aitkin County.

MAP UNIT	Drainage Code	Soil Moisture	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
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
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
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
736	5 = SWPD	07 = Wet-Mesic Loam	Ronneby-Mora complex	Coarse-loamy, mixed, superactive, frigid	Alfisols	Aeric	Gloss	aqualfs
732B	5 = SWPD	07 = Wet-Mesic Loam	Bushville loamy fine sand, 1 to 6 percent slopes	Loamy, mixed, superactive, frigid	Alfisols	Aquic	Hapl	udalfs
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

Table 4. Soil Moisture Content Assigned to USDA Soil Map Units classified in Cornish and Seavey Areas in Aitkin County.

MAP UNIT	Drainage Code	Soil Moisture	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
1372	6 = PD	08 = Wet Sand	Wealthwood loamy fine sand	Loamy, mixed, superactive, frigid	Alfisols	Arenic	Epi	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
1150	6 = PD	09 = Wet Loam	Jevne fine sandy loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
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
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
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

Table 4. Soil Moisture Content Assigned to USDA Soil Map Units classified in Cornish and Seavey 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
1031	7 = VPD	10 = Peat / Water	Histosols, ponded	Peat / water	Histosols	water	Water	water
W	Water	11 = Water	Water	water	water	water	water	water

Table 5. Cornish Area - High Value Conservation Forest: NPC types arranged by NRCS soil acres

NPC Code	Soil Code	Poly Count	Sum Acres	% NPC Area	Soil Moisture	Soil Drainage	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
MHN35A	618B	4	63.56	21.23%	05 = Mesic Loam	3 = WD	Itasca silt loam, 1 to 6 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35A	502	1	46.58	15.56%	07 = Wet-Mesic Loam	5 = SWPD	Dusler silt loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN35A	615	8	40.39	13.49%	06 = Wet-Mesic Sand	5 = SWPD	Cowhorn loamy very fine sand	Coarse-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Aeric	Endo	aquepts
MHN35A	204C	3	31.45	10.50%	05 = Mesic Loam	3 = WD	Cushing loam, 6 to 12 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35A	292	4	25.33	8.46%	07 = Wet-Mesic Loam	5 = SWPD	Alstad loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN35A	980	4	19.06	6.37%	09 = Wet Loam	7 = VPD	Blackhoof and Mahtowa soils	Fine-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts
MHN35A	629B	8	14.75	4.93%	02 = Dry-Mesic Sand	3 = WD	Wawina loamy very fine sand, 1 to 10 percent slopes	Coarse-loamy, mixed, superactive, frigid	Inceptisols	Typic	Dystr	udepts
MHN35A	928D	2	14.04	4.69%	03 = Dry-Mesic Loam	3 = WD	Cushing-Mahtomedi complex, 10 to 25 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35A	469B	1	7.26	2.42%	05 = Mesic Loam	4 = MD	Hillcity silt loam, 1 to 6 percent slopes	Coarse-silty, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
MHN35A	870E	1	5.53	1.85%	03 = Dry-Mesic Loam	3 = WD	Itasca-Goodland complex, 12 to 25 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35A	504B	6	4.86	1.62%	05 = Mesic Loam	4 = MD	Duluth fine sandy loam, 1 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35A	204B	2	3.43	1.15%	05 = Mesic Loam	4 = MD	Branstad loam, 2 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs

Table 5. Cornish Area - High Value Conservation Forest: NPC types arranged by NRCS soil acres

NPC Code	Soil Code	Poly Count	Sum Acres	% NPC Area	Soil Moisture	Soil Drainage	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
MHN35B	469B	5	131.23	17.73%	05 = Mesic Loam	4 = MD	Hillcity silt loam, 1 to 6 percent slopes	Coarse-silty, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
MHN35B	204C	6	104.01	14.05%	05 = Mesic Loam	3 = WD	Cushing loam, 6 to 12 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35B	204B	4	88.22	11.92%	05 = Mesic Loam	4 = MD	Branstad loam, 2 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
MHN35B	504B	7	68.6	9.27%	05 = Mesic Loam	4 = MD	Duluth fine sandy loam, 1 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35B	928D	6	60.65	8.19%	03 = Dry-Mesic Loam	3 = WD	Cushing-Mahtomedi complex, 10 to 25 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35B	502	7	55.16	7.45%	07 = Wet-Mesic Loam	5 = SWPD	Dusler silt loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN35B	292	12	50.11	6.77%	07 = Wet-Mesic Loam	5 = SWPD	Alstad loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN35B	618B	5	48.17	6.51%	05 = Mesic Loam	3 = WD	Itasca silt loam, 1 to 6 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35B	928C	7	39.44	5.33%	03 = Dry-Mesic Loam	3 = WD	Cushing-Mahtomedi complex, 2 to 10 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35B	928F	5	19.26	2.60%	03 = Dry-Mesic Loam	3 = WD	Cushing-Mahtomedi complex, 25 to 40 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN35B	147	1	8.54	1.15%	09 = Wet Loam	6 = PD	Spooner silt loam	Fine-silty, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
MHN35B	504C	2	6.87	0.93%	03 = Dry-Mesic Loam	3 = WD	Duluth fine sandy loam, 6 to 12 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs

Table 5. Cornish Area - High Value Conservation Forest: NPC types arranged by NRCS soil acres

NPC Code	Soil Code	Poly Count	Sum Acres	% NPC Area	Soil Moisture	Soil Drainage	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
MHN46A	292	1	2.12	75.71%	07 = Wet-Mesic Loam	5 = SWPD	Alstad loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN46A	502	1	0.63	22.50%	07 = Wet-Mesic Loam	5 = SWPD	Dusler silt loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN46A	204B	1	0.08	2.86%	05 = Mesic Loam	4 = MD	Branstad loam, 2 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
MHN46B	546	3	55.08	22.68%	10 = Peat	7 = VPD	Lupton muck	Euic, frigid	Histosols	Typic	Hapl	saprists
MHN46B	502	7	37.25	15.34%	07 = Wet-Mesic Loam	5 = SWPD	Dusler silt loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN46B	980	5	31.39	12.92%	09 = Wet Loam	7 = VPD	Blackhoof and Mahtowa soils	Fine-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts
MHN46B	544	8	30.21	12.44%	10 = Peat	7 = VPD	Cathro muck	Loamy, mixed, euic, frigid	Histosols	Terric	Hapl	saprists
MHN46B	292	7	24.18	9.95%	07 = Wet-Mesic Loam	5 = SWPD	Alstad loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN46B	628	6	18.91	7.79%	10 = Peat	7 = VPD	Talmoon muck, depressional	Muck over Fine-loamy, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
MHN46B	541	1	15.47	6.37%	10 = Peat	7 = VPD	Rifle peat	Euic, frigid	Histosols	Typic	Hapl	hemists
MHN46B	615	8	7.38	3.04%	06 = Wet-Mesic Sand	5 = SWPD	Cowhorn loamy very fine sand	Coarse-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Aeric	Endo	aquepts
MHN46B	928D	6	4.5	1.85%	03 = Dry-Mesic Loam	3 = WD	Cushing-Mahtomedi complex, 10 to 25 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN46B	618B	2	4.31	1.77%	05 = Mesic Loam	3 = WD	Itasca silt loam, 1 to 6 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN46B	204C	5	3.15	1.30%	05 = Mesic Loam	3 = WD	Cushing loam, 6 to 12 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs

Table 5. Cornish Area - High Value Conservation Forest: NPC types arranged by NRCS soil acres

NPC Code	Soil Code	Poly Count	Sum Acres	% NPC Area	Soil Moisture	Soil Drainage	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
MHN47B	292	9	131.76	24.07%	07 = Wet-Mesic Loam	5 = SWPD	Alstad loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN47B	502	7	126.1	23.04%	07 = Wet-Mesic Loam	5 = SWPD	Dusler silt loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
MHN47B	615	10	74.21	13.56%	06 = Wet-Mesic Sand	5 = SWPD	Cowhorn loamy very fine sand	Coarse-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Aeric	Endo	aquepts
MHN47B	504B	8	29.59	5.41%	05 = Mesic Loam	4 = MD	Duluth fine sandy loam, 1 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN47B	618B	3	24.12	4.41%	05 = Mesic Loam	3 = WD	Itasca silt loam, 1 to 6 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN47B	546	5	23.55	4.30%	10 = Peat	7 = VPD	Lupton muck	Euic, frigid	Histosols	Typic	Hapl	saprists
MHN47B	204C	6	22.05	4.03%	05 = Mesic Loam	3 = WD	Cushing loam, 6 to 12 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN47B	928D	6	17.57	3.21%	03 = Dry-Mesic Loam	3 = WD	Cushing-Mahtomedi complex, 10 to 25 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
MHN47B	625	2	14	2.56%	08 = Wet Sand	6 = PD	Sandwick loamy sand	Loamy, mixed, superactive, frigid	Alfisols	Arenic	Gloss	aqualfs
MHN47B	541	1	13.02	2.38%	10 = Peat	7 = VPD	Rifle peat	Euic, frigid	Histosols	Typic	Hapl	hemists
MHN47B	629B	8	10.57	1.93%	02 = Dry-Mesic Sand	3 = WD	Wawina loamy very fine sand, 1 to 10 percent slopes	Coarse-loamy, mixed, superactive, frigid	Inceptisols	Typic	Dystr	udepts
MHN47B	544	9	10.4	1.90%	10 = Peat	7 = VPD	Cathro muck	Loamy, mixed, euic, frigid	Histosols	Terric	Hapl	saprists
MHN47B	980	4	10.31	1.88%	09 = Wet Loam	7 = VPD	Blackhoof and Mahtowa soils	Fine-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts

Table 5. Cornish Area - High Value Conservation Forest: NPC types arranged by NRCS soil acres

NPC Code	Soil Code	Poly Count	Sum Acres	% NPC Area	Soil Moisture	Soil Drainage	Soil Map Unit Name	Soil Description	Order	Sub Group	Great Group	Sub Order
MHN47B	628	6	10.26	1.87%	10 = Peat	7 = VPD	Talmoon muck, depressional	Muck over Fine-loamy, mixed, superactive, frigid	Alfisols	Mollic	Endo	aqualfs
MHN47B	204B	4	7.5	1.37%	05 = Mesic Loam	4 = MD	Branstad loam, 2 to 6 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Oxyaquic	Gloss	udalfs
MHN47B	928F	2	4.89	0.89%	03 = Dry-Mesic Loam	3 = WD	Cushing-Mahtomedi complex, 25 to 40 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
WFN55B	546	1	54.76	89.33%	10 = Peat	7 = VPD	Lupton muck	Euic, frigid	Histosols	Typic	Hapl	saprists
WFN55B	563	1	4.76	7.77%	10 = Peat	7 = VPD	Northwood muck	Sandy over loamy, mixed, superactive, nonacid, frigid	Inceptisols	Histic	Hum	aquepts
WFN55B	502	1	0.99	1.62%	07 = Wet-Mesic Loam	5 = SWPD	Dusler silt loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
WFN55B	928D	1	0.64	1.04%	03 = Dry-Mesic Loam	3 = WD	Cushing-Mahtomedi complex, 10 to 25 percent slopes	Fine-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs
WFN64B	546	3	244.21	87.85%	10 = Peat	7 = VPD	Lupton muck	Euic, frigid	Histosols	Typic	Hapl	saprists
WFN64B	544	1	8.73	3.14%	10 = Peat	7 = VPD	Cathro muck	Loamy, mixed, euic, frigid	Histosols	Terric	Hapl	saprists
WFN64B	615	4	6.36	2.29%	06 = Wet-Mesic Sand	5 = SWPD	Cowhorn loamy very fine sand	Coarse-loamy, mixed, superactive, nonacid, frigid	Inceptisols	Aeric	Endo	aquepts
WFN64B	541	1	5.11	1.84%	10 = Peat	7 = VPD	Rifle peat	Euic, frigid	Histosols	Typic	Hapl	hemists
WFN64B	292	4	2.58	0.93%	07 = Wet-Mesic Loam	5 = SWPD	Alstad loam	Fine-loamy, mixed, superactive, frigid	Alfisols	Aquic	Gloss	udalfs
WFN64B	618B	2	2.1	0.76%	05 = Mesic Loam	3 = WD	Itasca silt loam, 1 to 6 percent slopes	Coarse-loamy, mixed, superactive, frigid	Alfisols	Haplic	Gloss	udalfs

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
956	18	Cornish	APn91	Open to interrupted canopy mixed Black Spruce and Tamarack on deep sphagnum peat of forested poor fen. Low blankets of green sphagnum forming low hummocks around ledum bases large hollows without water and covered with mosses. Largest trees are Tamarack 20-25cm dbh. Blue Spruce 10-20 (25) dense cover of Ledum with water sub shrubs Broad swale between upland rises blanketed by green spahgnum./Low hummocks and shallow mossy hollows. No standing water.Deep fibric peat >50cm	Scott C. Zager	7/17/2008 1:16:00 PM	0	Aitkin	Cornish	482395	5199481	52	23	35	SWNW
34	42	Cornish	FPn82	Mature rich peatland forest dominated by Tamarack and Black Spruce with 50-75% cover overall. Gaps filled with short Black Spruce, Alder and scattered Paper and Yellow Birch. Substrate blanketed with green sphagnum moss with patchy to thin narrow leaved sedges (mostly Carex trisperma). Ericaceous shrubs (Ledum) sparse to patchy and Bog Birch is infrequent. Oval basin between large moraine ridge and lateral moraine. Pleurozium schreberi Poly trichium	Scott C. Zager	8/21/2008 4:40:00 PM	0	Aitkin	Cornish	484570	5195456	51	23	12	SESW
987	28	Cornish	FPn82	Open canopy of mature tamarack (25-50% cover) crowns 10-20 (25)M tall; dbh 15-40cm. Cedar frequent in small groves (5-25% cover). Root hummocks with deep sphagnum blankets. Hollows wet to 5cm with green sphagnum. Alder interrupted, thinly dispersed to frequently thick lush herb and narrow leaved sedges. Depression within large basin. Sphagnum/Mucky peat to 50cm.	Scott C. Zager	7/23/2008 3:05:00 PM	0	Aitkin	Cornish	482936	5199731	52	23	35	NENW
948	12	Cornish	MHn35	Mature Red Oak abundant 85 yrs with Seedlings Paper, Maples in subcanopy opern shrub layer, Steep side slope Knoll and narrow ridges, irregular crests on slip. Stagnation moraine. Cut.	Scott C. Zager	7/16/2008 12:48:00 PM	0	Aitkin	Cornish	481769	5197836	51	23	3	SWNE

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
950	14	Cornish	MHn35	Mesic upland forest on narrow linear ridge-crest with silt-cap. Dominated by maturing Sugar Maple (DBH 15-25cm) with mature Red Oak and Paper Birch (25-45 DBH) frequent, dense canopy and subcanopy densely shades understory reducing coverage of shrubs, seedlings and herbs. Old snags and tip-ups are frequent. CWD 10-20% (40% locally) including very decayed trunks and large limbs. Old tip-up saddles prevalent. Overall commuunity trends to MHn47 bt somewhat depauperible on densely shaded crest where plot sampled. Rare Sugar Maple 60-70%cm DBH. Large broken snag of Big-Toothed Aspen (DBH 80-90cm). Ostrich Fern found abundantly within small local depression on crest. Groves of B.T. Aspen at margins of plot. Narrow ridge presumably a moraine, possibly esker deeply covered with silt. Organic layer substandard. Earthworms establishing. Mixed humus and A horizon depauperate flora due to dense shady, diversity and abundance ofherbs increases within canopy gaps.	Scott C. Zager	7/17/2008 9:45:00 AM	0	Aitkin	Cornish	482227	5199689	52	23	34	SENE
951	15	Cornish	MHn35	Mature Oak and Basswood with Sugar Maple on gently sloping terrace on upper slope of long - north-south running ridge. Open canopy due to death of large Basswood and plot within area of former crown. Upper slope on slight terrace with small depressions, but generally sloping 10-20%. Silt. Worms. No humus. Deep A horizon Dead snags and large tip-ups create open canopy with patch subcanopy and shrub layers.	Scott C. Zager	7/17/2008 10:53:00 AM	0	Aitkin	Cornish	482205	5199646	52	23	34	SENE
953	16	Cornish	MHn35	Dry-mesic Red Oak-Paper Birch forest on lower slope next to wet Ash forest. White Cedar forms a thin bed Frequent gaps eroded by snags. Subcanopy is patchy to closed locally. (Varies by asc or within ravines). Plot locally open sub-canopy and shrub layer. Elsewhere more shaded. Lower slope of long narrow ridge with lateral spurs. Slope undulate with micro ridges and swales or depressions which sometimes forms short running ravines. Silt loam with earthworms. E horizon is feint. Well drained, moderate slope (10-20%) next to wet forest.	Scott C. Zager	7/17/2008 11:57:00 AM	0	Aitkin	Cornish	482320	5199552	52	23	34	SENE

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
991	31	Cornish	MHn35	Description of general area (not plot). Heterogeneous canopy comprised of a bimodel distribution of large trees. Canopy openings and dense understory. Broad level crest of WPT, but low areas are frequent at margins and swales. Surface packed with old tip-up mounds. CWD is common 5-10% overall. Mostly branches but occasionally with large very decayed trunks. Mode DBH 20-30cm but density varies (B.A. 90-240). Open canopy with dense shrub layer. Closed canopy with common large trees (40-60cm) DBH with open understory and Lacus of Carex Pens. Sedge. Broad, level crest on a low oval ridge that is part of a complex pattern of low rises and broad swales within a larger basin next to a moraine. Excellent humus (all stages of decay with woody fragments throughout surface - not in pit). Deep silt over ro Extremely heterogeneous canopy varying in density and tree girth. Open gaps with dense understory. Closed canopy with open understory. Old very decayed trunks and tip-ups with scattered snags. Old stump occasional.	Scott C. Zager	7/25/2008 9:55:00 AM	0	Aitkin	Cornish	484994	5200083	52	23	25	SWSE
973	25	Cornish	MHn35b	Dry-mesic upland forest on knoll dominated by Sugar Maple and Basswood 25-35cm DBH with larger trees to 85cm DBH infrequently scattered throughout canopy 75-100% cover with small frequent gaps. Large gap due to recent tip-up. Subcanopy closed filling in canopy openings and densely shading substrate. Shrrub laye sparse. Low seedlings cover. Carex pensy dominates substrate typical dry-mesic herbs. CWD <5% with large tip-ups occasional. Lower knoll as part of a series of knolls and ridges of stagnation moraine. Good humus layer, thin A horizon well-developed, E horizon distinct. Well drained silt. No worms. Some past logging. Large Sugar Maples infrequent - 85cm.	Scott C. Zager	7/22/2008 2:54:00 PM	0	Aitkin	Cornish	483064	5198777	52	23	35	SESW

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
982	26	Cornish	MHn35b	Dry-mesic upland forest dominated by Red Oak with Quaking Aspen and Paper Birch locally common (25% cover total each), densely spaced large canopy trees 85% cover, crowns 25-30m tall; with mode DBH 25-45 cm with an occasional large Oak and Quaking Aspen. A few Paper Birch are in the subcanopy which is mostly dominated by maturing Sugar Maple (DBH 15-20cm, crowns 5-20m tall). These densely shade the sparse shrub and seedling layer. The low abundance of forbs and graminoids reflects dense shade. Plot on circular crest that is part of an irregular ridge on moraine with semi-permanent wet forest perched in depressions on upper slope. Circular crest on knoll of a lateral spur of stagnation moraine with irregular ridges, knolls and broad aprons on lower slope - often with low saddles between peaks. Occasional wet depressions. No worms. Well developed moderate humus. Thin A horizon a Crest with Paper Birch of various size classes (15-25cm DBH). Tip-ups occasional to locally common. Coarse woody debris 5-30% with limbs, branches and large trunks. All stages of decay. Crest marked with red paint. Forbs stunted on crest with dense shade.	Scott C. Zager	7/23/2008 11:00:00 AM	0	Aitkin	Cornish	482830	5199433	52	23	35	SENW
5883	9628	Cornish	MHn35b	Thick decid leaf duff. Mod CWD - incl. 1 windthrown aspen. Within plot relief from well-decayed logs. 2" organic over 8" very fine lt tan sand with silt. Stand #7.	Janet Boe	7/31/1996	5883	Aitkin	Cornish	484403	5198696	52	23	36	SW
28	38	Cornish	MHn46	Mesic to wet-mesic Black Ash-Basswood forest dominated by Black Ash with Basswood occasional in the canopy. Highly variable canopy structure with various heights and dominants (elsewhere Sugar Maple is prevalent in canopy). Canopy is interrupted to closed with frequent gaps due to tip-ups and broken limbs. Substrate pocked with small depressions formerly wet in spring now dry late summer. Soil layers with different types of sand and silt mixed with gravel. Coarse woody debris 5-15% cover with down trees and large limbs. Cedar infrequent throughout occurring in small groves. Yellow Birch occasional in canopy. Diverse her layers. Lower slope-toe slope of moraine on level terrace extending some distance from lower slope eastward. Somewhat poorly drained with dried depressions suggesting earlier standing water perched in sub horizons. Deep organic "A" horizon comprised of dark sil Black Ash DBH 60cm; Snags in ? frequent	Scott C. Zager	8/20/2008 3:12:00 PM	0	Aitkin	Cornish	485500	5195353	51	23	12	SESE

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
988	29	Cornish	MHn46	Wet-mesic forest growing on root masses over sphagnum peat. Canopy dominated by a mix of Black Ash, Paper Birch, Balsam Fir, and Cedar. Largest trees are Cedar and a few Birch. Canopy is interrupted with infrequent gaps (50-75% cover). Crowns 15-25m tall. Sugar Maple forms a dense subcanopy which is only interrupted by Cedars. Coarse woody debris is common 5-15% total cover of very decayed branches and tip-ups. Several snags of Birch are infrequently scattered creating small canopy gaps. Rich diverse forb layer growing on root hummocks. Notably absent are wet forest species. Moss layer is a mat of non-sphagnum mosses. Substrate is densely shaded. Toe slope of moraine forming apron at margin of large wetland basin extended upland through saddle lowlands between knolls. Wet, semi-decayed (sapric) sphagnum peat with woody fragments upper surface wet saturated in hollows (bare muck 25% surface area). Moose scat observed in plot. Deep, partially decayed sphagnum peat. Water fills pit to 20cm depth. Soil pit dug in hollow. Hummocks on tree roots extend upwards 30-50cm in height. Moose browse on Acer spicata (Moose Maple).	Scott C. Zager	7/23/2008 4:09:00 PM	0	Aitkin	Cornish	482726	5199624	52	23	35	SWNW
994	33	Cornish	MHn46	Highly variable canopy due to low substrate which rises from broad peatland basin. Scattered islands and archepelago dominated by Black Ash, Balsam Poplar, Balsam Fir, Red Maple and infrequent groves of Cedar (25-50cm DBH). Herb layer a mix of wet forest species and upland herbs. (e.g. Braken fern with Cinnamon fern). Low rises on islands with broad peatland basin.	Scott C. Zager	7/25/2008 11:45:00 AM	0	Aitkin	Cornish	485227	5200243	52	23	25	SESE
990	30	Cornish	MHn46b	Young regowth Aspen (pole size) comprised of dense cover 100%. With mesic mix of hardwood species in subcanopy including Black Ash, Red Maple, Basswood, Sugar Maple, and American Elm. Shrub layer sparse to partial due to dense shade. Good layer lush with a mixture of upland herbs and wet-mesic forest herbs (Spotted Hemlock, Coltsfoot). Grasses and sedge depauperate but with upland and wet meadow species (Carex stricta), Lady fern abundant dominating large patches. Nearby a lone Red Oak outside plot (35-40cm DBH). Soils somewhat poorly drained but no standing water. Low area between moraine knolls. Level to slightly undulating with shallow hollow and rises. Somewhat poorly drained with earthworms mixing topsoil. No E horizon. High chroma mottles in B1 just below surface. B2 Horizon with gleying in streak. No wa Young Aspen regeneration with wet-mesic hardwoods beneath. Wet flora includes tussock sedge.	Scott C. Zager	7/23/2008 5:33:00 PM	0	Aitkin	Cornish	482675	5199834	52	23	35	NWNW

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
29	39	Cornish	MHn47	Mesic hardwoods dominated by trees of two size classes. Large old trees and maturing trees in gaps. Several old growth Sugar Maple and Yellow Birch (45-75cm). Bimodel tree girth (15-25cm) dominated by Maples and 35-45cm dominated by Sugar Maples, Basswood and Yellow Birch open understory allowing lush herb growth and carpet by Carex pensylvanica. Shrubs and saplings sparse. Seedling layer with frequent Red Oak, and rare Bur Oak. Sugar Maple seedlings most abundant. Ground with frequent old tip-up mounds. Large down trees, snags are occasional to locally common. Crest of large interfluvial ridge on lowerslope of moraine. Moderately well drained silt loam over gravel and sand, high chroma mottles within 39cm from surface suggesting early high water table. Several old saddles and hollows from former tip-up mound Old growth trees with gaps created by tip-ups of large trees (specifically Cedar 60-70 cm DBH). Large Sugar Maple, Basswood, Black Ash and frequent Yellow Birch. Rare Botrychium oneidense observed. Sugar Maple DBH 45, 19 cm; Thuja occidentalis 22, 42 cm; Betula	Scott C. Zager	8/20/2008 4:40:00 PM	0	Aitkin	Cornish	485483	5195306	51	23	12	SESE
30	40	Cornish	MHn47	Mature rich hardwood forest with a biomodel size classes in canopy. Mode DBH 20-40cm; common large max DBH 45-65cm. Dominated by a mix of Sugar Maple, Basswood and Red Oak with very large Basswood and Yellow Birch frequent throughout. Subcanopy well developed blending shrub layer into lower canopy heights. Herb layer a mix of dry-mesic herb in small depressions, along nearby trail and margins of semi-permanent depressions dominated by Black Ash. Carex pensylvanica and Rice Mountain, grass frequent in graminoid layer. Several Red Oak are in younger size class of canopy; larger Oak are near crest and along trail CWD - 15-25%: large very decayed trunks, branches and stumps Upper slope - just below crest of linear moraine. Slope interrupted by depressions with semi-permanent wet forests. Silt cap extends some 100cm depth to gravel bases, red brown high dhroma mottles in shallow horizons suggests perched water table in spri Red Oak 20-62 m Yellow Birch 39-62 cm; Basswood 17-66 cm; Sugar Maple 20-56 cm, Large Yellow Birch frequent on slope. Young Yellow Birch with adventive roots on old White Pine stump. Area packed with old tip-up mounds and hollows.	Scott C. Zager	8/21/2008 10:14:00 AM	0	Aitkin	Cornish	484802	5195206	51	23	13	NWNE

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
32	41	Cornish	MHn47	Mature mesic, rich hardwoods, recently partially cut to canopy 25-50% cover, with a bimodel DBH 20-30cm and 45-60cm. Remaining high quality trees are mostly Sugar Maple and Basswood with large scattered Red Oak (40-60cm), large Black Ash at margin of cut. Dead snag of Yellow Birch (DBH 45-55cm) left in cut area. Subcanopy sparse comprised of Sugar Maple blending into lower canopy. Large saplings of Ironwood are common. Patchy flush of Sugar Maple seeding in groupings of 50-75% cover, but 25-50% overall. Many forbs and grasses extant, flush growth especially Penn sedge. Abundant forbs - very diverse. Cresst of moraine ridge with silt cap. Good humus layer and weak earthworm evidense. Rich organic A horizon. Red Oak - 50-60cm DBH. High quality forest practice with low impact from winter cut and selective logging. Good Job! Weak Red Oak release.	Scott C. Zager	8/21/2008 3:14:00 PM	0	Aitkin	Cornish	484795	5195390	51	23	12	SWSE
944	10	Cornish	MHn47	Old growth mesic hardwoods with bi-model size class. Old tree canopy 5-25% overall (higher in plot) dominated by Yellow Birch and Sugar Maple. Yellow Birch have aerial roots originating on old (White Pine?) stumps which are nearly fully decayed. Mature trees (20m tall crowns) are various species: Paper Birch, Sugar Maple, Basswood and Red Oak. The subcanopy is patchy (25-50%) but occasionally interrup (50-75%) dominated by Sugar Maple, Red Maple and tall Ironwood. Occasional snag and down trees throughout. White Cedar rare upslope becoming more frequent below. Mature Cedar over topped by other canopy. Old root saddles (hummocks) from ancient down trees. Infrequent. Betula alleghaniensis 35, 77 cm, 65cm; Acer saccharum 40, 61 cm; Thuja 30 cm; Betula papyrifera 33 cm; Acer rubrum; Tilia 40-45 cm On small knoll or ridge within rolling terrain of glacier Outwash on terrace next to large esker. Deep silt. Excellent humus laye (no worms). Coarse woody debris 5% overall (25% locally) Old growth Yellow Birch and Maple. Yellow Birch with aerial roots suggesting origin on Pine stumps. Large trunks, down with charcoal >8' height.	Scott C. Zager	7/15/2008 2:26:00 PM	0	Aitkin	Cornish	484759	5196091	51	23	12	SENW
949	13	Cornish	MHn47	Mesic Sugar Maple. Rich. Earthworms	Scott C. Zager	7/16/2008 1:16:00 PM	0	Aitkin	Cornish	480997	5197884	51	23	3	SWNW

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
999	35	Cornish	MHn47	Plot is a local inclusion of a Cedar grove within a larger deciduous forest. Plot is dominated by White Cedar (35-65cm DBH) with Black Ash, Basswood (25-35cm), Paper Birch (15-25cm DBH), and Red Maple (45-55cm), Yellow Birch (25-30cm) is also present. Local grove has a gap in the canopy but is otherwise closed. Subcanopy trees are tall blending into canopy. Open shrub layer and ground layer dominated by Beech fern and Carex pensylvanica (on slope). Shrub layer a mix of Beaked Hazel, Striped Maple and Sugar Maple. Lush herb layer mix of dry-mesic and mesic herbs. Wet-mesic species in small depressions at bottom of swale. Undulating low ridge rolling with slight rises and swales. Plot on lower slope/toe but includes small rises with narrow crests. Open understory with lush ferns. Large White Pine located near edge of plot (90-100cm DBH) Large Basswood (80-90cm DBH).	Scott C. Zager	7/25/2008 2:45:00 PM	0	Aitkin	Cornish	484453	5200252	52	23	25	SESW
8087	-1	Cornish	MHn47	Plot typical of MDL Rich Hardwood forest. With Aitkin Co. staff. Photos. No worm activity. Very homogeneous plot.	John Almendinger	6/11/1999	8087	Aitkin	Cornish H	484923	5195392	51	23	12	SE
5882	9627	Cornish	MHn47a	Thick spongy decid leaf duff. CWD common. Extensive wind throw adjac. to plot on north side of knoll. Moss covered logs & well-decayed, duff covered logs occasional. Yellow and paper birch.	Janet Boe	7/31/1996	5882	Aitkin	Cornish	484002	5199129	52	23	36	NW
972	24	Cornish	MHn47b	Mature grove of Cedar canopy amid younger Sugar Maples and Black Ash. Large trees in canopy (25-50% cover; with 40-45 cm DBH) are surrounded by immature Sugar Maple in the canopy and especially the subcanopy, which fills gaps. Coarse wood debris abundant (5-25%) with frequent tip-ups of large Cedars and Yellow Birch. Subcanopy encloses cover densely shading substrate except in canopy gap of recent wind throw Birch. Mature with Birch present in all stands mesic herbs include abundance of ferns including Beech Fern, Oak Fern, Osmunda, etc. Other mesic herbs, Wild Ginger common. Thuja DBH 40-55cm. Betula Alle 40-55cm Lower slope, or level terrace forming an apron around moraine knoll. Slightly elevated above adjacent Black Ash swamp. Silt over clayey loam with gravel. Mottles in E1 and Upper B horizon. Moderately well drained over semi impermeable horizon. Earthworm infestation light but humus mixed with A horizon.	Scott C. Zager	7/22/2008 2:40:00 PM	0	Aitkin	Cornish	483148	5198842	52	23	35	SESW

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
997	34	Cornish	MHn47b	Low rolling land with slight ridges and gentle slopes. Variable substrate moisture over all somewhat poor. Mostly Quaking Aspen regeneration less than 10m tall, with scattered White Pine (rare to infrequent). Also small groves of Balsam Fir and Balsam Poplar. Subcanopy comprised mostly of Acer spicatum, with some Sugar Maple. Shrub layer nearly absent. Outside of plot bearing north. Popu69Tr canopy 25-50% cover, mode DBH 20-30cm with infrequent scattered Thuj69OC. Rolling lowlands between knolls. Silt soil lacking A horizon. Mulch abundant. Cut cover area with weak A horizon somewhat.	Scott C. Zager	7/25/2008 1:36:00 PM	0	Aitkin	Cornish	484675	5200163	52	23	25	SESW
993	32	Cornish	OPn92	Open peatland with dense shrubby Tamarack (listed as subcanopy) within a scattered supercanopy of taller Tamarack. Shrub layer patchy with Bog Birch and stunted Alder. Sphagnum hummocks more prevalent near island margins becoming patchy to interrupted with lake sedge forming matrix between subshrubs (Leatherleaf, Labrador tea, Salix pediculatis) forms dense clones on sphagnum. Herb layer poorly represented by Equisefum fluvula swamp candles and other marsh herb species. Carex chrodorhiza represents all narrow leaved sedges. Margins of islands with tall Alder. Deep sphagnum peat. Hummocks 50-75% cover hollows with wet standing water dominated by Lake Sedge (Carex lacustris)	Scott C. Zager	7/25/2008 11:23:00 AM	0	Aitkin	Cornish	485283	5200246	52	23	25	SESE
8082	-1	Cornish	WFn55b	Plot typical of semiterrestrial Black Ash. With Aitkin Co. Foresters. Plot positioned in drain between two upland white cedar groves.	John Almendinger	6/11/1999	8082	Aitkin	Cornish H	484544	5196010	51	23	12	NW
8080	-1	Cornish	WFn55c	Releve done to characterize later-successional lowlnd hardwood-conifer forest. With Aitkin Co. foresters and Jessica Wahlquist. Numerous winter-cut stumps, mostly cedar. Mosses restricted to wood.	John Almendinger	6/14/1999	8080	Aitkin	Cornish H	485602	5196254	51	22	7	NW
954	17	Cornish	WFn64b	Immature Black Ash with scattered White Cedar densely covering swale with standing water. Subcanopy and shrub layer blend into canopy. Alder abundant, open water with various broad leaved sedges and grasses, hummocks (on root masses) covered by ferns and wet forest herbs. Moss layer comprised mostly of feather mosses with infrequent patches of green shade-tolerant sphagnum. Substrate densely shaded. Dense shrubs. CWD abundant 25% (50% mostly). On lower slope of long narrow rdge, on ridge spur wih undulating pattern of very wet Ash swales and wet Cedar forest on slight rises parallel to larger slope. Wet Ash characterized by standing water and mucky plots with vegetation on Alder and Ash root mass.	Scott C. Zager	7/17/2008 12:45:00 PM	0	Aitkin	Cornish	482346	5199518	52	23	35	SWNW

Table 6: Cornish HCVF - General Descriptions of Waypoint Sample Sites.

Wpt	Data Sheet	Man Unit	NPC Code	Combined Descriptions	Evaluator	Date	Rel No	County	Site Name	UTM East	UTM North	Twp	Rng	Sec	Sub Sec
971	23	Cornish	WFn64b	Wet Black Ash swamp with muck and standing water dominated by Black Ash l size classes with an interrupted canopy enclosed by subcanopy trees to densely shade the substrate. Open shrub layer. Substrate dominated by Carex lacustris (Lake Sedge) with patches of Blue Joint. Reed Canary Grass present in one large clone 5 x 10m in area. Upland hers and seedlings on tree hummocks around trunks. Several snags and tip-ups CWD 1-5%. Broad lowlands between knolls of stagnation moraine. Drainageway between Hay Lake and Bog Lake. Much soil wet with standing water to 25cm. Possibly with seepage. Brush is a braided stream with numerous stagnant pools and muck flats. Reed Canary dominates nearby open meadow.	Scott C. Zager	7/22/2008 12:34:00 PM	0	Aitkin	Cornish	483199	5199063	52	23	35	NWSE
984	27	Cornish	WFn64b	Mature, wet Black Ash swamp canopy 80% cover, DBH 25-35cm but with dense subcanopy. Shrub layer patchy to sparse with mostly Alder. Cedar is locally common but frequent throughout. Mud flats include mosses and sedges. Narrow leaved sedges comprised mostly of Carex leptelea 25% with Carex disperma about 15% cover. Richly diverse forest. Margins of large wetland basin. Perhaps the toe slope of adjacent moraine. Muck (saturated peat) and standing water cover 50-75% of area with root masses forming hummocks that support upland herbs. Rare species include non-listed Ranunculus lepponicus in two colonies on muck and water about 1m sq area. One plant of Polygonum hastata in hummock edge. Poa paludigena (maybe?) growing in mossy grassy hummock only 3 culm/flowering in florescence observ	Scott C. Zager	7/23/2008 12:31:00 PM	0	Aitkin	Cornish	483096	5199555	52	23	35	SENW

APPENDIX III

Sample Data Reports recorded at Cornish HCVF

WayPoint # 28 Data

POINT INFORMATION

Waypoint	Data Sheet	NPC Code	Polygon ID	Date
28	38	MHn46	28	8/20/2008 3:12:00 PM

NPC System	Mesic Hardwood Forest System
NPC Class	Northern Wet-Mesic Hardwood Forest
NPC Type	na
NPC SubType	na

Management Unit	Evaluator	Evaluator Organization
Cornish	Scott C. Zager	Wildlands Ecological Services

Releve #
0

LOCATION INFORMATION

UTM Zone	UTM Northing	UTM Easting	Site Name
0	5195353	485500	Cornish

County	Township	Range	Section	Sub Section
Aitkin	51	23	12	SESE

ECOLOGICAL RANK

Ecological Rank	Rationale for Ecological Rank
	Mature Black Ash-Basswood Forest. Old, large Black Ash frequent throughout.

OBSERVATIONS

General Description / Notes

Mesic to wet-mesic Black Ash-Basswood forest dominated by Black Ash with Basswood occasional in the canopy. Highly variable canopy structure with various heights and dominants (elsewhere Sugar Maple is prevalent in canopy). Canopy is interrupted to closed with frequent gaps due to tip-ups and broken limbs. Substrate pocked with small depressions formerly wet in spring now dry late summer. Soil layers with different types of sand and silt mixed with gravel. Coarse woody debris 5-15% cover with down trees and large limbs. Cedar infrequent throughout occurring in small groves. Yellow Birch occasional in canopy. Diverse her layers.

Unique / Notable Features

Black Ash DBH 60cm;Snags in ? frequent

Landscape Description

Lower slope-toe slope of moraine on level terrace extending some distance from lower slope eastward. Somewhat poorly drained with dried depressions suggesting earlier standing water perched in sub horizons. Deep organic "A" horizon comprised of dark sil

Bedrock Description

STRUCTURAL INFORMATION

Canopy Height (m)	*Subcanopy Height (m)*	*Shrub Height (m)*	*Subshrub Height (m)*
(20) 25-30	5-15	0.5-5	<0.5

Canopy Cover (%)	*Subcanopy Cover (%)*	*Shrub Cover (%)*	*Subshrub Cover (%)*
75-100	(25) 50-75	25-50	5-25

Canopy DBH	*Subcanopy DBH*
20-40 (60)	5-15

GramminoidCover	*ForbsCover*	*MossLichenCover*
5-25	25-50	5-25

LANDSCAPE / BEDROCK

Soil Map Unit	Elevation	Slope Position	Aspect	Gradient (%)	Drainage Type
	0.00	Toe	E		Somewhat Poorly

Litter Type	Litter Depth (cm)
Compacted decidious leaves	1

Humus Type	Humus Depth (cm)
Absent	

A Horizon	A Depth (cm)
Organic silt - dark	15

E Horizon	E Depth (cm)
Absent	

B Horizon	B Depth (cm)
B1: Olive, Gravel silt loam with high Chroma mottles	44

C Horizon	C Depth (cm)
B2: Fine Reddish Brown sand motle	>52

C2 Horizon	C2 Depth (cm)
Gravel and rock common throughout layers	

Bedrock Cover	Depth to Bedrock (m)	Bedrock Height (m)

Bare Ground	Water Pools Cover (%)	Water Pool Depth (cm)
5-25		

Species at Single Waypoint

WayPointId **28**

StructuralLayer 1 Canopy

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER69S2	Sugar maple (C) (Acer saccharum)		0	Outside Plot
BETU69AL	Yellow birch (C) (Betula alleghaniensis)		2	<1% (few 2-20)
FRAX69NI	Black ash (C) (Fraxinus nigra)		7	>75-100%
THUJ69OC	White cedar (C) (Thuja occidentalis)		0	Outside Plot
TILI69AM	Basswood (C) (Tilia americana)		3	1-5% (many >20)

StructuralLayer 2 Understory

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER15S2	Sugar maple (U) (Acer saccharum)		5	>25-50%
FRAX15NI	Black ash (U) (Fraxinus nigra)		5	>25-50%
TILI15AM	Basswood (U) (Tilia americana)		5	>25-50%

StructuralLayer 3 Shrub

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ABIEBALS	Balsam fir (Abies balsamea)		2	<1% (few 2-20)
ABIEBALS	Balsam fir (Abies balsamea)		2	<1% (few 2-20)
ACERSAC2	Sugar maple (Acer saccharum)		3	1-5% (many >20)
ACERSPIC	Mountain maple (Acer spicatum)		4	>5-25%
BETUALLE	Yellow birch (Betula alleghaniensis)		2	<1% (few 2-20)
FRAXPENN	Green ash (Fraxinus pennsylvanica)		3	1-5% (many >20)
PRUNVIRG	Chokecherry (Prunus virginiana)		2	<1% (few 2-20)
QUERMACR	Bur oak (Quercus macrocarpa)		1	Single (r)
QUERRUBR	Northern red oak (Quercus rubra)		1	Single (r)
RHAMALNI	Dwarf alder (Rhamnus alnifolia)		2	<1% (few 2-20)
RHUSVARY	Poison ivy (Rhus radicans var. rydbergii)		5	>25-50%
RIBEAMER	Wild black currant (Ribes americanum)		3	1-5% (many >20)
ULMUAMER	American elm (Ulmus americana)		3	1-5% (many >20)

StructuralLayer 4 Subshrub

AnalCode	KeyName	Crt #	Abd#	Abd Value
RUBUIDAE	Red raspberry (Rubus idaeus)		2	<1% (few 2-20)

StructuralLayer 6 Herb

AnalCode	KeyName	Crt #	Abd#	Abd Value
ARALNUDI	Wild sarsaparilla (Aralia nudicaulis)		3	1-5% (many >20)
ARISTRIP	Jack-in-the-pulpit (Arisaema triphyllum)		2	<1% (few 2-20)
ASARCANA	Wild ginger (Asarum canadense)		2	<1% (few 2-20)
ASTECILI	Lindley's aster (Aster ciliolatus)		2	<1% (few 2-20)
ASTELATE	Side-flowering aster (Aster lateriflorus)	2	2	<1% (few 2-20)
ATHYANGU	Lady-fern (Athyrium angustum)		3	1-5% (many >20)
CIRCALPI	Alpine enchanter's nightshade (Circaea alpina)		3	1-5% (many >20)
DRYOCART	Spinulose shield fern (Dryopteris carthusiana)		2	<1% (few 2-20)
EPIL_SPP	Willow-herb species (Epilobium sp.)		3	1-5% (many >20)
EQUIPRAT	Meadow horsetail (Equisetum pratense)		2	<1% (few 2-20)
EQUISYLV	Woodland horsetail (Equisetum sylvaticum)		3	1-5% (many >20)
FRAGVIRG	Common strawberry (Fragaria virginiana)		2	<1% (few 2-20)
GALIAPAR	Cleavers (Galium aparine)		1	Single (r)
GALITRI2	Sweet-scented bedstraw (Galium triflorum)		2	<1% (few 2-20)
GYMNDRYO	Common oak fern (Gymnocarpium dryopteris)		3	1-5% (many >20)
IMPA_SPP	Touch-me-not (Impatiens sp.)		3	1-5% (many >20)
LYCOLUCI	Shining firmoss (Lycopodium lucidulum)		2	<1% (few 2-20)
MAIACANA	Canada mayflower (Maianthemum canadense)		2	<1% (few 2-20)
MATTSTRU	Ostrich-fern (Matteuccia struthiopteris var. pensylvanica)		3	1-5% (many >20)
MITENUDA	Naked miterwort (Mitella nuda)		3	1-5% (many >20)
ONOCSENS	Sensitive fern (Onoclea sensibilis)		2	<1% (few 2-20)
OSMUCLAY	Interrupted fern (Osmunda claytoniana)		2	<1% (few 2-20)
PETAFRIG	Palmate sweet coltsfoot (Petasites frigidus var. palmatus)		2	<1% (few 2-20)
PRUNVULG	Heal-all (Prunella vulgaris)		2	<1% (few 2-20)
RANUABOR	Kidney-leaved buttercup (Ranunculus abortivus)		2	<1% (few 2-20)
RANUHISP	Hispid buttercup (Ranunculus hispidus)		2	<1% (few 2-20)

RUBUPUBE	Dwarf raspberry (Rubus pubescens)		3	1-5% (many >20)
SOLIGIGA	Giant goldenrod (Solidago gigantea)		1	Single (r)
STREROSE	Rose twistedstalk (Streptopus roseus)		3	1-5% (many >20)
VIOL_SPP	Violet species (Viola sp.)		3	1-5% (many >20)

StructuralLayer 7 Graminoid

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
AGROPERE	Autumn bentgrass (Agrostis perennans)		2	<1% (few 2-20)
BRACEREC	Bearded shorthusk (Brachyelytrum erectum)			
CAREGRAC	Graceful sedge (Carex gracillima)		3	1-5% (many >20)
CAREINTU	Bladder sedge (Carex intumescens)	4	3	1-5% (many >20)
CAREPEDU	Long-stalked sedge (Carex pedunculata)		2	<1% (few 2-20)
CAREPROJ	Projecting sedge (Carex projecta)		3	1-5% (many >20)
CARERADI	Carex radiata		2	<1% (few 2-20)
CINNLATI	Drooping woodreed (Cinna latifolia)		3	1-5% (many >20)
ELYMHYST	Bottlebrush grass (Elymus hystrix)		3	1-5% (many >20)
GLYCBORE	Northern manna grass (Glyceria borealis)	4	2	<1% (few 2-20)
GLYCSTRI	Fowl manna grass (Glyceria striata)		3	1-5% (many >20)
MILIEFFU	Woodland millet grass (Milium effusum var. cisatlanticum)		2	<1% (few 2-20)
PHLEPRAT	Timothy (Phleum pratense)		0	Outside Plot
POA_PALU	Fowl blue grass (Poa palustris)		2	<1% (few 2-20)

WayPoint # 29 Data

POINT INFORMATION

Waypoint	Data Sheet	NPC Code	Polygon ID	Date
29	39	MHn47	29	8/20/2008 4:40:00 PM

NPC System	Mesic Hardwood Forest System
NPC Class	Northern Rich Mesic Hardwood Forest
NPC Type	na
NPC SubType	na

Management Unit	Evaluator	Evaluator Organization
Cornish	Scott C. Zager	Wildlands Ecological Services

Releve #
0

LOCATION INFORMATION

UTM Zone	UTM Northing	UTM Easting	Site Name
0	5195306	485483	Cornish

County	Township	Range	Section	Sub Section
Aitkin	51	23	12	SESE

ECOLOGICAL RANK

Ecological Rank	Rationale for Ecological Rank
	Mesic old growth hardwood forest dominated by large Sugar Maple, Basswood with Yellow Birch Tip-up with large diameter trunk 60-70cm DBH

OBSERVATIONS

General Description / Notes

Mesic hardwoods dominated by trees of two size classes. Large old trees and maturing trees in gaps. Several old growth Sugar Maple and Yellow Birch (45-75cm). Bimodel tree girth (15-25cm) dominated by Maples and 35-45cm dominated by Sugar Maples, Basswood and Yellow Birch open understory allowing lush herb growth and carpet by Carex pensylvanica. Shrubs and saplings sparse. Seedling layer with frequent Red Oak, and rare Bur Oak. Sugar Maple seedlings most abundant. Ground with frequent old tip-up mounds. Large down trees, snags are occasional to locally common.

Unique / Notable Features

Old growth trees with gaps created by tip-ups of large trees (specifically Cedar 60-70 cm DBH). Large Sugar Maple, Basswood, Black Ash and frequent Yellow Birch. Rare Botrychium oneidense observed.Sugar Maple DBH 45, 19Thuja occidentalis 22, 42Betula

Landscape Description

Crest of large interfluvial ridge on lowerslope of moraine. Moderately well drained silt loam over gravel and sand, high chroma mottles within 39cm from surface suggesting early high water table. Several old saddles and hollows from former tip-up mound

Bedrock Description

STRUCTURAL INFORMATION

Canopy Height (m)	Subcanopy Height (m)	Shrub Height (m)	Subshrub Height (m)
20-25 (30)	2-20	0.5-2	<0.5

Canopy Cover (%)	Subcanopy Cover (%)	Shrub Cover (%)	Subshrub Cover (%)
50-75 (100)	25-50	5-25	5-25

Canopy DBH	Subcanopy DBH
15-25 & 35-45 (75)	5-15

GramminoidCover	ForbsCover	MossLichenCover
50-75	25-50	<1

LANDSCAPE / BEDROCK

Soil Map Unit	Elevation	Slope Position	Aspect	Gradient (%)	Drainage Type
	0.00		E	2	Moderately

Litter Type	Litter Depth (cm)
Deciduous leaves and sedges	1

Humus Type	Humus Depth (cm)
Moderate humus - all stages decay - roots - no worms	6

A Horizon	A Depth (cm)
dark silty loam	10

E Horizon	E Depth (cm)
Olive Gray silt loam	39

B Horizon	B Depth (cm)
Dark Brown loamy, medium sand with Choc-Red-Brown mottles	59

C Horizon	C Depth (cm)
Gravel and small rocks in B horizon	

C2 Horizon	C2 Depth (cm)

Bedrock Cover	Depth to Bedrock (m)	Bedrock Height (m)

Bare Ground	Water Pools Cover (%)	Water Pool Depth (cm)

Species at Single Waypoint

WayPointId **29**

StructuralLayer 1 Canopy

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER69RU	Red maple (C) (Acer rubrum)		3	1-5% (many >20)
ACER69S2	Sugar maple (C) (Acer saccharum)		6	>50-75%
BETU69AL	Yellow birch (C) (Betula alleghaniensis)		4	>5-25%
FRAX69NI	Black ash (C) (Fraxinus nigra)		0	Outside Plot
THUJ69OC	White cedar (C) (Thuja occidentalis)		2	<1% (few 2-20)
TILI69AM	Basswood (C) (Tilia americana)		5	>25-50%

StructuralLayer 2 Understory

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER15S2	Sugar maple (U) (Acer saccharum)		5	>25-50%

StructuralLayer 3 Shrub

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ABIEBALS	Balsam fir (Abies balsamea)		2	<1% (few 2-20)
ACERRUBR	Red maple (Acer rubrum)		2	<1% (few 2-20)
ACERSAC2	Sugar maple (Acer saccharum)		4	>5-25%
BETUALLE	Yellow birch (Betula alleghaniensis)		3	1-5% (many >20)
CORYCORN	Beaked hazelnut (Corylus cornuta)		3	1-5% (many >20)
FRAXNIGR	Black ash (Fraxinus nigra)		3	1-5% (many >20)
FRAXPENN	Green ash (Fraxinus pennsylvanica)		2	<1% (few 2-20)
LONICANA	Fly honeysuckle (Lonicera canadensis)		2	<1% (few 2-20)
LONIHIRS	Hairy honeysuckle (Lonicera hirsuta)		1	Single (r)
QUERALBA	White oak (Quercus alba)		1	Single (r)
QUERRUBR	Northern red oak (Quercus rubra)		3	1-5% (many >20)
TILIAMER	Basswood (Tilia americana)		3	1-5% (many >20)
ULMUAMER	American elm (Ulmus americana)		3	1-5% (many >20)

StructuralLayer 6 Herb

AnalCode	KeyName	Crt #	Abd#	Abd Value
AMPHBRAC	Hog peanut (Amphicarpaea bracteata)	3	1-5%	(many >20)
ASTELATE	Side-flowering aster (Aster lateriflorus)	2	<1%	(few 2-20)
ASTEMACR	Large-leaved aster (Aster macrophyllus)	3	1-5%	(many >20)
ATHYANGU	Lady-fern (Athyrium angustum)	3	1-5%	(many >20)
BOTRMULT	Leathery grapefern (Botrychium multifidum)	2	<1%	(few 2-20)
BOTRONEI	Blunt-lobed grapefern (Botrychium oneidense)	2	<1%	(few 2-20)
CLINBORE	Bluebead lily (Clintonia borealis)	3	1-5%	(many >20)
COPTTRIF	Goldthread (Coptis trifolia var. groenlandica)	2	<1%	(few 2-20)
DRYOCART	Spinulose shield fern (Dryopteris carthusiana)	2	<1%	(few 2-20)
EQUIPRAT	Meadow horsetail (Equisetum pratense)	2	<1%	(few 2-20)
EQUISYLV	Woodland horsetail (Equisetum sylvaticum)	2	<1%	(few 2-20)
GALITRI2	Sweet-scented bedstraw (Galium triflorum)	2	<1%	(few 2-20)
GYMNDRYO	Common oak fern (Gymnocarpium dryopteris)	3	1-5%	(many >20)
HEPAAMER	Round-lobed hepatica (Anemone americana)	3	1-5%	(many >20)
LYCOANNO	Bristly clubmoss (Lycopodium annotinum)	4	>5-25%	
LYCODEND	Groundpine (Lycopodium dendroideum)	3	1-5%	(many >20)
MAIACANA	Canada mayflower (Maianthemum canadense)	3	1-5%	(many >20)
ONOCSENS	Sensitive fern (Onoclea sensibilis)	2	<1%	(few 2-20)
OSMOCLAY	Clayton's sweet cicely (Osmorhiza claytonii)	2	<1%	(few 2-20)
OSMUCLAY	Interrupted fern (Osmunda claytoniana)	2	<1%	(few 2-20)
PETAFRIG	Palmate sweet coltsfoot (Petasites frigidus var. palmatus)	2	<1%	(few 2-20)
PHACFRAN	Franklin's phacelia (Phacelia franklinii)	3	1-5%	(many >20)
RUBUPUBE	Dwarf raspberry (Rubus pubescens)	3	1-5%	(many >20)
SANIMARI	Maryland black snakeroot (Sanicula marilandica)	2	<1%	(few 2-20)
STREROSE	Rose twistedstalk (Streptopus roseus)	3	1-5%	(many >20)
TRIEBORE	Starflower (Trientalis borealis)	2	<1%	(few 2-20)
TRILCERN	Nodding trillium (Trillium cernuum)	2	<1%	(few 2-20)
UVULSESS	Pale bellwort (Uvularia sessilifolia)	3	1-5%	(many >20)

StructuralLayer 7 Graminoid

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
BRACEREC	Bearded shorthusk (Brachyelytrum erectum)		3	1-5% (many >20)
CAREARC2	Drooping wood sedge (Carex arctata)		3	1-5% (many >20)
CAREDEWE	Dewey's sedge (Carex deweyana)		1	Single (r)
CAREINTU	Bladder sedge (Carex intumescens)		2	<1% (few 2-20)
CAREPENS	Sun-loving sedge (Carex pensylvanica)		6	>50-75%
MILIEFFU	Woodland millet grass (Milium effusum var. cisatlanticum)		2	<1% (few 2-20)
ORYZASPE	Moutain rice grass (Oryzopsis asperifolia)		3	1-5% (many >20)

WayPoint # 944 Data

POINT INFORMATION

Waypoint	Data Sheet	NPC Code	Polygon ID	Date
944	10	MHn47	944	7/15/2008 2:26:00 PM

NPC System	Mesic Hardwood Forest System
NPC Class	Northern Rich Mesic Hardwood Forest
NPC Type	na
NPC SubType	na

Management Unit	Evaluator	Evaluator Organization
Cornish	Scott C. Zager	Wildlands Ecological Services

Releve #
0

LOCATION INFORMATION

UTM Zone	UTM Northing	UTM Easting	Site Name
0	5196091	484759	Cornish

County	Township	Range	Section	Sub Section
Aitkin	51	23	12	SENW

ECOLOGICAL RANK

Ecological Rank	Rationale for Ecological Rank
	BA = 130 sq ft/ac Bidal size class with Sugar pleand Yellow Bich as old growth with mature Oak, Paper Birch and Maple. Snags occasional.

OBSERVATIONS

General Description / Notes

Old growth mesic hardwoods with bi-model size class. Old tree canopy 5-25% overall (higher in plot) dominated by Yellow Birch and Sugar Maple. Yellow Birch have aerial roots originating on old (White Pine?) stumps which are nearly fully decayed. Mature trees (20m tall crowns) are various species: Paper Birch, Sugar Maple, Basswood and Red Oak. The subcanopy is patchy (25-50%) but occasionally interrup (50-75%) dominated by Sugar Maple, Red Maple and tall Ironwood. Occasional snag and down trees throughout. White Cedar rare upslope becoming more frequent below. Mature Cedar over topped by other canopy. Old root saddles (hummocks) from ancient down trees. Infrequent.Betula alleghaniensis 35, 77 cm, 65Acer saccharum 40, 61 cmThuja 30 cmBetula papyrifera 33 cmAcer rubrumTilia 40-45 cm

Unique / Notable Features

Old growth Yellow Birch and Maple. Yellow Birch with aerial roots suggesting origin on Pine stumps.Large trunks, down with charcoal >8' height

Landscape Description

On small knoll or ridge within rolling terrain of glacier Outwash on terrace next to large esker. Deep silt. Excellent humus laye (no worms). Coarse woody debris5% overall (25% locally)

Bedrock Description

STRUCTURAL INFORMATION

Canopy Height (m)	Subcanopy Height (m)	Shrub Height (m)	Subshrub Height (m)
20-30	10-20	0.5-2 (10)	<0.5

Canopy Cover (%)	Subcanopy Cover (%)	Shrub Cover (%)	Subshrub Cover (%)
(75) 90-100	25-50	25-50 (75)	5-25

Canopy DBH	Subcanopy DBH
5 and 35-77cm (6-10" - 14-28	5-15

GramminoidCover	ForbsCover	MossLichenCover
25-50	5-25	<1

LANDSCAPE / BEDROCK

Soil Map Unit	Elevation	Slope Position	Aspect	Gradient (%)	Drainage Type
	0.00	Crest		0-2	Well

Litter Type	Litter Depth (cm)
Birch, Maple, Oak, etc.	2

Humus Type	Humus Depth (cm)
Moderate all stages of decay	8

A Horizon	A Depth (cm)
Dark silt	10

E Horizon	E Depth (cm)
Light gray silt	26

B Horizon	B Depth (cm)
None	0

C Horizon	C Depth (cm)
Yellow-Brown silt (moist)	>108

C2 Horizon	C2 Depth (cm)

Bedrock Cover	Depth to Bedrock (m)	Bedrock Height (m)

Bare Ground	Water Pools Cover (%)	Water Pool Depth (cm)
5-25		

Species at Single Waypoint

WayPointId **944**

StructuralLayer 6 Herb

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACTARUBR	Red baneberry (Actaea rubra)	2	1	Single (r)
ARALNUDI	Wild sarsaparilla (Aralia nudicaulis)		4	>5-25%
ARALRACE	American spikenard (Aralia racemosa)		1	Single (r)
ASTEMACR	Large-leaved aster (Aster macrophyllus)		3	1-5% (many >20)
ATHYANGU	Lady-fern (Athyrium angustum)		1	Single (r)
CLINBORE	Bluebead lily (Clintonia borealis)		3	1-5% (many >20)
DRYOCART	Spinulose shield fern (Dryopteris carthusiana)		2	<1% (few 2-20)
GYMNDRYO	Common oak fern (Gymnocarpium dryopteris)		2	<1% (few 2-20)
LYCOANNO	Bristly clubmoss (Lycopodium annotinum)		2	<1% (few 2-20)
LYCODEND	Groundpine (Lycopodium dendroideum)		2	<1% (few 2-20)
MAIACANA	Canada mayflower (Maianthemum canadense)		3	1-5% (many >20)
OSMOCLAY	Clayton's sweet cicely (Osmorhiza claytonii)		2	<1% (few 2-20)
OSMUCLAY	Interrupted fern (Osmunda claytoniana)		1	Single (r)
PTERAQUI	Bracken (Pteridium aquilinum var. latiusculum)		2	<1% (few 2-20)
SANGCANA	Bloodroot (Sanguinaria canadensis)		1	Single (r)
SMILRACE	Racemose false Solomon's-seal (Smilacina racemosa)		2	<1% (few 2-20)
SMILSTEL	Starry false Solomon's seal (Smilacina stellata)	4	3	1-5% (many >20)
STREROSE	Rose twistedstalk (Streptopus roseus)		2	<1% (few 2-20)
TRIEBORE	Starflower (Trientalis borealis)		2	<1% (few 2-20)
UVULGRAN	Large-flowered bellwort (Uvularia grandiflora)		2	<1% (few 2-20)
UVULSESS	Pale bellwort (Uvularia sessilifolia)		4	>5-25%

WayPoint # 950 Data

POINT INFORMATION

Waypoint	Data Sheet	NPC Code	Polygon ID	Date
950	14	MHn35	950	7/17/2008 9:45:00 AM

NPC System	Mesic Hardwood Forest System
NPC Class	Northern Mesic Hardwood Forest
NPC Type	na
NPC SubType	na

Management Unit	Evaluator	Evaluator Organization
Cornish	Scott C. Zager	Wildlands Ecological Services

Releve #
0

LOCATION INFORMATION

UTM Zone	UTM Northing	UTM Easting	Site Name
0	5199689	482227	Cornish

County	Township	Range	Section	Sub Section
Aitkin	52	23	34	SENE

ECOLOGICAL RANK

Ecological Rank	Rationale for Ecological Rank
	BA = 190 sq ft/acMaturing to mature upland forest with worms slight altering soil. Second growth, deep shade

OBSERVATIONS

General Description / Notes

Mesic upland forest on narrow linear ridge-crest with silt-cap. Dominated by maturing Sugar Maple (DBH 15-25cm) with mature Red Oak and Paper Birch (25-45 DBH) frequent, dense canopy and subcanopy densely shades understory reducing coverage of shrubs, seedlings and herbs. Old snags and tip-ups are frequent. CWD 10-20% (40% locally) including very decayed trunks and large limbs. Old tip-up saddles prevalent. Overall commuunity trends to MHn47 bt somewhat depauperible on densely shaded crest where plot sampled. Rare Sugar Maple 60-70%cm DBH. Large broken snag of Big-Toothed Aspen (DBH 80-90cm) Ostrich Fern found abundantly within small local depression on crest. Groves of B.T. Aspen at margins of plot.

Unique / Notable Features

Earthworms establishing. Mixed humus and A horizon depauperate flora due to dense shady, diversity and abundance ofherbs increases within canopy gaps.

Landscape Description

Narrow ridge presumably a moraine, possibly esker deeply covered with silt. Organic layer substandard.

Bedrock Description

STRUCTURAL INFORMATION

Canopy Height (m)	*Subcanopy Height (m)*	*Shrub Height (m)*	*Subshrub Height (m)*
20-25	2-20	0.5-2	<0.5

Canopy Cover (%)	*Subcanopy Cover (%)*	*Shrub Cover (%)*	*Subshrub Cover (%)*
85-100	75-100	1-5	1-5

Canopy DBH	*Subcanopy DBH*
15-25 & (45-65)	5-15

GramminoidCover	*ForbsCover*	*MossLichenCover*
<1	1-5	<1

LANDSCAPE / BEDROCK

Soil Map Unit	Elevation	Slope Position	Aspect	Gradient (%)	Drainage Type
	0.00	Crest		0-4	Well

Litter Type	Litter Depth (cm)
	3

Humus Type	Humus Depth (cm)
Humus mixed with a worms	

A Horizon	A Depth (cm)
Dark organic silt and detritus	10

E Horizon	E Depth (cm)
Gray Brown silt	38

B Horizon	B Depth (cm)
Olive Brown silt with clayey nodules	67

C Horizon	C Depth (cm)

C2 Horizon	C2 Depth (cm)

Bedrock Cover	Depth to Bedrock (m)	Bedrock Height (m)

Bare Ground	Water Pools Cover (%)	Water Pool Depth (cm)
90-100		

Species at Single Waypoint

WayPointId **950**

StructuralLayer 1 Canopy

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER69S2	Sugar maple (C) (Acer saccharum)		6	>50-75%
BETU69PA	Paper birch (C) (Betula papyrifera)		3	1-5% (many >20)
POPU69GR	Big-toothed aspen (C) (Populus grandidentata)		4	>5-25%
QUER69RU	Northern red oak (C) (Quercus rubra)		5	>25-50%
TILI69AM	Basswood (C) (Tilia americana)		4	>5-25%

StructuralLayer 2 Understory

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER15S2	Sugar maple (U) (Acer saccharum)		7	>75-100%
OSTR15VI	Ironwood (U) (Ostrya virginiana)		3	1-5% (many >20)
TILI15AM	Basswood (U) (Tilia americana)		4	>5-25%

StructuralLayer 3 Shrub

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACERSAC2	Sugar maple (Acer saccharum)		3	1-5% (many >20)
CORNALTE	Pagoda dogwood (Cornus alternifolia)	4	2	<1% (few 2-20)
DIRCPALU	Leatherwood (Dirca palustris)		2	<1% (few 2-20)
QUERRUBR	Northern red oak (Quercus rubra)		1	Single (r)
RIBECYNO	Prickly gooseberry (Ribes cynosbati)		2	<1% (few 2-20)
TILIAMER	Basswood (Tilia americana)		2	<1% (few 2-20)

StructuralLayer 6 Herb

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACTARUBR	Red baneberry (Actaea rubra)		2	<1% (few 2-20)
AMPHBRAC	Hog peanut (Amphicarpaea bracteata)		2	<1% (few 2-20)
ARALNUDI	Wild sarsaparilla (Aralia nudicaulis)		2	<1% (few 2-20)
ARALRACE	American spikenard (Aralia racemosa)		2	<1% (few 2-20)
ASTEMACR	Large-leaved aster (Aster macrophyllus)		2	<1% (few 2-20)
ATHYANGU	Lady-fern (Athyrium angustum)		2	<1% (few 2-20)

EQUIPRAT	Meadow horsetail (Equisetum pratense)	2	<1% (few 2-20)
MATTSTRU	Ostrich-fern (Matteuccia struthiopteris var. pensylvanica)	3	1-5% (many >20)
ONOCSENS	Sensitive fern (Onoclea sensibilis)	1	Single (r)
OSMOCLAY	Clayton's sweet cicely (Osmorhiza claytonii)	2	<1% (few 2-20)
PTERAQUI	Bracken (Pteridium aquilinum var. latiusculum)	2	<1% (few 2-20)
SOLIGIGA	Giant goldenrod (Solidago gigantea)	2	<1% (few 2-20)
UVULGRAN	Large-flowered bellwort (Uvularia grandiflora)	2	<1% (few 2-20)
UVULSESS	Pale bellwort (Uvularia sessilifolia)	2	<1% (few 2-20)
VIOLPUBE	Yellow violet (Viola pubescens)	3	1-5% (many >20)

StructuralLayer 7 Graminoid

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
BRACEREC	Bearded shorthusk (Brachyelytrum erectum)	2		<1% (few 2-20)
CAREDEWE	Dewey's sedge (Carex deweyana)	1		Single (r)
CAREPENS	Sun-loving sedge (Carex pensylvanica)	3		1-5% (many >20)
FESTOBTU	Nodding fescue (Festuca obtusa = F. subverticellata)	2		<1% (few 2-20)

WayPoint # 973 Data

POINT INFORMATION

Waypoint	Data Sheet	NPC Code	Polygon ID	Date
973	25	MHn35b	973	7/22/2008 2:54:00 PM

NPC System	Mesic Hardwood Forest System
NPC Class	Northern Mesic Hardwood Forest
NPC Type	Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest
NPC SubType	na

Management Unit	Evaluator	Evaluator Organization
Cornish	Scott C. Zager	Wildlands Ecological Services

Releve #
0

LOCATION INFORMATION

UTM Zone	UTM Northing	UTM Easting	Site Name
0	5198777	483064	Cornish

County	Township	Range	Section	Sub Section
Aitkin	52	23	35	SESW

ECOLOGICAL RANK

Ecological Rank	Rationale for Ecological Rank
	Basal Area = 120 sq ft/ac

OBSERVATIONS

General Description / Notes

Dry-mesic upland forest on knoll dominated by Sugar Maple and Basswood 25-35cm DBH with larger trees to 85cm DBH infrequently scattered throughout canopy 75-100% cover with small frequent gaps. Large gap due to recent tip-up. Subcanopy closed filling in canopy openings and densely shading substrate. Shrrub laye sparse. Low seedlings cover. Carex pensy dominates substrate typical dry-mesic herbs.CWD <5% with large tip-ups occasional.

Unique / Notable Features

No worms. Some past logging. Large Sugar Maples infrequent - 85c

Landscape Description

Lower knoll as part of a series of knolls and ridges of stagnation moraine. Good humus layer, thin A horizon well-developed, E horizon distinct. Well drained silt.

Bedrock Description

STRUCTURAL INFORMATION

Canopy Height (m)	*Subcanopy Height (m)*	*Shrub Height (m)*	*Subshrub Height (m)*
20-25	5-20	0.5-2	<0.5

Canopy Cover (%)	*Subcanopy Cover (%)*	*Shrub Cover (%)*	*Subshrub Cover (%)*
(65) 75-100	75-100	5-25 (100)	5-25

Canopy DBH	*Subcanopy DBH*
25-35 (40-85)	5-15

GramminoidCover	*ForbsCover*	*MossLichenCover*
50-75	25-50	<1

LANDSCAPE / BEDROCK

Soil Map Unit	Elevation	Slope Position	Aspect	Gradient (%)	Drainage Type
	0.00	Crest	N	0-5	Well

Litter Type	Litter Depth (cm)
Maple and Oak	2

Humus Type	Humus Depth (cm)
Moderate: All stages of decay (no worms)	6

A Horizon	A Depth (cm)
Dark silt	7

E Horizon	E Depth (cm)
Dark Gray silt	17

B Horizon	B Depth (cm)
None	

C Horizon	C Depth (cm)
Yellow Brown fine silt (some very fine sand)	58

C2 Horizon	C2 Depth (cm)

Bedrock Cover	Depth to Bedrock (m)	Bedrock Height (m)

Bare Ground	Water Pools Cover (%)	Water Pool Depth (cm)
1-5		

Species at Single Waypoint

WayPointId **973**

StructuralLayer 1 Canopy

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER69S2	Sugar maple (C) (Acer saccharum)		6	>50-75%
TILI69AM	Basswood (C) (Tilia americana)		5	>25-50%

StructuralLayer 2 Understory

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER15S2	Sugar maple (U) (Acer saccharum)		7	>75-100%
OSTR15VI	Ironwood (U) (Ostrya virginiana)		3	1-5% (many >20)

StructuralLayer 3 Shrub

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACERSAC2	Sugar maple (Acer saccharum)		4	>5-25%
OSTRVIRG	Ironwood (Ostrya virginiana)		3	1-5% (many >20)
QUERRUBR	Northern red oak (Quercus rubra)		2	<1% (few 2-20)
RIBECYNO	Prickly gooseberry (Ribes cynosbati)		1	Single (r)
TILIAMER	Basswood (Tilia americana)		2	<1% (few 2-20)
ULMUAMER	American elm (Ulmus americana)		1	Single (r)

StructuralLayer 6 Herb

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
APOCANDR	Spreading dogbane (Apocynum androsaemifolium)		1	Single (r)
ARALNUDI	Wild sarsaparilla (Aralia nudicaulis)		4	>5-25%
ARALRACE	American spikenard (Aralia racemosa)		2	<1% (few 2-20)
ASTEMACR	Large-leaved aster (Aster macrophyllus)		3	1-5% (many >20)
ATHYANGU	Lady-fern (Athyrium angustum)		3	1-5% (many >20)
BOTRVIRG	Rattlesnake fern (Botrychium virginianum)		2	<1% (few 2-20)
EQUIPRAT	Meadow horsetail (Equisetum pratense)		2	<1% (few 2-20)
LYCODEND	Groundpine (Lycopodium dendroideum)		3	1-5% (many >20)
MAIACANA	Canada mayflower (Maianthemum canadense)		4	>5-25%
OSMOCLAY	Clayton's sweet cicely (Osmorhiza claytonii)		2	<1% (few 2-20)

PTERAQUI	Bracken (Pteridium aquilinum var. latiusculum)		2	<1% (few 2-20)
SANGCANA	Bloodroot (Sanguinaria canadensis)		3	1-5% (many >20)
UVULSESS	Pale bellwort (Uvularia sessilifolia)		3	1-5% (many >20)
VIOLPUBE	Yellow violet (Viola pubescens)	4	2	<1% (few 2-20)

StructuralLayer 7 Graminoid

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
BRACEREC	Bearded shorthusk (Brachyelytrum erectum)		2	<1% (few 2-20)
CAREPENS	Sun-loving sedge (Carex pensylvanica)		5	>25-50%
ORYZASPE	Moutain rice grass (Oryzopsis asperifolia)		2	<1% (few 2-20)

WayPoint # 982 Data

POINT INFORMATION

Waypoint	Data Sheet	NPC Code	Polygon ID	Date
982	26	MHn35b	982	7/23/2008 11:00:00 AM

NPC System	Mesic Hardwood Forest System
NPC Class	Northern Mesic Hardwood Forest
NPC Type	Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest
NPC SubType	na

Management Unit	Evaluator	Evaluator Organization
Cornish	Scott C. Zager	Wildlands Ecological Services

Releve #
0

LOCATION INFORMATION

UTM Zone	UTM Northing	UTM Easting	Site Name
0	5199433	482830	Cornish

County	Township	Range	Section	Sub Section
Aitkin	52	23	35	SENW

ECOLOGICAL RANK

Ecological Rank	Rationale for Ecological Rank
	Basal Area = 220 sq ft/ac

OBSERVATIONS

General Description / Notes

Dry-mesic upland forest dominated by Red Oak with Quaking Aspen and Paper Birch locally common (25% cover total each), densely spaced large canopy trees 85% cover, crowns 25-30m tall; with mode DBH 25-45 cm with an occasional large Oak and Quaking Aspen. A few Paper Birch are in the subcanopy which is mostly dominated by maturing Sugar Maple (DBH 15-20cm, crowns 5-20m tall). These densely shade the sparse shrub and seedling layer. The low abundance of forbs and graminoids reflects dense shade. Plot on circular crest that is part of an irregular ridge on moraine with semi-permanent wet forest perched in depressions on upper slope.

Unique / Notable Features

Crest with Paper Birch of various size classes (15-25cm DBH). Tip-ups occasional to locally common. Coarse woody debris 5-30% with limbs, branches and large trunks. All stages of decay. Crest marked with red paint. Forbs stunted on crest with dense s

Landscape Description

Circular crest on knoll of a lateral spur of stagnation moraine with irregular ridges, knolls and broad aprons on lower slope - often with low saddles between peaks. Occasional wet depressions. No worms. Well developed moderate humus. Thin A horizon a

Bedrock Description

STRUCTURAL INFORMATION

Canopy Height (m)	Subcanopy Height (m)	Shrub Height (m)	Subshrub Height (m)
25-30	5-20	0.5-5	<0.5

Canopy Cover (%)	Subcanopy Cover (%)	Shrub Cover (%)	Subshrub Cover (%)
85	75-100	1-5	1-5

Canopy DBH	Subcanopy DBH
(15) 25-45 (55)	5-15 (20)

GramminoidCover	ForbsCover	MossLichenCover
1-5	5-25	<1

LANDSCAPE / BEDROCK

Soil Map Unit	Elevation	Slope Position	Aspect	Gradient (%)	Drainage Type
	0.00	Crest		0-5	Well

Litter Type	Litter Depth (cm)
Oak, Maple and Birch leaves	1

Humus Type	Humus Depth (cm)
Moderate: all stages decay (no worms)	5

A Horizon	A Depth (cm)
Dark silt	6

E Horizon	E Depth (cm)
Dark Gray silt	17

B Horizon	B Depth (cm)
None	0

C Horizon	C Depth (cm)
Yellow Brown silt	>80

C2 Horizon	C2 Depth (cm)

Bedrock Cover	Depth to Bedrock (m)	Bedrock Height (m)

Bare Ground	Water Pools Cover (%)	Water Pool Depth (cm)
50-75		

Species at Single Waypoint

WayPointId **982**

StructuralLayer 1 Canopy

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
BETU69PA	Paper birch (C) (Betula papyrifera)		4	>5-25%
POPU69TR	Quaking aspen (C) (Populus tremuloides)		4	>5-25%
QUER69RU	Northern red oak (C) (Quercus rubra)		6	>50-75%
TILI69AM	Basswood (C) (Tilia americana)		3	1-5% (many >20)

StructuralLayer 2 Understory

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER15S2	Sugar maple (U) (Acer saccharum)		7	>75-100%
BETU15PA	Paper birch (U) (Betula papyrifera)		2	<1% (few 2-20)
OSTR15VI	Ironwood (U) (Ostrya virginiana)		2	<1% (few 2-20)

StructuralLayer 3 Shrub

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACERSAC2	Sugar maple (Acer saccharum)		3	1-5% (many >20)
CORNALTE	Pagoda dogwood (Cornus alternifolia)	4	2	<1% (few 2-20)
DIRCPALU	Leatherwood (Dirca palustris)		2	<1% (few 2-20)
OSTRVIRG	Ironwood (Ostrya virginiana)		2	<1% (few 2-20)
POPUTREM	Quaking aspen (Populus tremuloides)		2	<1% (few 2-20)
TILIAMER	Basswood (Tilia americana)		2	<1% (few 2-20)

StructuralLayer 6 Herb

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ANEMQUIN	Wood anemone (Anemone quinquefolia)		2	<1% (few 2-20)
ARALNUDI	Wild sarsaparilla (Aralia nudicaulis)		3	1-5% (many >20)
ASTEMACR	Large-leaved aster (Aster macrophyllus)		2	<1% (few 2-20)
CAULTHAL	Blue cohosh (Caulophyllum thalictroides)		1	Single (r)
EQUIPRAT	Meadow horsetail (Equisetum pratense)		2	<1% (few 2-20)
PRENALBA	White rattlesnakeroot (Prenanthes alba)		2	<1% (few 2-20)
SMILRACE	Racemose false Solomon's-seal (Smilacina racemosa)		2	<1% (few 2-20)

SOLIFLEX	Zigzag goldenrod (Solidago flexicaulis)	1	Single (r)
STREROSE	Rose twistedstalk (Streptopus roseus)	2	<1% (few 2-20)
UVULGRAN	Large-flowered bellwort (Uvularia grandiflora)	2	<1% (few 2-20)
UVULSESS	Pale bellwort (Uvularia sessilifolia)	2	<1% (few 2-20)
VIOL_SPP	Violet species (Viola sp.)	2	<1% (few 2-20)

StructuralLayer 7 Graminoid

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
CAREPENS	Sun-loving sedge (Carex pensylvanica)	3	1-5% (many >20)	
ORYZASPE	Moutain rice grass (Oryzopsis asperifolia)	2	<1% (few 2-20)	

WayPoint # 991 Data

POINT INFORMATION

Waypoint	Data Sheet	NPC Code	Polygon ID	Date
991	31	MHn35	991	7/25/2008 9:55:00 AM

NPC System	Mesic Hardwood Forest System
NPC Class	Northern Mesic Hardwood Forest
NPC Type	na
NPC SubType	na

Management Unit	Evaluator	Evaluator Organization
Cornish	Scott C. Zager	Wildlands Ecological Services

Releve #
0

LOCATION INFORMATION

UTM Zone	UTM Northing	UTM Easting	Site Name
0	5200083	484994	Cornish

County	Township	Range	Section	Sub Section
Aitkin	52	23	25	SWSE

ECOLOGICAL RANK

Ecological Rank	Rationale for Ecological Rank
	Basal Area varies: 90 & 240 sq ft/acHeterogeneous mature forest with patchy to interrupted canopy with densely shading understory.

OBSERVATIONS

General Description / Notes

Description of general area (not plot). Heterogeneous canopy comprised of a bimodel distribution of large trees. Canopy openings and dense understory. Broad level crest of WPT, but low areas are frequent at margins and swales. Surface packed with old tip-up mounds. CWD is common 5-10% overall. Mostly branches but occasionally with large very decayed trunks. Mode DBH 20-30cm but density varies (B.A. 90-240). Open canopy with dense shrub layer. Closed canopy with common large trees (40-60cm) DBH with open understory and Lacus of Carex Pens. Sedge.

Unique / Notable Features

Extremely heterogeneous canopy varying in density and tree girth. Open gaps with dense understory. Closed canopy with open understory. Old very decayed trunks and tip-ups with scattered snags. Old stump occasional.

Landscape Description

Broad, level crest on a low oval ridge that is part of a complex pattern of low rises and broad swales within a larger basin next to a moraine. Excellent humus (all stages of decay with woody fragments throughout surface - not in pit). Deep silt over ro

Bedrock Description

STRUCTURAL INFORMATION

Canopy Height (m)	*Subcanopy Height (m)*	*Shrub Height (m)*	*Subshrub Height (m)*
10-30	2-20	0.5-2	<0.5

Canopy Cover (%)	*Subcanopy Cover (%)*	*Shrub Cover (%)*	*Subshrub Cover (%)*
50-90	50-100	25-100	0-25

Canopy DBH	*Subcanopy DBH*
20-30 (40-60)	5-15

GramminoidCover	*ForbsCover*	*MossLichenCover*
1-5 & 25-50	1-25	<1

LANDSCAPE / BEDROCK

Soil Map Unit	Elevation	Slope Position	Aspect	Gradient (%)	Drainage Type
	0.00	Crest			Well

Litter Type	Litter Depth (cm)
Deciduous leaves	2

Humus Type	Humus Depth (cm)
Moderate - all stages decay - Excellent	4

A Horizon	A Depth (cm)
Dark silt	5

E Horizon	E Depth (cm)
Gray silt	16

B Horizon	B Depth (cm)
None observed	

C Horizon	C Depth (cm)
Yellow Brown silt becoming Olive Brown below	100

C2 Horizon	C2 Depth (cm)
Rock - impenetrable	>100

Bedrock Cover	Depth to Bedrock (m)	Bedrock Height (m)

Bare Ground	Water Pools Cover (%)	Water Pool Depth (cm)
25-50		

Species at Single Waypoint

WayPointId **991**

StructuralLayer 1 Canopy

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER69S2	Sugar maple (C) (Acer saccharum)		6	>50-75%
BETU69PA	Paper birch (C) (Betula papyrifera)		3	1-5% (many >20)
TILI69AM	Basswood (C) (Tilia americana)		3	1-5% (many >20)

StructuralLayer 2 Understory

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ACER15S2	Sugar maple (U) (Acer saccharum)		6	>50-75%
OSTR15VI	Ironwood (U) (Ostrya virginiana)		4	>5-25%

StructuralLayer 3 Shrub

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ABIEBALS	Balsam fir (Abies balsamea)		2	<1% (few 2-20)
ACERRUBR	Red maple (Acer rubrum)		3	1-5% (many >20)
ACERSAC2	Sugar maple (Acer saccharum)		7	>75-100%
CORNALTE	Pagoda dogwood (Cornus alternifolia)		2	<1% (few 2-20)
CORYCORN	Beaked hazelnut (Corylus cornuta)		3	1-5% (many >20)
OSTRVIRG	Ironwood (Ostrya virginiana)		3	1-5% (many >20)
QUERRUBR	Northern red oak (Quercus rubra)		0	Outside Plot
TILIAMER	Basswood (Tilia americana)		3	1-5% (many >20)

StructuralLayer 6 Herb

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
ANEMQUIN	Wood anemone (Anemone quinquefolia)		2	<1% (few 2-20)
BOTRVIRG	Rattlesnake fern (Botrychium virginianum)		2	<1% (few 2-20)
CLINBORE	Bluebead lily (Clintonia borealis)		2	<1% (few 2-20)
DRYOCART	Spinulose shield fern (Dryopteris carthusiana)		2	<1% (few 2-20)
GALITRI2	Sweet-scented bedstraw (Galium triflorum)		3	1-5% (many >20)
HEPAAMER	Round-lobed hepatica (Anemone americana)		3	1-5% (many >20)
LYCOCLAV	Running clubmoss (Lycopodium clavatum)		2	<1% (few 2-20)

LYCODEND	Groundpine (Lycopodium dendroideum)		3	1-5% (many >20)
LYCOLUCI	Shining firmoss (Lycopodium lucidulum)		2	<1% (few 2-20)
MAIACANA	Canada mayflower (Maianthemum canadense)		3	1-5% (many >20)
OSMOCLAY	Clayton's sweet cicely (Osmorhiza claytonii)	4	2	<1% (few 2-20)
PHACFRAN	Franklin's phacelia (Phacelia franklinii)		2	<1% (few 2-20)
PTERAQUI	Bracken (Pteridium aquilinum var. latiusculum)		2	<1% (few 2-20)
RUBUPUBE	Dwarf raspberry (Rubus pubescens)		2	<1% (few 2-20)
STREROSE	Rose twistedstalk (Streptopus roseus)		2	<1% (few 2-20)
TRIEBORE	Starflower (Trientalis borealis)		2	<1% (few 2-20)
UVULSESS	Pale bellwort (Uvularia sessilifolia)		3	1-5% (many >20)
VIOL_SPP	Violet species (Viola sp.)		2	<1% (few 2-20)

StructuralLayer 7 Graminoid

AnalCode	*KeyName*	*Crt #*	*Abd#*	*Abd Value*
BRACEREC	Bearded shorthusk (Brachyelytrum erectum)		3	1-5% (many >20)
CAREARC2	Drooping wood sedge (Carex arctata)		2	<1% (few 2-20)
CAREDEWE	Dewey's sedge (Carex deweyana)		2	<1% (few 2-20)
CAREPENS	Sun-loving sedge (Carex pensylvanica)		4	>5-25%
ORYZASPE	Moutain rice grass (Oryzopsis asperifolia)		3	1-5% (many >20)

APPENDIX IV

Representative NRCS Soil Series Descriptions Occurring within Cornish HCVF

ALSTAD SERIES

The Alstad component is on flats on moraines. Slope ranges from 0 to 4 percent. The parent material consists of loamy till. The Alstad series consists of very deep, somewhat poorly drained soils that formed in loamy, calcareous till. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during May. Organic matter content in the surface horizon is about 4 percent. Clay content in the particle-size control section (weighted average)--18 to 27 percent. Sand content in the particle-size control section (weighted average)--45 to 65 percent

Rock fragments--1 to 15 percent, gravel; 0 to 5 percent, cobbles, mixed lithology, some are limestone and some are shale.

Ap--0 to 23 centimeters; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; friable; many fine and medium roots; about 2 percent gravel and 1 percent cobbles; slightly acid; clear smooth boundary.

E--23 to 38 centimeters; brown (10YR 5/3) fine sandy loam, very pale brown (10YR 7/3) dry; moderate medium platy structure parting to weak very fine subangular blocky; friable; common fine roots; many medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; about 3 percent gravel and 1 percent cobbles; very strongly acid; clear wavy boundary.

E/B--38 to 46 centimeters; about 60 percent pale brown (10YR 6/3) fine sandy loam (E), very pale brown (10YR 7/3) dry; weak thick platy structure parting to weak very fine subangular blocky; friable; extends as tongues into yellowish brown (10YR 5/4) sandy clay loam (Bt); moderate fine subangular blocky structure; firm; few faint dark yellowish brown (10YR 4/4) clay films in root channels and pores; common distinct light brownish gray (10YR 6/2) coats of silt and sand grains on faces of some peds; few fine roots; few fine faint and distinct grayish brown (10YR 5/2) iron depletions; many medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; about 3 percent gravel and 1 percent cobbles; moderately acid; clear wavy boundary.

B/E--46 to 61 centimeters; about 70 percent yellowish brown (10YR 5/4) sandy clay loam (Bt); moderate fine subangular blocky structure; firm; few faint dark yellowish brown (10YR 4/4) clay films on faces of peds and in root channels and pores; common distinct light brownish gray (10YR 6/2) coats of silt and sand grains on faces of peds; few fine rounded iron-manganese concretions; penetrated by tongues of pale brown (10YR 6/3) fine sandy loam (E), very pale brown (10YR 7/3) dry; weak thin platy structure; friable; few fine roots; few fine distinct and faint grayish brown (10YR 5/2) iron depletions; many medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; about 3 percent gravel and 1 percent cobbles; strongly acid; clear wavy boundary.

Bt1--61 to 97 centimeters; brown (10YR 4/3) sandy clay loam; moderate fine and medium subangular blocky structure; very firm; few fine roots; common faint brown (10YR 5/3) and distinct dark brown (7.5YR 3/4) clay films on faces of peds and in pores; few prominent very dark brown (10YR 2/2) clay films in root channels and in pores; common medium rounded iron-manganese concretions; common fine faint grayish brown (10YR 5/2) iron depletions; many medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; about 3 percent gravel and 1 percent cobbles; moderately acid; clear wavy boundary.

Bt2--97 to 124 centimeters; brown (10YR 4/3) sandy clay loam; moderate fine subangular blocky structure; firm; few fine roots; common prominent very dark brown (10YR 2/2) clay films on some major vertical faces of peds and in root channels and pores; common medium rounded iron-manganese concretions; common fine faint grayish brown (10YR 5/2) iron depletions; many medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; about 3 percent gravel and 1 percent cobbles; some of the gravel are shale fragments; neutral; clear wavy boundary.

BCk--124 to 152 centimeters; dark yellowish brown (10YR 4/4) fine sandy loam; massive; friable; common medium rounded iron-manganese concretions; common fine carbonate threads; few medium rounded soft masses of calcium carbonate; many medium prominent strong brown (7.5YR 5/6) and common fine distinct dark brown (7.5YR 3/4) masses of iron accumulation; common fine distinct grayish brown (10YR 5/2) iron depletions; about 6 percent gravel and 1 percent cobbles; some of the gravel are shale fragments; moderately alkaline; strong effervescence.

BRANSTAD SERIES

The Branstad series consists of very deep, moderately well drained soils formed in loamy calcareous till on moraines. Permeability is moderate in the upper part of the solum and moderately slow or moderate in the lower part of the solum and in the substratum. Slopes range from 2 to 20 percent.

Ap--0 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; many very fine and fine roots; many very fine and fine tubular pores; about 3 percent gravel; slightly alkaline; abrupt smooth boundary. (6 to 9 inches thick)

E--9 to 14 inches; brown (10YR 5/3) fine sandy loam, light gray (10YR 7/2) dry; weak fine platy structure; friable; few very fine and fine roots; few very fine and fine tubular pores; about 3 percent gravel; slightly alkaline; clear wavy boundary. (0 to 9 inches thick)

E/B--14 to 20 inches; about 60 percent brown (10YR 5/3) fine sandy loam (E), light gray (10YR 7/2) dry; weak fine platy structure; friable; extends as tongues into brown (10YR 4/3) sandy clay loam (Bt); moderate medium subangular blocky structure; friable few very fine roots; few very fine tubular pores; few distinct brown (7.5YR 4/4) clay films on faces of peds; about 3 percent gravel; slightly alkaline; clear wavy boundary.

B/E1--20 to 36 inches; about 60 percent brown (10YR 4/3) sandy clay loam (Bt); moderate medium subangular blocky structure; friable; few distinct brown (7.5YR 4/4) clay films on faces of peds; penetrated by tongues of brown (10YR 5/3) fine sandy loam (E), light gray (10YR 7/2) dry; weak fine subangular blocky structure; friable; few very fine roots; few very fine tubular pores; common medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; about 3 percent gravel; neutral; clear wavy boundary.

B/E2--36 to 45 inches; about 85 percent brown (10YR 4/3) sandy clay loam (Bt); weak medium subangular blocky structure; friable; few distinct brown (7.5YR 4/4) clay films on faces of peds; penetrated by brown (10YR 5/3) fine sandy loam (E), light gray (10YR 7/2) dry; weak medium subangular blocky structure; friable; few very fine roots; few very fine tubular pores; common coarse prominent strong brown (7.5YR 5/6) masses of iron accumulation; about 3 percent gravel; some of the gravel are shale fragment; moderately acid; gradual wavy boundary. (Glossic horizon - 8 to 40 inches thick)

Bt1--45 to 55 inches; brown (10YR 4/3) sandy clay loam; weak coarse prismatic structure parting to weak medium subangular blocky; friable; few very fine roots; few very fine tubular pores; common distinct brown (7.5YR 4/4) clay films on faces of peds; common faint brown (10YR 5/3) coatings of E material on faces of peds; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation; few fine distinct grayish brown (10YR 5/2) iron depletions; few black (N 2.5/0) iron-manganese concretions; about 3 percent gravel; some of the gravel are shale fragments; moderately acid; clear wavy boundary.

Bt2--55 to 68 inches; brown (10YR 4/3) fine sandy loam; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; few distinct brown (7.5YR 4/4) clay films on faces of peds; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation; about 4 percent gravel; some of the gravel are shale fragments; neutral; gradual wavy boundary. (Combined thickness of the Bt horizon ranges from 8 to 35 inches.)

Btk--68 to 80 inches; brown (10YR 4/3) fine sandy loam; weak coarse prismatic structure; friable; few

distinct brown (7.5YR 4/4) clay films on faces of peds; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation; common prominent light gray (10YR 7/1) soft masses of calcium carbonate; about 5 percent gravel; some of the gravel are shale fragments; strongly effervescent; moderately

CATHRO SERIES

Cathro soils commonly are in relatively small depressions mainly within ground moraines, end moraines, lake plains and outwash plains. This component is on swamps. 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 parent material consists of organic material over loamy till. The ground water carrying minerals from the surrounding upland, influences the composition of the organic deposit. 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. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during March, April, May, June, November. Organic matter content in the surface horizon is about 72 percent.

Woody fragments over 2cm in size comprise less than 15 percent of the organic material. The surface tier exclusive of loose surface litter or mosses, is comprised of mucky peat (hemic material) or muck (sapric material) material with an unrubbed fiber content that ranges from about 20 percent to 50 percent; rubbed is less than 20 percent. Up to 4 inches of peat is on the surface in some pedons. The surface tier is weak or moderate fine granular structure. Typically the structure grade becomes stronger as the amount of recognizable woody material increases.

The subsurface tier is muck (sapric material). The unrubbed fiber content ranges from 50 to less than 10 percent and is less than 16 percent after rubbing. Some pedons have thin layers of mucky peat (hemic material) in the control section. Ash content of the organic layer just above the loamy substratum is as much as 40 percent in some pedons. The depth to the loamy C horizon ranges from 16 to 51 inches.

0a1--0 to 6 inches; black (5YR 2/1) rubbed and pressed muck (sapric material); about 40 percent fiber, about 15 percent rubbed; weak fine granular structure; nonsticky; primarily herbaceous fibers; neutral (pH 6.8 in water); clear wavy boundary.

0a2--6 to 11 inches; black (5YR 2/1) broken face and rubbed muck (sapric material), dark reddish brown (5YR 2/2) pressed; about 35 percent fiber, about 10 percent rubbed; weak medium granular structure; nonsticky; primarily herbaceous fibers; neutral (pH 6.8 in water); clear smooth boundary.

0a3--11 to 23 inches; black (5YR 2/1) on broken face and rubbed muck (sapric material); about 40 percent fibers, less than 10 percent rubbed; massive; nonsticky; primarily herbaceous fibers; neutral (pH 6.8 in water); abrupt smooth boundary. (Combined thickness of Oa horizons is 15 to 51 inches.)

Cg--23 to 60 inches; grayish brown (2.5Y 5/2) sandy loam; massive; slightly sticky; common coarse prominent reddish brown (5YR 5/3) and common coarse distinct brown (10YR 5/3) Fe concentrations; strongly effervescent; moderately alkaline.

COWHORN SERIES

Cowhorn soils are on plane surfaces on lake plains, river terraces and deltas. The parent material consists of sandy and silty glaciolacustrine deposits. Slopes are 0 to 3 percent. They formed in loamy glaciolacustrine sediments more than 40 inches thick. An apparent water table is as high as between 1.5 to 2.5 feet at some time during April to June in most years. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the

most restrictive layer is high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 18 inches during April, May. Organic matter content in the surface horizon is about 2 percent.

Ap--0 to 8 inches; grayish brown (10YR 5/2) loamy very fine sand, gray (10YR 6/1) dry; weak fine and very fine granular and weak fine subangular blocky structure; very friable; many medium roots; few black (10YR 2/1) and very dark gray (10YR 3/1) worm casts; strongly acid; abrupt wavy boundary. (6 to 10 inches thick)

Bw1--8 to 9 inches; light yellowish brown (10YR 6/4), yellowish brown (10YR 5/4), and light brownish gray (10YR 6/2) loamy very fine sand; weak medium and fine subangular blocky structure; very friable; many medium roots; strongly acid; abrupt wavy boundary.

Bw2--9 to 15 inches; pale brown (10YR 6/3) and brown (10YR 5/3) loamy very fine sand; weak medium and coarse subangular blocky structure; very friable; many fine and medium roots; few fine prominent yellowish brown (10YR 5/8) Fe concentrations; moderately acid; clear wavy boundary.

Bw3--15 to 36 inches; light gray (2.5Y 7/2) and light yellowish brown (2.5Y 6/3) loamy very fine sand; weak medium and coarse subangular blocky structure; very friable; few fine roots; common fine prominent yellowish brown (10YR 5/6) and yellowish brown (10YR 5/4) and few medium prominent brown (10YR 5/3) Fe concentrations; few fine black (5YR 2/1) soft nodules; strongly acid; gradual smooth boundary.

Bw4--36 to 51 inches; light brownish gray (2.5Y 6/2) and light olive gray (5Y 6/2) loamy very fine sand; weak medium and coarse subangular blocky structure; very friable; few fine roots; common large prominent brownish yellow (10YR 6/8) and common medium prominent strong brown (7.5YR 5/8) Fe concentrations; few fine black (5YR 2/1) soft nodules; few narrow pipe stem formation; moderately acid; gradual smooth boundary. (Combined thickness of the Bw horizon is 24 to 68 inches.)

C--51 to 60 inches; olive gray (5Y 5/2) and light olive gray (5Y 6/2) very fine sand; massive; very friable; few coarse prominent yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 5/8) Fe concentrations; slightly alkaline.

CUSHING SERIES

The Cushing series consists of very deep, well drained soils that formed in loamy calcareous till on ground moraines.These soils have moderate permeability in the solum and moderately slow in the underlying till. Slopes range from 20 to 35 percent. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent.

A--0 to 5 inches; black (10YR 2/1) fine sandy loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; many very fine, fine and medium fibrous roots; many very fine and fine and few medium tubular pores; 5 percent gravel; neutral; clear wavy boundary. (6 to 9 inches thick)

E--5 to 15 inches; brown (10YR 5/3) fine sandy loam; light gray (10YR 7/2) dry; moderate fine platy structure; friable; common very fine, fine and medium fibrous roots; common very fine and fine and few medium tubular pores; 5 percent gravel; slightly acid; clear wavy boundary. (0 to 15 inches thick)

B/E1--15 to 24 inches; 70 percent dark yellowish brown (10YR 4/4) sandy clay loam (Bt); moderate medium subangular blocky structure; friable; few very fine and fine fibrous roots; few very fine and fine tubular pores; common distinct brown (7.5YR 4/3) clay films on ped faces; penetrated by tongues of brown (10YR 5/3) fine sandy loam (E), light gray (10YR 7/2) dry; moderate fine platy structure; friable; 3 percent gravel; neutral; gradual wavy boundary.

B/E2--24 to 33 inches; 85 percent dark yellowish brown (10YR 4/4) sandy clay loam (Bt); strong medium prismatic parting to weak fine subangular blocky structure; friable; few very fine and fine fibrous roots; few very fine and fine tubular pores; many distinct brown (7.5YR 4/3) clay films on ped faces; penetrated by tongues of brown (10YR 5/3) fine sandy loam (E), light gray (10YR 7/2) dry; friable; 3 percent gravel; neutral; gradual wavy boundary. (Combined thickness of the B/E horizons is 4 to 20 inches thick)

Bt--33 to 57 inches; dark yellowish brown (10YR 4/4) loam; strong medium prismatic parting to moderate medium subangular blocky structure; friable; few very fine fibrous roots; few very fine tubular pores; many distinct brown (7.5YR 4/3) clay films on faces of peds; brown (10YR 5/3) sand skeletons on prism faces; 3 percent gravel; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulations; slightly acid; gradual wavy boundary. (4 to 28 inches thick)

Btk--57 to 65 inches; yellowish brown (10YR 5/4) fine sandy loam; strong coarse prismatic parting to strong medium subangular blocky structure; friable; few very fine fibrous roots; few prominent brown (7.5YR 4/3) clay films on faces of peds; 3 percent gravel; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulations; few fine light gray (10YR 7/2) soft masses of calcium carbonates; slightly effervescent; moderately alkaline; clear wavy boundary. (0 to 15 inches thick)

Bk--65 to 73 inches; yellowish brown (10YR 5/4) fine sandy loam; strong coarse prismatic structure; friable; few very fine fibrous roots; 3 percent gravel; many medium prominent strong brown (7.5YR 5/6) masses of iron accumulations; common fine light gray (10YR 7/2) masses of calcium carbonates; moderately effervescent; moderately alkaline; gradual wavy boundary. (0 to 20 inches thick)

BC--73 to 85 inches; yellowish brown (10YR 5/4) fine sandy loam; massive structure; friable; 3 percent gravel; many coarse prominent strong brown (7.5YR 5/6) masses of iron accumulations and few fine gray (7.5YR 6/1) iron depletions; many medium fine light gray (10YR 7/2) masses of calcium carbonates; violently effervescent; moderately alkaline.

DULUTH SERIES

The Duluth series is on summits and on linear and convex back slopes of moraines and till plains. The parent material consists of a mantle of loamy eolian or glaciofluvial deposits and the underlying firm loamy till of the St. Louis sublobe of the Des Moines lobe of the Late Wisconsinan glaciation. Thickness of the loamy mantle and depth to till ranges from 10 to 51 centimeters Duluth series consists of very deep, well drained soils that formed in a friable mantle of loamy eolian or glaciofluvial deposits and in the underlying firm loamy till on moraines and till plains. Slopes range from 6 to 45 percent. Depth to a root restrictive layer is greater than 60inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 13 inches during April. Organic matter content in the surface horizon is about 1 percent. Rock fragment content--total 1 to 10 percent; with 1 to 10 percent gravel, 0 to 2 percent cobbles and 0 to 1 percent stones. Rock fragments are mostly of mixed lithology. The loamy mantle averages less than 18 percent clay. The till ranges from 20 to 35 percent clay and contains less than 45 percent sand.

A--0 to 13 centimeters; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many very fine and fine and common medium and few coarse roots; 3 percent gravel and 2 percent cobbles; strongly acid; abrupt wavy boundary. (3 to 15 centimeters thick; if an Ap, as thick as 20 centimeters)

E--13 to 33 centimeters; brown (10YR 5/3) fine sandy loam, very pale brown (10YR 7/3) dry; weak thick platy parting to weak fine granular structure; very friable; common very fine and fine and common medium roots; 3 percent gravel; strongly acid; clear wavy boundary. (3 to 30 centimeters thick)

E/B--33 to 46 centimeters; 80 percent brown (10YR 5/3) fine sandy loam (E), 20 percent brown (7.5YR 4/4) loam (Bt); weak fine subangular blocky structure; friable; common very fine and fine and

few medium roots; common discontinuous brown (7.5YR 4/3) clay films on ped faces; many pale brown (10YR 6/3) silt coats on ped faces; 5 percent gravel and 2 percent cobbles; strongly acid; clear wavy boundary. (combined thickness of the E/B, B/E, 2E/B or 2B/E is 5 to 48 centimeters)

2Bt1--46 to 74 centimeters; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky parting to moderate fine subangular blocky structure; firm; few fine roots; common discontinuous reddish brown (5YR 4/3) clay films on ped faces; 5 percent gravel and 1 percent cobbles; moderately acid; gradual wavy boundary.

2Bt2--74 to 97 centimeters; reddish brown (5YR 4/4) clay loam; moderate coarse subangular blocky structure; firm; few fine roots; common discontinuous reddish brown (5YR 4/3) clay films on ped faces; 5 percent gravel and 1 percent cobbles; slightly acid; gradual wavy boundary. (combined thickness of the 2Bt horizons is 38 to 127 centimeters)

2BC--97 to 127 centimeters; reddish brown (5YR 5/4) clay loam; weak coarse subangular blocky structure; firm; 8 percent gravel and 1 percent cobbles; slightly acid; gradual wavy boundary. (0 to 38 centimeters thick)

2C--127 to 203 centimeters; reddish brown (5YR 4/4) clay loam; massive; firm; 8 percent gravel and 1 percent cobbles; slightly acid.

DUSLER SERIES

The Dusler component formed in loamy glacial till on till floored lake plains, and moraines. The parent material consists of loamy till. The Dusler series consists of very deep, somewhat poorly drained soils. Permeability is moderate in the mantle and slow in the underlying material. These soils have plane or slightly convex slopes range from 0 to 3 percent on gently undulating to rolling moraines and till floored lake plains. They formed primarily in reddish brown, loam or clay loam glacial till of the Superior lobe of the late Wisconsin glaciation. A thin mantle of aeolian or water-deposited sediments overlies the till in some places. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 6 inches during April. Organic matter content in the surface horizon is about 2 percent. The rock fragment content by volume is 1 to 10 percent with 1 to 10 percent gravel, 0 to 2 percent cobbles and 0 to 1 percent stones. The rock fragments are of mixed lithology, but are mostly of igneous origin.

A--0 to 4 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; strong fine granular and strong very fine subangular blocky structure; friable; many fine and very fine roots; 2 percent gravel; strongly acid; clear wavy boundary. (3 to 7 inches thick)

E1--4 to 11 inches; very dark gray (10YR 3/1) silt loam, light brownish gray (10YR 6/2) dry; moderate fine platy structure; very friable; many fine and very fine roots; many very fine continuous vertical pores; few fine iron and manganese oxide concretions; 2 percent gravel; strongly acid; clear wavy boundary.

E2--11 to 15 inches; gray (10YR 6/1) fine sandy loam, white (10YR 8/2) dry; weak fine and medium platy structure; very friable; common fine and very fine roots; many very fine continuous vertical pores; common fine prominent strong brown (7.5YR 5/6) Fe concentrations; few fine iron and manganese oxide concretions; 2 percent gravel; strongly acid; clear wavy boundary. (combined thickness of the E horizons is 3 to 12 inches)

E/B--15 to 22 inches; 65 percent reddish gray (5YR 5/2) sandy loam, pinkish white (5YR 8/2) dry (E); 35 percent reddish brown (5YR 4/3) loam, reddish brown (5YR 5/3) dry (B); moderate coarse platy structure; firm; slightly hard; brittle; few roots; few vesicular pores; common fine distinct yellowish red (5YR 5/8) Fe concentrations; 2 percent gravel; strongly acid; clear wavy boundary. (2 to 10 inches thick)

Bt1--22 to 37 inches; reddish brown (5YR 4/3) loam; moderate coarse prismatic structure parting to strong medium subangular blocky; firm; hard; few moderately thick dark gray (5YR 4/1) clay films on

faces of prisms and in roots channels; common thin dark reddish brown (5YR 3/3) clay films on horizontal and vertical faces of blocky peds; common fine prominent yellowish red (5YR 5/8) Fe concentrations; 2 percent gravel; moderately acid; diffuse smooth boundary.

Bt2--37 to 47 inches; reddish brown (5YR 4/3) loam; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; friable; hard; moderately thick dark gray (5YR 4/1) clay films in root channels and few thin dark reddish brown (5YR 3/3) clay films on vertical faces of peds; 2 percent gravel; slightly acid; diffuse smooth boundary.

Bt3--47 to 55 inches; reddish brown (5YR 4/3) loam; moderate fine and medium subangular blocky structure; friable; hard; moderately thick dark gray (5YR 4/1) clay films in root channels; few thin dark reddish (5YR 3/3) clay films on vertical faces of peds; 2 percent gravel; slightly acid; diffuse smooth boundary. (combined thickness of the Bt horizons is 16 to 34 inches)

C--55 to 80 inches; reddish brown (5YR 4/3) loam; massive; with weak medium plate-like soil fragments dissected by few 2 to 3 millimeter vertical fractures 1 to 5 feet apart; firm; 2 percent gravel; neutral.

ITASCA SERIES

Itasca soils have convex slopes on undulating to steep moraines. Slope gradient dominantly is 3 to 12 percent, but ranges from 1 to 40 percent. These soils formed in a silty mantle of aeolian or lacustrine sediments and underlying loamy glacial till. The Itasca series consists of very deep, well drained soils that formed in a silty mantle and underlying loamy till on moraines. These soils have moderate permeability. The silty and loamy mantle (material 1), which has 0 to 2 percent of rock fragments, ranges from 10 to 32 inches thick. It typically has less than 50 percent of particles coarser than very fine sand. The glacial till (material 2) has 55 to 70 percent of sand and 2 to 8 percent gravel and 0 to 2 percent cobbles of mixed lithology. A lag line with as much as 35 percent (by volume) of rock fragments is at the base of the upper sediment in some pedons. The parent material consists of silty glaciolacustrine deposits over loamy till. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded

Oe--0 to 1 inches; dark brown (10YR 3/3) organic litter, mainly leaves and twigs. (0 to 3 inches thick)

E--1 to 4 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/1) dry; weak very fine crumb and weak very thin platy structure; very friable; many medium roots; moderately acid; clear wavy boundary. (0 to 5 inches thick)

Bw--4 to 10 inches; yellowish brown (10YR 5/4) silt loam, very pale brown (10YR 7/4) dry; weak very fine subangular blocky structure; very friable; many medium roots; moderately acid; clear wavy boundary. (3 to 13 inches thick)

E'--10 to 20 inches; pale brown (10YR 6/3) silt loam; weak medium and fine subangular blocky structure; very friable; many medium roots; common vesicular pores; moderately acid; clear smooth boundary. (3 to 11 inches thick)

2E/B--20 to 25 inches; 80 percent grayish brown (10YR 5/2) (E'), and 20 percent dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) (Bt), fine sandy loam; weak medium and fine subangular blocky structure; very friable; many fine and medium roots; common vesicular pores; about 3 percent gravel; moderately acid; clear wavy boundary.

2B/E--25 to 36 inches; 70 percent dark brown (10YR 4/3) fine sandy loam (Bt) with 30 percent tongues of grayish brown (10YR 5/2) fine sandy loam (E'); weak medium and coarse subangular blocky structure; firm; few distinct dark brown (10YR 3/3 and 4/3) clay films on faces of peds; about 5 percent gravel; common fine roots; moderately acid; gradual wavy boundary. (Combined thickness of 2E/B and 2B/E horizons is 6 to 20 inches.)

2Bt1--36 to 44 inches; yellowish brown (10YR 5/4) fine sandy loam; moderate coarse and medium

angular blocky structure parting to weak distinct platy; firm; many thin dark brown (10YR 3/3) clay films on faces of blocky peds; few dark reddish brown (5YR 3/2) coatings; about 5 percent gravel; common fine roots; neutral; clear wavy boundary.

2Bt2--44 to 56 inches; brown (10YR 5/3) fine sandy loam; weak very coarse angular and subangular blocky structure parting to weak thin platy structure; firm; common distinct dark brown (10YR 4/3) clay films on faces of peds; few dark reddish brown (5YR 3/2) coatings; few strong brown (7.5YR 5/6) soft iron nodules; about 5 percent gravel; common fine roots; neutral; gradual smooth boundary. (Combined Bt horizon is 14 to 38 inches thick.)

2C--56 to 69 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; friable; about 5 percent gravel; few fine roots; few light gray (10YR 7/2) lime threads; slightly effervescent; moderately alkaline.

HILLCITY SERIES

The Hillcity series is on moraines. It consists of very deep, moderately well drained soils formed in silty aeolian deposits over loamy glacial till on glacial moraines. Permeability is moderate. Slopes range from 1 to 6 percent. Hillcity silt loam, on a linear slope of 4 percent, under northern hardwoods forest. Depth to carbonates ranges from 40 to more than 70 inches. The argillic horizon averages 6 to 18 percent clay. The eolian material ranges from 40 to 60 inches thick. It is mainly silt and very fine sand with less than 15 percent fine sand and coarser particles. Some pedons have a thin (less than 6 inches) lag layer at the base of the eolian material. It ranges from sand to coarse sandy loam and has 5 to 25 percent by volume of pebbles. The soil moisture control section is dry in one or more horizons for some time in most years. Hillcity soils are on convex surfaces on glacial moraines. They formed in a silty eolian mantle over loamy glacial till. Slopes are mostly complex and range from 1 to 6 percent. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 41 inches during May. Organic matter content in the surface horizon is about 2 percent.

Oe--0 to 2 inches; well decomposed organic litter. (0 to 3 inches thick)

E--2 to 6 inches; grayish brown (10YR 5/2) silt loam; light brownish gray (10YR 6/2) and light gray (10YR 7/2) dry; moderate medium and thin platy structure; very friable; many fine roots; moderately acid; clear wavy boundary. (1 to 5 inches thick)

Bw--6 to 17 inches; brown (10YR 4/3) silt loam; weak coarse subangular blocky structure; very friable; many fine roots; moderately acid; clear smooth boundary. (4 to 12 inches thick)

E'--17 to 20 inches; light brownish gray (10YR 6/2) very fine sandy loam; light gray (10YR 7/2) dry; weak thin platy structure; very friable; many very fine roots; slightly acid; clear wavy boundary. (2 to 10 inches thick)

B/E--20 to 24 inches; about 70 percent dark yellowish brown (10YR 4/4) silt loam (Bt) with 30 percent tongues of pale brown (10YR 6/3) silt loam (E); weak coarse subangular blocky structure; very friable; common very fine roots; common faint pale brown (10YR 6/3) silt coats on faces of peds; few discontinuous distinct brown (10YR 4/3) clay films on faces of peds; moderately acid; clear wavy boundary. (3 to 10 inches thick)

Bt--24 to 32 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium and coarse subangular blocky structure; friable; common very fine roots; common distinct brown (10YR 4/3) clay films on the faces of peds; moderately acid; clear smooth boundary. (4 to 11 inches thick)

E and Bt--32 to 43 inches; pale brown (10YR 6/3) very fine sandy loam (E) interspersed with yellowish brown (10YR 5/4) very fine sandy loam (Bt) lamellae; weak very thick and thick platy structure; very friable; common very fine roots; few fine distinct yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 4/6) Fe concentrations in the lower part of the horizon; neutral; clear wavy boundary. (0 to 21 inches thick)

2C--43 to 80 inches; light olive brown (2.5Y 5/3) loam; massive; friable; few very fine roots; few fine prominent strong brown (7.5YR 5/8) Fe concentrations and few fine faint light brownish gray (2.5Y 6/2) Fe depletions; 3 percent gravel; slightly effervescent; slightly alkaline.

LUPTON SERIES

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. This component occurs on swamps. The parent material consists of organic material. 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. Slopes typically are from 0 to 2 percent, but may range to 15 percent. 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 0.2 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. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 0 inches during April, May, June, November. Organic matter content in the surface horizon is about 80 percent.

The organic layers are greater than 51 inches thick. Woody fragments comprising up to 30 percent of the volume in some pedons are mixed throughout the control section in the form of twigs, branches, logs, or stumps. Surface tier commonly is sapric material, but some pedons are hemic or consist of various proportions of hemic and sapric material. This tier has a weak to medium, coarse to very fine granular structure. Some pedons have up to 4 inches of fibric material on the surface.

The subsurface tier primarily is sapric material. Some pedons contain layers of hemic material within the subsurface and bottom tiers but their combined thickness is less than 10 inches. A few thin layers of fibric material are also in the bottom two tiers of some pedons but their combined thickness is less than 5 inches. The upper part of the subsurface tier typically has a weak to moderate, fine to coarse granular structure; however, some pedons are massive or coarse blocky that parts to a granular or fine to medium subangular blocky structure. The lower portion of the subsurface tier commonly is either massive or has thick platy structure consisting primarily of herbaceous fibers. In some pedons, where the lower part of the tier is comprised of woody materials, the structure is similar to that in the upper part. The aggregated material in the subsurface tier breaks abruptly under pressure between the fingers. The unrubbed, well decomposed sapric material resembles woody tissue. The bottom tier has variable amounts of woody and herbaceous fiber. The structure is commonly massive or thick platy.

Oa1--0 to 10 inches; black (5YR 2/1) broken face and rubbed muck; about 15 percent fiber, 5 percent rubbed; weak coarse granular structure parting to weak fine granular; very friable; about 5 percent woody fibers; about 20 percent mineral; slightly alkaline (pH 7.5 in water); clear smooth boundary.

Oa2--10 to 20 inches; dark reddish brown (5YR 2/2) broken face, black (5YR 2/1) rubbed muck; about 30 percent fiber, less than 10 percent rubbed; weak fine granular structure; very friable; primarily woody fibers; some are up to 8 to 10 cm. long and 2 to 3 cm. wide; slightly alkaline (pH 7.5 in water); gradual smooth boundary.

Oa3--20 to 27 inches; dark reddish brown (5YR 2/2) broken face and rubbed muck; about 30 percent fiber, less than 10 percent rubbed; weak fine granular structure; very friable; primarily woody fibers; a few fibers are up to 10 to 20 cm. long and 2 to 4 cm. wide all breaking down on rubbing; slightly

alkaline (pH 7.5 in water); clear smooth boundary.

Oa4--27 to 42 inches; dark reddish brown (5YR 2/2) broken face and rubbed muck; about 40 percent fibers, less than 10 percent rubbed; massive; primarily herbaceous fibers; few woody fibers; slightly alkaline (pH 7.5 in water); clear smooth boundary.

Oa5--42 to 65 inches; very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed muck; about 30 percent fibers, less than 10 percent rubbed; massive; primarily herbaceous fibers; slightly alkaline (pH 7.5 in water).

MAHTOMEDI SERIES

The Mahtomedi series is on moraines. The parent material consists of sandy and gravelly outwash.consists of very deep, excessively drained, rapidly permeable soils formed in sandy outwash of Late Wisconsinan Age on glacial moraines and outwash plains. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. These upland soils have slopes ranging from 0 to 45 percent. Free carbonates typically are absent to depths of 10 feet or more, but a small amount are in the C horizon of some pedons. Content of rock fragments in the control section averages between 10 and 35 percent by volume but subhorizons in some pedons have less than 10 percent or more than 35 percent. They are mostly of igneous origin and commonly 0.2 to 5 cm in diameter but ranges to 2 percent cobbles in the A horizon and 10 percent in the B and C horizons. The texture of the fine-earth fraction in the control section is sand or coarse sand. Mottles are below a depth of 30 inches in some pedons. These soils have plane or convex slopes on glacial moraines and outwash plains. Slope gradients range from 0 to 45 percent.

A--0 to 5 inches; very dark gray (10YR 3/1) loamy sand, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; very friable; about 5 percent gravel; moderately acid; abrupt smooth boundary. (0 to 7 inches thick)

E--5 to 8 inches; brown (7.5YR 5/2) sand; single grain; loose; about 10 percent gravel; strongly acid; clear smooth boundary. (0 to 13 inches thick)

Bw1--8 to 15 inches; brown (7.5YR 4/4) gravelly coarse sand; single grained; loose; about 25 percent gravel and 10 percent cobbles; strongly acid; clear smooth boundary.

Bw2--15 to 30 inches; reddish brown (5YR 4/4) gravelly sand; single grain; loose; about 18 percent gravel and 2 percent cobbles; strongly acid; gradual smooth boundary. (Combined thickness of the Bw horizons is 4 to 30 inches.)

C1--30 to 44 inches; reddish brown (5YR 5/4) gravelly sand; single grain; loose; about 25 percent gravel and 1 percent cobbles; strongly acid; gradual smooth boundary.

C2--44 to 60 inches; light reddish brown (5YR 6/3) gravelly sand; single grain; loose; about 15 percent gravel and 1 percent cobbles; moderately acid.

MAHTOWA SERIES

The Mahtowa component is on depressions on moraines. The parent material consists of very deep, very poorly drained soils that formed in loamy glacial till on moraines. These soils have concave slopes with gradients of less than 1 percent on nearly level to rolling glacial moraines. Slopes range from 0 to 1 percent. They formed primarily in reddish brown, loam or clay loam till of the Superior lobe of the Late Wisconsin glaciation. A thin mantle of better sorted sediments overlies the till in some places. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during March, April, May, June, July, October, November. Organic matter content in the surface horizon is about 65 percent. This soil meets hydric criteria.

The content of rock fragments in the 0 to 60 inch series control section typically ranges from 2 to 8 percent, but the upper part of the series control section in some pedons has less than 2 percent. The fragments are mixed in lithology but are mostly of igneous origin. Mean annual soil temperature ranges from 38 to 45 degrees F. The mollic epipedon ranges from 8 to 16 inches in thickness. In the particle-size control section the average content of clay ranges from 18 to 35 percent and the content of sand coarser than very fine sand is about 15 to 35 percent.
A1--0 to 2 inches; dark reddish brown (5YR 2/2) silt loam; friable; recent overwash; abrupt irregular boundary. (0 to 4 inches thick)

A2--2 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; massive in parts with weak medium platy structure in other parts; hard, friable, slightly plastic; abundant roots; few pores; about 2 percent gravel; slightly acid; abrupt wavy boundary.

A3--9 to 12 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak coarse subangular blocky structure parting to weak thick platy; very hard, firm, plastic; few roots; very few pores; few inclusions of very dark gray (10YR 3/1); about 2 percent gravel; slightly acid; abrupt irregular boundary. (Combined thickness of the A horizons is 8 to 16 inches)

Bg1--12 to 16 inches; olive gray (5Y 5/2) loam; weak thin platy structure; hard, friable, slightly plastic; few fine and medium prominent reddish brown (5YR 4/4) Fe concentrations and few fine prominent greenish gray (5G 6/1) Fe depletions; few roots; about 5 percent 1 to 2 mm pores; about 5 percent gravel; neutral; clear wavy boundary.

Bg2--16 to 21 inches; grayish brown (2.5Y 5/2) loam; weak thin platy structure; hard, friable, slightly plastic; common fine and medium prominent yellowish red (5YR 5/6) and reddish brown (5YR 4/4) Fe concentrations and few fine prominent greenish gray (5G 6/1) Fe depletions; few roots; about 5 percent 1 to 2 mm pores; about 5 percent gravel; neutral; abrupt smooth boundary. (Combined thickness of the Bg horizons is 6 to 16 inches)

Bw1--21 to 28 inches; reddish brown (5YR 4/3) loam; weak thin platy structure parting to weak very fine angular blocky structure; hard, friable; plastic; few root channels lined with gray (5Y 5/1) clay films; few fine prominent dark brown (7.5YR 3/2) and strong brown (7.5YR 5/8) Fe concentrations; about 5 percent gravel; neutral; gradual smooth boundary.

Bw2--28 to 40 inches; reddish brown (5YR 4/3) loam; weak thin platy structure parting to weak very fine angular blocky structure; very hard; friable; plastic; few root channels lined with gray (5Y 5/1) clay films; common fine distinct reddish brown (5YR 5/4) Fe concentrations; about 5 percent gravel; neutral; gradual smooth boundary. (Combined thickness of the Bw horizons is 12 to 36 inches)

C--40 to 60 inches; reddish brown (5YR 4/3) loam; few lenses up to 2 inches thick of heavy clay loam; weak thin platy structure parting to weak very fine angular blocky structure; very hard; friable; plastic; about 5 percent gravel; slightly effervescent; slightly alkaline.

NORTHWOOD SERIES

Northwood soils are in shallow depressions and drainageways on lake plains. Slopes are 0 to 1 percent. The parent material consists of organic material over sandy and silty glaciolacustrine deposits. The Northwood series consists of very deep, very poorly drained soils that formed in herbaceous organic materials overlying stratified loamy and sandy lacustrine deposits underlain by loamy calcareous till or lacustrine sediments. These soils formed in a thin organic layer and sandy and loamy sediments, and the underlying till or lacustrine sediments. Very poorly drained. The permeability is moderate or moderately rapid in the upper organic layer, rapid in the sandy layers and moderate or moderately slow in the underlying loamy material. Surface runoff is very low or ponded. Depth to seasonal high saturation is at the surface at periods from November to July in normal years. In addition, ponding may occur during periods of snow melt and high rainfall events. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal

zone of water saturation is at 0 inches during March, April, May, June, July, November. Organic matter content in the surface horizon is about 65 percent. Nonirrigated land capability classification is 6w. This soil meets hydric criteria. Permeability is moderate or moderately rapid permeability in the organic material, rapid in the sandy sediments and moderate or moderately slow in the underlying loamy material. The depth to the loamy till or lacustrine sediments ranges from 20 to 40 inches. Rock fragments range from 0 to 15 percent in the upper material and 0 to 10 percent in the underlying loamy till or lacustrine sediments.

Oa--0 to 9 inches; black (10YR 2/1) muck, very dark gray (10YR 3/1) dry; weak thin platy structure; very friable; about 2 percent fibers rubbed; neutral; abrupt smooth boundary. (8 to 16 inches thick)

A--9 to 14 inches; very dark gray (5Y 3/1) fine sandy loam; weak fine angular blocky structure; very friable; about 3 percent gravel; neutral; clear wavy boundary. (3 to 8 inches thick)

Bg1--14 to 18 inches; olive gray (5Y 4/2) loamy fine sand; weak fine subangular blocky structure; very friable; few fine faint gray (5Y 6/1) Fe depletions and few fine prominent yellowish brown (10YR 5/6) Fe concentrations; about 5 percent gravel; neutral; abrupt wavy boundary.

Bg2--18 to 24 inches; grayish brown (2.5Y 5/2) loamy fine sand; single grain; loose; common fine prominent yellowish brown (10YR 5/6) Fe oncentrations; about 10 percent gravel; neutral; abrupt wavy boundary. (Combined thickness of Bg horizons is 6 to 32 inches.)

2BCkg--24 to 64 inches; olive gray (5Y 5/2) loam; weak medium and coarse subangular blocky structure; friable; few fine faint gray (5Y 6/1) Fe depletions and common medium prominent yellowish brown (10YR 5/6) Fe concentrations; common distinct irregularly shaped carbonates in seams and soft masses; about 3 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary. (0 to 40 inches thick)

2Cg--64 to 80 inches; olive gray (5Y 4/2) clay loam; massive; friable; many coarse prominent olive brown (2.5Y 4/4) Fe depletions and common medium prominent yellowish red (5YR 5/6) Fe concentrations; few fine distinct light gray (5Y 7/1) irregularly shaped carbonates in soft masses; about 3 percent gravel and 1 percent cobbles with 1 percent weathered shale and granite fragments; strongly effervescent; moderately alkaline.

The Rifle series consists of very deep, very poorly drained soils formed in organic deposits more than 51 inches thick in swamps, bogs and depressional areas within ground moraines, end moraines, outwash plains, and lake plains. Slope gradients are less than 2 percent. The natural drainage class is very poorly drained. The seasonal high water table ranges from 1 foot above the surface to 1 foot below the surface from November to June. Surface runoff and internal drainage is very slow; permeability is moderately rapid. The parent material consists of herbaceous organic material. Depth to a root restrictive layer is greater than 60 inches. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during March, April, May, June, November. Organic matter content in the surface horizon is about 95 percent. Nonirrigated land capability classification is 6w. This soil meets hydric criteria.

The thickness of the organic soil layers exceeds 51 inches. The organic material is estimated to be primarily herbaceous fibers, however, some pedons contain less than 15 percent by volume of woody fragments that cannot be crushed between the fingers.The layers in the subsurface and bottom tier are commonly massive, but in some pedons they have weak thick platy structure. The materials are dominantly of hemic material. In some pedons, layers of fibric or sapric materials are within the subsurface and bottom tier but total thickness of either material is less than 10 inches. Some pedons have limnic materials at depths of 51 inches or greater.

Oi1--0 to 2 inches; yellowish brown (10YR 5/4) broken face and rubbed peat, light yellowish brown (10YR 6/4) pressed; 90 to 100 percent sphagnum

moss rubbed; massive; neutral; clear smooth boundary.

Oi2--2 to 4 inches black (5YR 2/1) broken face, rubbed and pressed peat; about 90 percent fiber, 60 percent rubbed; massive; primarily sphagnum moss and some woody fragments; neutral; abrupt smooth boundary.

Oe1--4 to 8 inches; black (5YR 2/1) broken face and rubbed mucky peat, dark reddish brown (5YR 2/2) pressed; about 30 percent fiber and 10 percent rubbed; weak fine granular structure; woody and herbaceous fibers; neutral; abrupt smooth boundary.

Oe2--8 to 20 inches; dark reddish brown (5YR 2/2) broken face, rubbed and pressed mucky peat; about 65 percent fiber and 20 percent rubbed; weak thick platy structure; primarily herbaceous fibers few woody fragments; neutral; clear smooth boundary.

Oe3--20 to 39 inches; dark reddish brown (5YR 2/2) broken face and rubbed mucky peat, dark reddish brown (5YR 3/3) pressed; about 80 percent fiber and 20 percent rubbed; weak thick platy structure; primarily herbaceous fibers; neutral; gradual smooth boundary.

Oe4--39 to 60 inches; dark reddish brown (5YR 2/2) broken face, rubbed and pressed mucky peat; about 70 percent fiber, and 15 percent rubbed; weak thick platy structure; primarily herbaceous fibers; neutral.

WAWINA SERIES

The Wawina component is on lake plains. The parent material consists of sandy glaciolacustrine deposits. The Wawina series consists of very deep, well drained soils formed in sediments that are dominantly very fine sand. They are on lacustine plains, deltas and river terraces. These soils have moderately rapid permeability. Slopes range from 0 to 12 percent. Wawina loamy very fine sand on a 4 percent convex slope in a lacustrine plain under aspen and birch forest. Depth to free carbonates exceeds 60 inches in most pedons. The 10- to 40-inch particle-size control section averages 50 to 75 percent of very fine sand, 5 to 25 percent of silt, 2 to 10 percent of clay, and the total of silt plus clay not exceeding 30 percent. The soil moisture control section is dry for 20 to 35 consecutive days during the 120 days following the summer solstice. The Wawina soils are on convex surfaces on lacustrine plains, river terraces and deltas. Slopes are 0 to 12 percent. They formed in sediments more than 40 inches thick that are predominantly very fine sand. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent.

Oi--0 to 1 inches; organic litter, mainly leaves and small stems. (0 to 2 inches thick)

E1--1 to 3 inches; dark gray (10YR 4/1) loamy very fine sand, light gray (10YR 6/1) dry; weak very fine granular structure; very friable; many fine roots; moderately acid; abrupt wavy boundary.

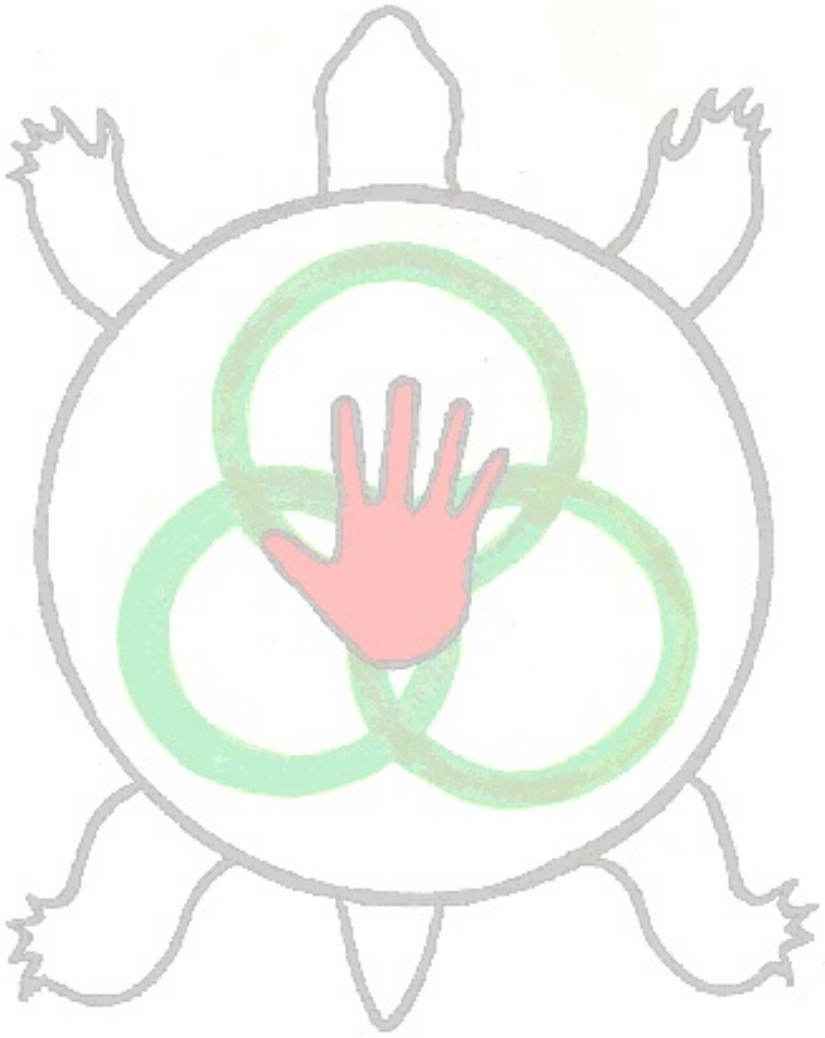
E2--3 to 4 inches; dark grayish brown (10YR 4/2) loamy very fine sand, light brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; many fine roots; moderately acid; abrupt wavy boundary. (Combined thickness of the E horizon is 1 to 6 inches.)

Bw1--4 to 10 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) very fine sand; weak fine and moderately subangular blocky structure; very friable; common fine roots; medium acid; clear wavy boundary. (5 to 12 inches thick)

Bw2--10 to 32 inches; pale brown (10YR 6/3) very fine sand; weak coarse prismatic structure; very friable; few fine roots; slightly acid; clear smooth boundary. (10 to 25 inches thick)

Bw3--32 to 60 inches; light olive brown (2.5Y 5/4) very fine sand; few medium and fine yellowish brown (10YR 5/4) iron and clay precipitate nodules; massive; very friable; a discontinuous yellowish brown (10YR 5/4) loamy very fine sand lamellae 1/4 inch thick at 47 inch depth, slightly acid.

WILDLANDS



ECOLOGICAL SERVICES

WILDLANDS

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.

ECOLOGICAL

SERVICES