Cass Lake and Lake Winnibigoshish
Ecosystem Analysis at the Watershed Scale

The Mississippi River photo by Lynn Jackson

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Table of Contents
Cass Winnie Ecosystem Analysis at the Watershed Scale

Appendicies

INTRODUCTION

An analysis conducted on the Cass Lake and Lake Winnibigoshish watersheds in the Chippewa National Forest in north central Minnesota was initiated in December of 1999. A watershed analysis guide (hereafter referred to as the guide) completed under the direction of an intergovernmental advisory committee directed the analysis process (Anonymous 1995). The following discussion quoted from the introduction of this federal guide describes the importance of conducting analyses at the watershed scale and provides the impetus behind our analysis. "Watershed analysis is a procedure used to characterize the human, aquatic, riparian, and terrestrial features, conditions, processes, and interactions (collectively referred to as 'ecosystem elements') within a watershed. It provides a systematic way to understand and organize ecosystem information. In so doing, watershed analysis enhances our ability to estimate direct, indirect, and cumulative effects of our management activities and guide the general type, location, and sequence of appropriate management activities within a watershed."

Our analysis followed a six step process according to the guide that: 1) characterized the dominant features and processes of these watersheds, 2) identified human- and resource-related issues and key questions that would drive the analysis, 3) described current conditions of multiple aspects of these watersheds, 4) described reference (i.e., prior to major human disturbance) conditions, 5) synthesized and interpreted results gathered from steps 1-4, and finally 6) developed recommendations that could be used to direct inventory/monitoring and management efforts.

Through internal and public outreach, we identified human and resource related issues and key questions that would receive attention in the analysis.

This analysis will produce a "living" document. Appendices and other additions will continue to be produced over time as new data is obtained or new issues are recognized. The findings and recommendations within this analysis represent a foundation on which to develop site-specific project proposals and to base specific future decisions.

Step 1: Characterization of the Watershed

The purpose of this step is to identify the dominant physical biological, and human processes and features of the Cass Lake and Lake Winnibigoshish (hereafter Cass-Winnie) watersheds that affect ecosystem function or condition. These watershed characteristics provide an overall perspective of this watershed and establish the context from which this watershed analysis will follow.

The Cass-Winnie watersheds are located within the headwaters of the Mississippi River drainage. The total drainage area is 1442 square miles 75% of which is upstream of the outlet at Cass Lake. The landscape was shaped by glacial activity that occurred between 9,000-13,000 years ago. Landscapes within the Cass-Winnie watersheds are a mosaic of upland forests, forested wetlands, lakes, streams, and non-forested bogs and meadows. Most (51%) of these watersheds are forested; however, water is also a major component (Table 1) and Cass L. and L. Winnie are among the largest lakes in Minnesota. There are 376 lakes mapped within the watersheds. One hundred and two of the lakes are greater than 10 acres; Lake Winnibighoshish is the largest lake at 56,765 acres. The average size of lakes greater than 10 acres is 952 acres. The average size of all lakes is 259 acres. The Mississippi River bisects the watersheds and there are 48 miles of perennial streams and rivers and 9 miles of intermittent stream.

Table 1. Land use within the Cass Lake and Lake Winnibigoshish watersheds.

Landuse/Cover Type	Percent
Forest	51
Water	34
Wetland	12
Agriculture	2
Urban	1

The Cass-Winnie watershed consists of 289,704 acres of which there are 6 public landowners in addition to tribal and private owners. Public owners consist of the U.S. Forest Service, the State of Minnesota and four counties: Beltrami, Cass, Hubbard and Itasca (Table 2). The Forest Service is the largest public landowner with 100,428 acres or 36% of the total acres.

Table 2. Distribution of land ownership within the Cass Lake and Lake Winnibigoshish watersheds.

Owner	Acres	Percentage of Total Watershed
Forest Service	101,428	35
State	36,883	13
Other Ownership	45,739	16
Beltrami County	5,524	2
Hubbard County	1,621	<1
Itasca County	594	<1
Cass County	355	<1
Water	97,561	34

Climate is characterized by wide variations in temperature and moderate winter precipitation. Summer rainfall is ample. During the summer months, the large water areas tend to moderate the day temperatures and to lower the night temperatures thereby providing some relief from the summer heat. Mean precipitation in the watershed is between 24 to 26 inches annually and evaporation estimates are between 30 to 32 inches annually (Gunard, 1985 Kuehnast et. al., 1982 and Farnworth et al., 1982, Minnesota State Climatologists Office, 1998 and 1999). Most of the rainfall occurs between May and September peaking in June and lowest precipitation occurs in February (Beltrami SWCD).

The human role in the watersheds throughout the millennia is evident. American Indians lived in the area by about 9,000 years ago and there is some evidence of even earlier use. From that time forward, Indians of various cultural traditions affected the watersheds in a variety of ways. Their role within the ecosystem probably became more intensive through time as population density increased in the centuries prior to the arrival of Euroamericans.

In terms of wide-ranging landscape processes, human impact through the use of fire was a major process. Prior to the later half of the 19th century, forest communities of the area were largely shaped by the use of fire that often swept in from the prairies to the west or was ignited (either accidentally or purposefully) by local Indian communities. These re-occurring disturbance events influenced present day vegetation communities and brought a unique "prairie influence" to these watersheds.

Through treaty and federal legislation most of the ancestral lands of the Ojibwe people were ceded and opened to logging, farming and permanent settlement by Euroamericans in the late 19th century. The communities of Cass Lake and Bena were established in 1898 along a new railroad right-of-way that traversed the length of the watersheds and the Indian Reservation. A Forest Reserve that would eventually become the Chippewa National Forest was established in 1902. This era of increased use and settlement forever changed the character of the watersheds in a number of ways.

Commercial tree harvesting and the suppression of fire affected the composition, structure, and spatial arrangement of forested landscapes, and thus have likely affected associated wildlife. With the industrial logging initiated in the area a century ago, most of the old-growth pine was removed from the landscape within just a few years. The slash left behind in cutover areas created a high risk of catastrophic wildfire and the era of active fire suppression began. One of the effects of fire suppression was to cause a decline in fire dependent pine forests and an increase in forest species such as hardwoods, balsam fir and dense shrubs that often displace fire-dependent communities in the absence of fire. While pine remains a major forest component and is still harvested, commercial timber operations of more recent decades have focused primarily on the use and regeneration of aspen. Despite fire suppression, extensive timber harvest, construction of dams, and roads, these watersheds still support diverse fish, wildlife, invertebrate and plant communities, some species of which are relatively uncommon in other areas of the Chippewa. In particular the gray wolf and Canada lynx and the piping plover and bald eagle are Federally listed species that the watershed currently provides or once provided habitat for and 18 birds, 1 amphibian, 1 mammal, 1 reptile, 2 fish, 3 mollusks, 2 insect and 19 plants on the Regional Foresters Sensitive species list that may be present within these watersheds. There are

also 88 species on the Leech Lake Band of Ojibwe's list, most but not all of which are contained in these other lists.

The practice of temporarily damming waterways to provide flow for floating logs during the early pine logging, also altered both terrestrial and aquatic habitats within the watershed. Permanent dams at Stump L., Cass L., and L. Winnie and other smaller control structures now control water levels in the Mississippi R. and headwaters lakes. The most dramatic permanent change of water elevation came with the construction of Winnie Dam, which raised the water elevation in the lake by about 9 feet beginning in 1884. These dams have changed the natural hydrology, affected aquatic and riparian communities associated with the lakes and rivers, and altered human use and settlement of shoreline areas.

Roads within these watersheds are also responsible for alterations to aquatic and terrestrial habitats. There are 812 miles of road in the watersheds that equate to a density of 2.7 miles per square mile. There area also 92 stream crossings. Roads affect terrestrial habitats by reducing the amount of remote habitats and continuous forest canopy. In addition, roads affect aquatic habitats by introducing sediment to streams and by creating barriers to fish movement.

Together, the Cass and Winnie Watersheds comprise the highest density of recreational use on the Chippewa National Forest. The historic and traditional use of these areas, in addition to an exponential growth of the general population, has led to increased development over the years to meet recreational demand. Development has occurred on both public and private lands. Infrastructure within the watersheds that is tied to tourism is plentiful. In addition, habitats within these watersheds support popular walleye and muskellunge sport fisheries and recreational hunting for numerous species of waterfowl, white-tailed deer and ruffed grouse.

Local communities and businesses rely on the rich water and forest resources within the Cass-Winnie watersheds. Land resources support consumptive and non-consumptive recreation that, in turn, supports numerous resorts/motels, restaurants, and shops. These watersheds also support a logging industry. They are also the home of the Leech Lake Band of Ojibwe and the majority of the watersheds are within the boundaries of the Reservation and the watersheds support the traditional subsistence lifestyle of band members. They are one of the largest employers in the area.

The local economy is tied to tourism and forest products ranging from supplying building materials to supplying other products such as balsam boughs, birch bark, maple syrup, wild rice and a variety of berries.

Step 2: Identification of Issues and Key Questions

The purpose of this step is to focus the analysis on specific resource-related issues that were identified by Forest Service resource professionals and the public to be of primary importance to the overall health of the Cass-Winnie watersheds. Some issues identified as being important are based on perception. Analyses that are to follow this step will use available data to evaluate the validity of these perceptions. Questions related to particular issues are raised and will be used to structure our analyses of current and reference conditions, and aid in the development of recommendations. The following issues and related questions are arranged under their respective core topic. Core topics, issues, and questions are in no particular order of emphasis.

I. Biodiversity

A. *Issue*: Aquatic and terrestrial habitats at a variety of scales has changed considerably from pre-European settlement. These changes may affect the viability of plant and animal communities.
   1. *Question:* How have the composition, structure and spatial arrangement of terrestrial habitats changed from pre-European conditions?
   2. *Question*: Have changes to aquatic and terrestrial habitats affected plant and animal populations within watersheds over time?
   3. *Question*: How are current forest, lake and stream management practices affecting aquatic and terrestrial habitat conditions?
   4. *Question*: How did Native Americans affect the environment prior to the arrival of Europeans?
   5. *Question*: What landscape level processes or factors required for maintenance of biodiversity are currently missing from the Cass Winnie watersheds?
   6. *Question*: Does this watershed provide unique opportunities for creation/maintenance and protection of these features?
   7. *Question*: What is the current fire risk and condition within the watersheds and how have terrestrial habitat conditions changed?

B. *Issue*: These watersheds contain nearly 60 species of special concern and these species require conservation efforts for their continued existence.
   1. *Question*: What species are currently of special concern?
   2. *Question*: Which aspects of their habitat require special attention for their continued existence?

C. *Issue*: Invasive exotic species invasions threaten biodiversity
   1. *Question*: Are invasive exotics present or in near proximity to these watersheds?
   2. *Question*: Is it likely that invasive exotic species will become established within these watersheds?

II. Hydrology

A. *Issue*: Stream and lake morphometry has been affected by human-caused hydrological changes. An increase amount of impervious area and loss of has resulted in a change in runoff and water retention.

1. *Question*: How have the following factors affected stream flow frequency, volume of discharge and timing as well as channel morphology and lake level fluctuations?
   - Dams
   - Riparian area modification including change in species composition
   - Large scale harvest at turn of the century

2. *Question*: How have dams altered the morphometry of Cass L. and L. Winnie including the loss of exposed beach.

3. *Question*: To what degree has the amount of impervious surfaces changed within and upstream of the watersheds?

B. *Issue*: A high degree of erosion has occurred as a result of human-caused hydrological changes affecting:
   - Cultural Heritage Sites
   - Private Property
   - Special Uses Permit Areas
   - National Forest lands and Recreation sites

1. Question: How many heritage sites are at risk?

2. Question: How have dams on Cass L. and L. Winnie affected shoreline erosion and what is the extent of active erosion and stabilized shorelines?

D. *Issue*: Historic regulating authorities for dams, drainage and flowage easements may not be realistic due to the development upstream of these watersheds.

1. *Question*: What are the historic agreements that are still in place?

2. Question: To what degree do groundwater elevations play a role in managing Cass, Bemidji, and Lake Winnibigoshish?

III. Water Quality and Fisheries

A. *Issue*: Water quality has decreased through time
   1. *Question*: What are trends in water clarity?
   2. *Question*: What are the past and present sources of phosphorus inputs and what were/are their relative contributions?

B. *Issue*: Contaminants have affected water quality and fisheries
   1. *Question*: How many lakes/streams in this watershed have contaminant advisories and to what degree?

C. *Issue*: Alterations to fish habitat have affected fisheries
   1. *Question*: How have the following factors affected fish habitat?
      - Road crossings of streams
      - Shoreline erosion on Cass and Winnie
      - Erosion control measures
      - Timber harvesting in riparian areas
      - Dams that reduce water flow

D. *Issue*: Recreational angling has affected fisheries
   1.*Question:* What are past and present levels of effort, harvest, size and abundance.

IV. Recreation

A. *Issue:* Recreation development and use has changed over time in terms of the types of amenities provided and numbers of visitors and their preferences. Some recreational uses and development may result in conflicts with other forest resources and conflicts may also occur between recreationists who participate in various legitimate uses within the watershed.

1.*Question:* What are the current uses and how has recreation use changed over time?
2.*Question*: What is the relationship between public and private recreation opportunities?
3.*Question*: Is the current mix of public and private recreation opportunities meeting current demand? What recreation opportunities are needed to meet future demands?
4.*Question:* How has recreation pressure affected resources?
5.*Question:* How have limits and special regulations affected recreation use?
6.*Question:* How can the Forest Service affect shoreline management change as it relates to Special Use Permittees?

V. Social/Traditional Resources

A. *Issue:* Cities and un-incorporated communities within the watersheds have a close tie to federal lands for their economic base. The local economy is tied to the health of the ecosystem and there may be conflicts between economic growth and resource conditions.

1.*Question:* What are the major human uses and characteristics influencing the watersheds?
2. *Question:* What are the demographic, economic and governmental trends that influence the watersheds?
3.*Question:* What are the key watershed factors that are important in maintaining a vital outdoor recreation economy, forest products economy, and community viability?
4.*Question:* What collaborative management opportunities exist with local communities including the Leech Lake Band of Ojibwe?
5.*Question:* How does access affect the collection of traditional resources within the watershed?
6.*Question:* What level of infrastructure is needed to maintain economic viability of the communities within the watersheds while protecting and enhancing unique watershed features?
7. Question: How does the existing vegetative composition within the watershed match up with the desired future condition as defined in the Forest Plan? What activities are occurring within the watershed as a result of implementing the Forest Plan?

Steps 3 and 4: Comparison of Current and Reference Conditions

Using the issues and questions as a guide, we analyzed whether conditions in the watershed have changed through time. Ideally, we would prefer to evaluate whether conditions have changed since European settlement (late 1800's). However, for most cases this was not possible since data is lacking from this time period. Nevertheless, we use relevant past and present data available in this watershed to evaluate time trends or compare past and present conditions. A detailed qualitative history of the area has been compiled for the project file. The discussions below will set the stage and answer the questions posed for each core topic.

Core Topic: Biodiversity

Factors influencing biodiversity of plant and animal communities are numerous and difficult to quantify because of the complexity of ecosystems. Although we cannot quantify the degree to which biodiversity has changed since European settlement in the Cass-Winnie watersheds, we can examine how habitats have changed and factors that are likely responsible for these changes. Given our understanding of species-habitat relationships, we can infer whether biodiversity has been affected since European settlement and identify current threats to biodiversity. The approach used in the Cass Winnie watershed assessment is similar to that described by Malcolm Hunter (1999). Hunter succinctly synthesizes some of the current theory regarding ecosystem management and the emphasis that is often placed on natural patterns and processes (Hunter 1999, p. 29). The principle is that manipulation of forest ecosystems should work within the limits established by natural disturbance patterns prior to extensive human alteration of the landscape. The key assumption involved is that native species evolved under these circumstances (known as the "range of natural variability"), and thus that maintaining a full range of similar conditions under management offers the best assurance against losses of biodiversity. This is analogous to the "coarse-filter" approach (i.e., conserving diverse ecosystems and landscapes), in that it should maintain habitats for the vast majority of species. The idea is that with an effective coarse-filter strategy in place, the more costly and information-intensive fine-filter management can be focused on the few species of special concern.

Following this approach, biodiversity (the wide variety of plants, animals, and other life forms found within our forest ecosystems) should be ensured through framing our land management decisions such that they are within the range of natural variability. The Cass-Winnie watershed assessment indicates where forest community conditions are not currently within this range, and makes recommendations regarding how to rectify this situation when consistent with Forest Plan direction and goals. This is the coarse-filter approach referred to by Hunter.

The end result is that habitat is available for a wide range of species. Consequently, there is a better likelihood of ensuring that viable populations of species are maintained rather than focusing on single species. When placed in the context of the growing number of threatened, endangered, and sensitive species that warrant consideration and protection, this approach is preferable to managing for single species.

Understanding historic conditions and processes, and using RNV as an analysis tool, provides a description of conditions that sustained many of the species and communities that are now reduced in number, size, or extent that have changed functionally. It is also possible to

identify those habitats, communities or components that are missing, limited or at risk. In addition, the TES (threatened/endangered/sensitive) species list alerts us to those "few species of special concern" Hunter references, which may need special attention. Because each land management decision we make at the project scale can result in impacts to these species, we analyze each species specific to each project.

The cumulative effects of our actions, and the larger, landscape-scale picture of our land management decisions can be extremely important to the welfare of some species. Hence, some of the focus of the Cass-Winnie assessment is on those TES species that appear to warrant concern at the larger scale in order to assure their continued viability.

How have the composition, structure and spatial arrangement of terrestrial habitats changed from pre-European conditions? How has management of forests affected terrestrial ecosystems? What landscape level processes or factors required for maintenance of biodiversity are currently missing from the Cass Winnie watersheds?

Prior to European settlement, landscapes were shaped by several natural disturbance factors such as fire, weather events, and insect and disease infestations. These factors interacted to create highly dynamic landscapes through space and time with diverse habitats. Native Americans influenced the landscape following deglaciation that occurred about 12,000 years ago, the Cass/Winnie watershed has been a focal point for human settlement. Archaeological sites within the watershed reveal human presence as early as about 9,000 years ago and there is scant evidence of even earlier occupations. From that time forward, humans have affected their surroundings in a variety of ways and the extent and intensity of the human impacts has increased through time.

Although the following generalized model of human settlement over this time span would be similar elsewhere in the Lake States, the specific expression within and immediately surrounding the Cass/Winnie watershed is distinctive due to several factors including the cultures present, the abundance of food staples from an aquatic system that included a vast fishery and extensive wild rice beds, the advantages of unhindered water transport, and the proximity to a major ecotone allowing access to resources offered by both prairie and forested systems.

With the possible exception of the use of fire, impacts of the earliest people within the ecosystem would be local and of short duration given low population density and a nomadic settlement pattern. As the millennia pass, however, the archaeological record reveals the use of new technologies and subsistence-settlement patterns that support larger populations and semi-permanent or regularly visited habitation areas. These changes are evidenced in the last three thousand years, and most clearly recognized in the past one thousand years.

The larger populations of the last several centuries prior to the arrival of Europeans would create greater impact within the ecosystems of the watershed than previous occupations. The development of fire-dependent vegetative communities within this watershed is likely the direct result of the human use of fire during this time. With the exception of fire, however, these impacts would continue to be localized.

It is possible that several hundred people could have lived within the watershed at various points in time during these later centuries. Such occupation could affect the local availability of plant and animal resources. Regularly visited habitation areas would have created openings, diminished wood available for fuel or building materials and otherwise altered local plant communities. In the Cass/Winnie watershed these habitation areas are manifested in the archaeological record as having dense middens of processed, burned, and trampled animal bone and other debris and that occasionally include the development of anthropic soil horizons.

While scores of archaeological sites along the shorelines within the Cass/Winnie watersheds attest to an impact by the early American Indian people, such effects are minor compared with the large-scale extraction of resources to come with the arrival of Europeans.

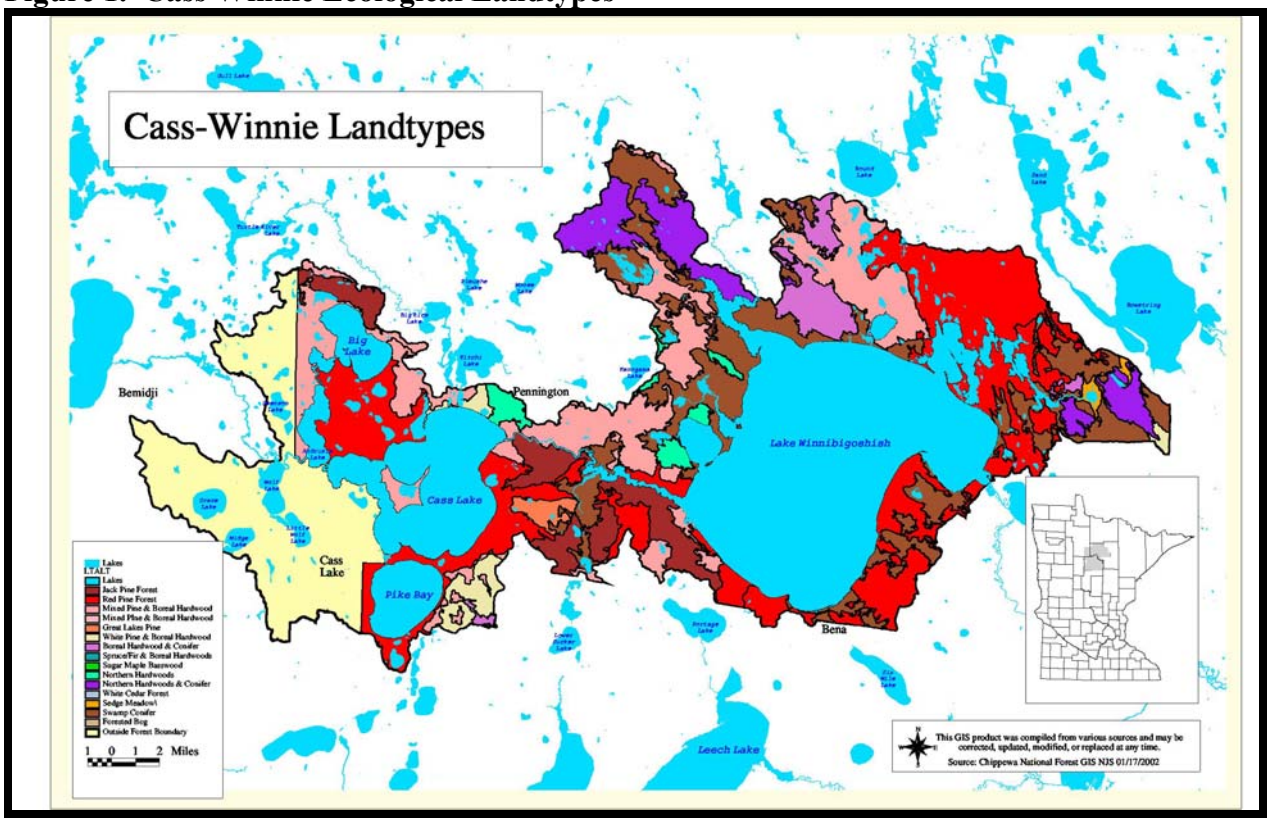
Analysis of the composition, structure and spatial arrangement of terrestrial ecosytems uses the National Hierarchical Framework of Ecological Units that was developed by the U.S. Forest Service (ECOMAP 1993). The ecological classification system within this Framework provides a tool for classifying and stratifying land and water resources at a variety of scales through integration of information about geology, landform, soils water, vegetation, and climate. These classifications represent relatively homogeneous units having similarities among their resource capabilities, biophysical relationships, and general response to disturbances or management strategies.

The landtype is the level in the Framework most appropriate for the Cass-Winnie watershed analysis. The Chippewa National Forest has classified and delineated landtypes within the proclamation boundary (Shadis 1996; Table 3). The individual landtype polygons mapped within the Cass-Winnie watershed have been assigned to and grouped by Native Plant Community (NPC; Table 4; Almendinger and Hanson 1998). These NPCs provide the context for comparing current to past vegetation condition in terms of forest community composition, structure, and spatial arrangement.

Table 3. Landtypes and associated fire tolerance found within the Chippewa

Landtype	Fire Tolerance	Dominant Vegetation
5	Dependent	Jack Pine Forest
6	Dependent	Red Pine Forest
15	Dependent	Mixed Pine-Hardwood Forest
20	Dependent	Great Lakes Pine Forest
25	Tolerant	White Pine-Hardwood Forest
35	Tolerant	Boreal Hardwood-Conifer Forest
46	Intolerant	Northern Hardwood Forest
55	Intolerant	Northern Hardwood-Conifer Forest
70	Dependent	Wet Meadow
75	Intolerant	Conifer Swamp Forest

Figure 1. Cass Winnie Ecological Landtypes *

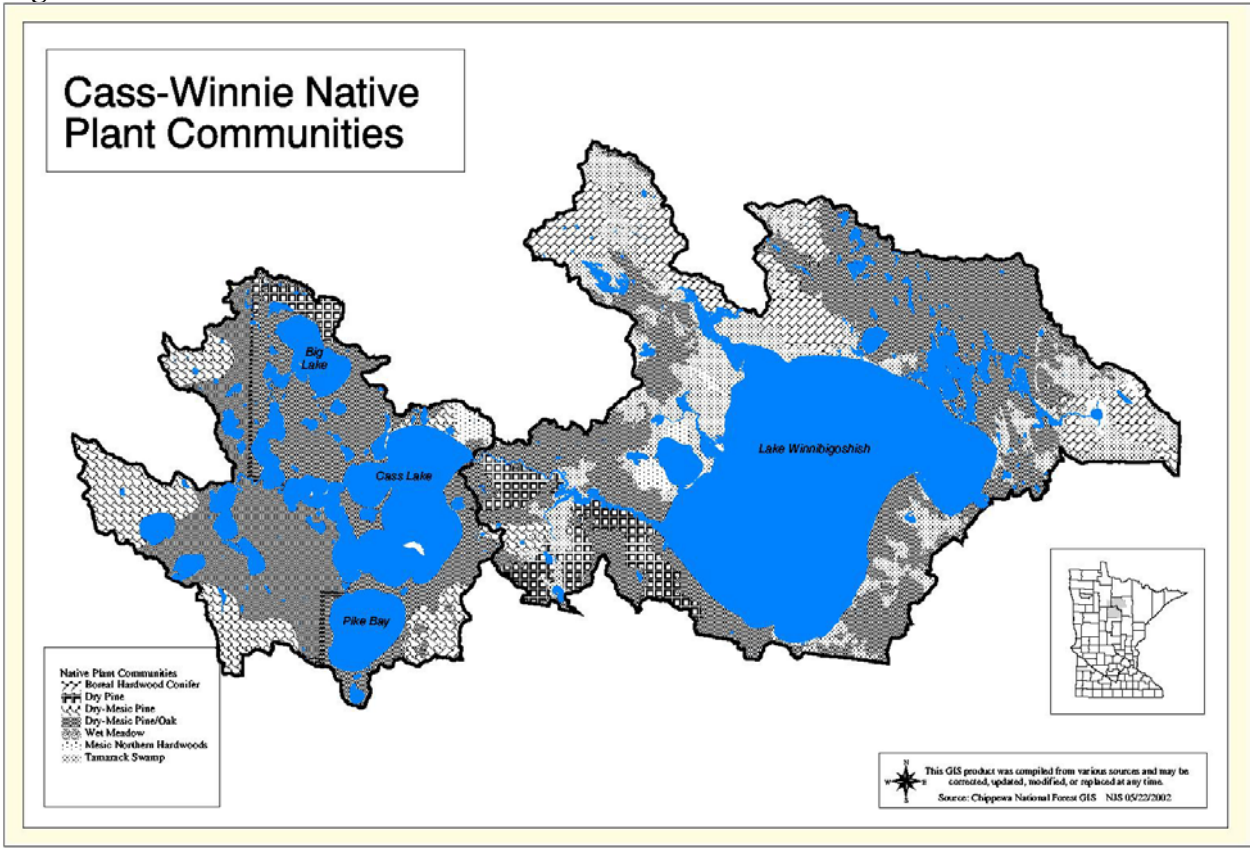


*See Larger Map in Appendix A

Table 4. Native Plant Communities and their associated landtypes within Cass Winnie Watersheds

Native Plant Communities	Dry Pine	Dry-Mesic Pine	Dry-Mesic Pine/ Oak	Mesic Northern Hardwoods	Mesic Boreal Hardwood/ Conifer	Wet Meadow	Tamarack Swamp
Landtypes	**5**	**20,25**	**6,15,**	**46**	**35, 55**	**70**	**75**

Figure 2. Cass Winni Native Plant Communities *



* See larger map in Appendix A

Native Plant Community Types will be the basis for discussions regarding habitat characteristics, biodiversity and fire analyses.

Our interpretation of forest conditions provided in the original public land survey notes (mid to late 1800s) allows us to associate NPCs as described by the Minnesota Department of Natural Resources (Almendinger and Hanson 1998) to each landtype mapped on the Chippewa. The age class structure for an individual NPC is derived using a model developed by Dr. Lee Frelich (Frelich 1999) with the University of Minnesota. This model predicts the amount of upland forest expected to occur within each vegetation growth stage, i.e., successional stage, under the natural disturbance regime inherent within each NPC. These tools provide the background for discussing and analyzing forest vegetation and wildlife habitat conditions. They also allow us to incorporate some of the concepts embodied in discussions involving the range of natural variation (RNV), within which ecosystems maintain health and sustainability.

Seven NPCs are associated with the vegetation and wildlife habitat analysis of the Cass-Winnie Watershed. All of these communities within Cass Winnie are in the Minnesota Drift and Lake Plains Section. They are Dry Pine, Dry-Mesic Pine/Oak, Dry-Mesic Pine, Mesic Northern Hardwoods, Mesic Boreal Hardwood/Conifer, Tamarack Swamp and Wet Meadow communities. The Dry Pine, Dry-Mesic Pine, Dry-Mesic Pine/Oak NPCs are considered to be fire dependent communities. Landscape-level fires occurring on a periodic and relatively frequent basis played a major role in shaping the composition, structure, and spatial arrangement of the forested stands represented in each of these communities. In fact, 69 percent of the

watersheds are fire dependent communities. These forests were dependent upon fire to persist and regenerate. Fire ecology common to all three communities included forest maintenance and forest replacement fires.

Forest maintenance fires were primarily surface fires that occurred relatively frequently at any time during the snow free season, when fuel moisture conditions were adequate to sustain fire. Fire size could range from a few hundred acres to thousands of acres depending upon weather and landscape conditions. Time of year, intensity, and duration of fire produced varying vegetation effects. In general, forest maintenance fires were hot enough to kill thinner bark species and younger fire resistant species and occasionally scarred over-story fire resistant species. Over-story tree mortality was slight, with mortality of mostly fire sensitive individuals, small groups (<1-2 acres), and/or patches (10s of acres), which may have included fire resistant species. These fires also tended to 1) remove fire sensitive species from the under-story, 2) create seedbeds for regeneration of fire resistant species, 3) eliminate fuel accumulation before it reached levels capable of producing stand-replacing events, and 4) help maintain healthy communities.

Forest replacement fires occurred on well to excessively well-drained sandy to loamy sites in pine and pine boreal hardwood systems that had periodic maintenance fires. Maintenance fires reduced fuel buildup and restricted forest replacement fires to areas where fires had been excluded either by chance or because an area was in a protected setting. Therefore size tended to be smaller (100s of acres) and patchy due to non-uniform distribution of fuels. These high intensity replacement fires (crown and/or surface) regenerated forested stands by killing a majority of the over-story on tens to hundreds of acres. These fires also tended to prepare a seedbed for regeneration while eliminating some of the woody competition. Factors that influenced fire behavior included: weather, stand structure and composition, fuels, soil and fuel moisture, topographic position, and context relative to lakes and wetlands. Changes in the percent of tree mortality reflected changes in fire behavior across the landscape.

The chart below indicates the percentage and acreage of each community type within the Forest boundary and the acreage of the community type within the Cass Winnie Watersheds.

Table 5. Community Type and Acreage (all ownerships)

Community Type	Forest Percent	Forest Acreage	Acreage within Cass Winnie	Percent of the Watersheds
Dry Pine	2	20,000	11,573	6
Dry Mesic Pine	19	198,116	5,642	3
Dry Mesic Pine/Oak	21	340,000	114,469	60
Mesic Northern Hardwoods	11	118,440	3,326	2
Mesic Boreal Hardwood/Conifer	21	150,318	18,523	10
Wet Meadow	3	37,768	939	<1
Tamarack Swamp	19	200,781	35,156	19

Descriptions of each of six community types are included below. Descriptions include both historic and current condition as well as a description of ecologic processes, a description of a mature community including canopy and under-story vegetation. The wet meadow community is not described.

Dry Pine Native Plant Community-The *Dry Pine* soils generally are sandy and somewhat excessively to excessively well drained. The flat to gently undulating topography and sandy geologic materials influence fire intensity and extent. Frequent stand replacement fires favor jack pine and jack and red pine forests. The *Dry Pine* community is most closely associated with Landtype 5 as identified in the ecological classification system for the Chippewa National Forest. Vernal pools or small (<1/4acre) seasonally flooded wetlands occur at a ratio of 6 pools per square mile. Although this community type represents a small portion of the watershed acreage, Cass/Winni is the major area within the Forest proclamation boundary where this community type occurs.

Historic vegetation in the Dry Pine Native Plant Community-The public land surveyors described the *Dry Pine* NPC as primarily forested with a few references to *Jack Pine Barons*. Jack pine (54%) and red pine (18%) were used frequently as bearing trees. Tamarack, aspen and white pine were common bearing trees, and paper birch, balsam fir, spruce, and red maple were rarely used. Portions were described as burned, dead, dead forest, or scattered timber. Areas of wind throw were infrequently mentioned in association with burned forest. The forest vegetation consisted of a mosaic of patches 100s to 1000s of acres in size that occurred on uniform landscapes that tended to have frequent stand replacement fires. Tamarack, aspen, and white pine tended to co-occur with each other. Aspen also occurred as forests and thickets in these fire dependent systems. Inclusional wetlands were often described as open meadows. Relatively frequent, every 5-50 years forest maintenance fires probably occurred on these droughty landscapes. Some controversy exists as to the role of maintenance fires in *Dry Pine* NPCs. Records, to reconstruct fire regimes in the form of fire scars, are rare in this NPC due to its limited acreage, frequent stand replacing fire events, and the shorter life expectancy of jack pine.

Dry Pine NPC as a mature, native forest has a mixed canopy of jack and red pine, with very few deciduous trees other than some paper birch. The relative abundance of the pines as canopy dominants involves a succession of jack pine dominance following disurbance with red pine replacing the jack pine at about 80 years. Historically, we believe that this succession rarely proceeded beyond 70-100 years, thus the typical canopy was a mixture of jack pine and slightly taller red pines, with only scattered white pine (Almendinger and Hanson 1998).

Shrubs, such as beaked hazelnut, prairie willow, American hazelnut, juneberries, wild rose, bush honeysuckle, chokecherry, and poison ivy are common and somewhat abundant. Lowbush blueberry, trailing arbutus, wintergreen, bearberry and red raspberry are often present. The forb layer is well-developed and includes bracken fern, a variety of flowering plants, sedges, and grasses (Almendinger and Hanson 1998).

Current vegetation in the Dry Pine Native Plant Community-Summaries of current vegetation from Forest Inventory Assessment (FIA) data and from compartment and stand inventory information from the Chippewa NF combined data system show marked changes from historic vegetation. Because the current Forest Plan (1986) restricts clear cuts to ≤ 40 acres, the Dry Pine NPC is more fragmented and patch sizes are much smaller than historic patch sizes.
For many years, red pine was the preferred pine to plant and many acres of jack pine were replaced with red pine. Today jack pine numbers are only 1/10 of what they were in the past. Intra-stand diversity is generally less. Red pine plantations are more monotypic having less jack pine, upland tamarack, and aspen, and age class distribution has shifted to the younger age classes.

Dry-Mesic Pine Native Plant Community- Soils generally are loamy to fine textured, are often stratified, and well to moderately well drained. The *Dry-Mesic Pine* community is most closely associated with Landtype 25 as identified in the ecological classification system for the Chippewa National Forest. Landtype 20 has also been assigned to this plant community. Vernal pools or small (<1/4 acre) seasonally flooded wetlands occur at a ratio of 15 pools per square mile. The undulating to rolling topography and geologic materials influence soil drainage patterns and fire intensity and extent. Vernal pools within LT 25 were identified as keystone ecosystem components in the North Guthrie Timber Sale EA (USFS 1997, Salminen 1997). This community type is the major component of the Cass Winnie watersheds.

Historic vegetation in the Dry-Mesic Pine Native Plant Community-The public land surveyors described the *Dry-Mesic Pine* NPC as primarily forested. Aspen, paper birch, white pine, red pine, and tamarack were used frequently as bearing trees. Balsam fir, spruce, white cedar and red maple, were common bearing trees; and red oak, sugar maple, basswood, and elm were rarely used. Portions were described as burned, dead, or dead forest, or scattered timber. Areas of wind throw were infrequently mentioned in association with burned forest and wetland forest types. On small portions of the landscape that either by chance or because of location had a longer fire rotation, a component of late successional hardwoods (e.g., sugar maple, ash, and basswood) and/or a component of balsam fir, spruce, and white cedar was present. The balsam fir, spruce, and white cedar were not distributed evenly across the Section and increased in relative abundance from southwest to northeast.

Frequent (every 25-100 years) forest maintenance surface fires were associated with well-drained loamy sites on these landscapes. The broken topography on these landscapes controlled fire intensity and extent, and consequently, created a patchy landscape. For example, where fire was intense, red pine and jack pine regeneration dominated. Where it was less intense, white pine and early successional hardwoods had an advantage. Northern hardwoods were dominant in areas lacking fire. Thus, the patchy nature of wildfire created patchy forest structure in terms of species and age class composition.

Dry-Mesic Pine NPC as a mature, native forest is multiple-storied, with a coniferous super-canopy of mostly pine and a mixed sub-canopy. Red and white pine are the typical canopy dominants. These trees tend to co-occur, but along with jack pine, occasionally occur in pure stands. The canopy composition of approximately 40% of the stands consisted entirely of pine.

White spruce and balsam fir are occasionally in the canopy with the pines, but they are usually younger trees that have filled canopy gaps. Similarly, deciduous trees, such as paper birch, red maple, red and bur oak, quaking aspen, and bigtooth aspen, which generally occupy a subcanopy position occasionally reach the pine canopy (Almendinger and Hanson 1998).

Shrubs, such as beaked hazelnut, juneberries, wild rose, bush honeysuckle, chokecherry, round-leaved dogwood, and fly honesuckle are common and moderately abundant. Lowbush blueberry is often present. The forb layer is generally well-developed and includes ferns, a variety of flowering plants, sedges, and grasses (Almendinger and Hanson, 1998).

Current vegetation in the Dry-Mesic Pine Native Plant Community-Summaries of current vegetation from Forest Inventory Assessment (FIA) data and from compartment and stand inventory information from the Chippewa NF combined data system show dramatic changes from historic vegetation. Turn of the century logging removed most of the pine. Today white pine has not returned to its former numbers for a variety of reasons. They include Forest policy with regard to favoring blister rust resistant white pine stock (only recently available) over natural regeneration or local seed source and fire suppression that favors northern hardwoods and balsam fir (shade tolerant species which also out competes pine). However, red pine has greatly increased because of the Forest's red pine planting program, dating back to the Civilian Conservation Corps era. Intra-stand diversity is generally less. Aspen stands and red pine plantations are typically monotypic and upland tamarack is absent. Again, age class distribution is skewed towards younger age classes in this NPC. The result is a great increase in younger even-aged monotypic stands of red pine or aspen and stands that are succeeding to northern hardwoods and spruce-fir within this NPC.

Dry-Mesic Pine/Oak Native Plant Community- The *Dry-Mesic Pine/Oak* Soils generally are loamy to fine textured, are often stratified, and well to moderately well drained. The undulating to steeply rolling topography and geologic materials influence soil drainage patterns and fire intensity and extent. The *Dry-Mesic Pine/Oak* NPC is most closely associated with Landtypes 6,15 and 16 as identified in the ecological classification system for the Chippewa National Forest. Vernal pools or small (<1/4 acre) seasonally flooded wetlands occur at a ratio of 12 pools per square mile. Vernal pools within LT 15 were identified as keystone ecosystem components in the North Guthrie Timber Sale EA (USFS 1997, Salminen 1997). This community type makes up a small portion of the Cass/Winnie watersheds.

Historic vegetation in the Dry-Mesic Pine/Oak Native Plant Community-The public land surveyors described this community as primarily forested. Quaking aspen, red pine, paper birch, tamarack, white pine, and jack pine were used frequently as bearing trees. Spruce and white cedar were common bearing trees, and balsam fir, red maple, red oak, and elm were rarely used. Portions were described as burned, dead, dead forest, or scattered timber. Areas of wind throw were infrequently mentioned in association with burned forest and wetland forest types. The forest vegetation consisted of a mosaic of large and small patches responding to local variations in fire frequency, intensity, and duration. Tamarack, aspen, and birch tended to co-occur with each other or with pines. Aspen also occurred as forests and thickets in these fire dependent systems. Inclusional wetlands were described as forested by tamarack or white cedar.

Relatively frequent (every 5-50 years) forest maintenance surface fires were associated with droughty sites on these landscapes. The structure of the forest and the relative abundance of species changed in response to the fire cycle. Many of the species associated with the *Dry-Mesic Pine/Oak* forest persist throughout the entire successional cycle but their relative abundance changes in response to the redevelopment of the forest canopy. Structural changes in the forest are a combination of selective mortality due to fire, insects, disease, and windthrow followed by episodes of recruitment. The shifts between hardwoods and pine were largely a consequence of the type and frequency of fires.

Dry-Mesic Pine/Oak NPC as a mature, native forest is a diverse vertically complex canopy, with a supercanopy of pine and a subcanopy of oak, aspen, and red maple. Jack, red or white pine can occur alone or in mixtures as the supercanopy dominants. These three pines occur at nearly equal frequency. The amount and distribution of pines and hardwoods in the overstory was a product of fire frequency, with shorter fire intervals favoring jack and red pine and longer intervals favoring white pine and hardwoods (Almendinger and Hanson 1998).

Shrubs, such as beaked hazelnut, juneberries, wild rose, bush honeysuckle, chokecherry, and poison ivy are common and somewhat abundant. Lowbush blueberry, blackberry, red raspberry and dewberry are often present. The forb layer is well-developed and includes ferns, a variety of flowering plants, sedges, and grasses. (Almendinger and Hanson 1998).

Current vegetation in the Dry-Mesic Pine/Oak Native Plant Community-Summaries of current vegetation from Forest Inventory Assessment (FIA) data and from compartment and stand inventory information from the Chippewa NF combined data system show great changes from historic vegetation. Fire suppression has allowed northern hardwoods and balsam fir to increase in numbers and in acreage in settings where forest maintenance fires would historically have limited their occurrence. This is largely due to their ability to out compete shade intolerant red and jack pine. Red pine has greatly increased because of the Forest's red pine planting program, dating back to the Civilian Conservation Corps era. Intra-stand diversity is generally less. Aspen stands and red pine plantations are more monotypic and jack pine, white pine, and upland tamarack are greatly reduced in numbers. Age class distribution has shifted to the younger age classes, leaving older age classes under-represented. The result is a great increase in younger even-aged monotypic stands and older stands that are slowly converting to northern hardwoods and spruce-fir within this NPC.

Mesic Northern Hardwood Native Plant Community is considered to be fire sensitive. Wind is considered the primary disturbance in the *Mesic Northern Hardwoods* NPC. Soils generally have loamy to fine textured surfaces and clay loam subsoils, and are well to moderately well drained. The undulating to gently rolling topography and geologic materials influence soil drainage patterns. The Mesic Northern Hardwood NPC is most closely associated with Landtypes 45 and 46 as identified in the ecological classification system for the Chippewa National Forest. Vernal pools or small (<1/4 acre) seasonally flooded wetlands occur at a ratio of 28 pools per square mile and are likely a keystone component integral to ecosystem function.

Historic vegetation in the Mesic Northern Hardwood Native Plant Community The public land surveyors described the *Mesic Northern Hardwood* NPC as primarily forested. Northern hardwoods and paper birch were used frequently as bearing trees. Balsam fir, aspen, and white pine were common bearing trees; and white cedar was rarely used. Areas of wind throw were infrequently mentioned. The natural vegetation was strongly dominated by sugar maple and basswood on the knolls and sideslopes. It transitions into a mixture of sugar maple, basswood, and white birch with a small component of yellow birch and northern white cedar on the level and slightly concave portions of the landscape. Early successional species are essentially absent.

The *Mesic Northern Hardwood* NPC was historically dependent upon gap-phase dynamics for its typical all-age structure and regeneration of trees. In this process, the death of individual trees or small clusters of trees provide canopy openings that are quickly filled by trees in the understory. The gaps may be formed by any number of processes that weaken or kill trees and ultimately result in windfalls of varying sizes from individual trees to tens of acres. A mature native forest has a canopy of sugar maple and basswood. Other canopy trees include paper birch, yellow birch, bur oak, red oak, and an occasional ironwood. Balsam fir, red pine, white pine, and white cedar occur in the canopy, but are never abundant. (Almendinger and Hanson, 1998).

Shrubs, such as beaked hazelnut, mountain maple, chokecherry, fly honeysuckle, leatherwood, and pagoda dogwood are common and somewhat abundant. The forb layer is floristically diverse and includes lady-fren, rattlesnake fern, large-leaved aster, wild sarsaparilla, yellow bellwort, canada mayflower, early meadow-rue, wood anemone, bluebead lily, common pyrola and mariland black snakeroot (Almendinger and Hanson, 1998).

Current vegetation in the Mesic Northern Hardwood Native Plant Community
Summaries of current vegetation from Forest Inventory Assessment (FIA) data and from compartment and stand inventory information from the Chippewa NF combined data system show great changes from historic vegetation. The practice of clear cutting has fragmented what was primarily a continuous canopy forest and skewed age class distribution towards the younger age classes. Intra-stand diversity is generally less. Northern hardwood stands are less diverse. Even though white pine, spruce/fir, white birch, and red pine were not abundant historically, currently their presence is greatly reduced within this NPC.

Mesic Boreal Hardwood/Conifer Native Plant Community disturbances resulted from fire, wind, and insects. Disturbances from spruce budworm infestation, wind, (and, or) fire, were moderately frequent. Fires generally followed mortality by spruce budworm infestations or wind throw. Balsam fir root-rot fungi and quaking aspen Hypoxylon canker and white trunk rot are often pervasive by 60-80 years, making stands susceptible to fairly large blowdown patches. Aspen, white birch, and tamarack regenerated following fire. Without fire, balsam fir, white spruce, and white cedar typically regenerated. Stand replacement fires are estimated at 70-110 year intervals in this NPC. The *Mesic Boreal Hardwood Conifer NPC* occurs on gently rolling portions of the landscape generally on topographically lower and moister positions. Soils generally are loamy to fine textured and moist to wet. It is most closely associated with Landtypes 35, 40, and 55 as identified in the ecological classification system for the Chippewa

National Forest. Vernal pools or small (<1/4acre) seasonally flooded wetlands occur at a ratio of 17 pools per square mile. Vernal pools within LT 35 were identified as keystone ecosystem components in the North Guthrie Timber Sale EA (USFS 1997, Salminen 1997).

Historic vegetation in the Mesic Boreal Hardwood/Conifer Native Plant Community was described by public land surveyors as primarily forested. Tamarack, spruce, aspen, paper birch, and balsam fir were used frequently as bearing trees. White cedar and white pine were common bearing trees; and ash, elm, red pine, jack pine, and basswood were rarely used. Areas of wind throw and of burned, dead forest, or scattered timber, were infrequently mentioned. The natural vegetation was strongly dominated by a mixed canopy of balsam fir, white spruce, white pine, tamarack, white cedar, white birch and aspen. Tamarack, white birch, and aspen regenerated after fires that prepared a seedbed and controlled competition. Although these patches of tamarack, white birch, and aspen could be as large as 1,000 acres, mixed conifer stands dominated and replaced these early successional species.

Mesic Boreal Hardwood/Conifer NPC is the "pulpbasket" of northern Minnesota forests and extensive clear-cut logging has favored aspen and white birch in these communities. This makes it difficult to characterize this NPC as a mature native forest. Older stands show the tendency to succeed to mesic hardwoods. Red maple, basswood, black ash, and bur oak are the most common later-successional trees that occur in the canopy. In the older stands sampled, the canopy has a coniferous component. Most often this is balsam fir, but white pine, white spruce, and white cedar are occasional. The typical condition is for two or three tree species to share an interrupted canopy (50-75% cover), with crowns just touching or interrupted by blowdown gaps (Almendinger and Hanson, 1998).

Shrubs, such as beaked hazelnut, mountain maple, stoloniferous juneberries, bush honeysuckle, chokecherry, downy arrow-wood, and prickly gooseberry are common and somewhat abundant. The forb layer is floristically diverse and includes lady-fren, bracken fern, large-leaved aster, wild sarsaparilla, bunchberry, canada mayflower, early meadow-rue, wood anemone, bluebead lily, common pyrola, Mariland black snakeroot, red baneberry, wild ginger, and sweet coltsfoot (Almendinger and Hanson, 1998).

Current vegetation in the Mesic Boreal Hardwood/Conifer Native Plant Community-Summaries of current vegetation from Forest Inventory Assessment (FIA) data and from compartment and stand inventory information from the Chippewa NF combined data system show great changes from historic vegetation. The practice of clear cutting has decreased average stand size, favored the aspen type, and shifted age class distribution to the younger age classes. Intra-stand diversity is generally less with a loss of white pine, spruce/fir, tamarack, white birch, northern hardwoods and red pine and a net gain in aspen.

Tamarack Swamp Forest Native Plant Community

The *Tamarack Swamp Forest NPC* occurs on 200,860 acres or 13% of the total area within the Chippewa National Forest proclamation boundary. About 18% of this community is found within the Cass-Winnie watershed. It occurs on the lowest portions of the landscape, either at or near the regional water table. Soils consist of accumulations of organic matter in the form of

peat or muck. Decomposition is slow in these saturated soils. However, the water table usually drops below the rooting zone for at least part of the growing season. The surface waters within *Tamarack Swamp Forest NPC* range from near neutral to acidic.

The *Tamarack Swamp Forest NPC* is most closely associated with Landtypes 75 and 76 as identified in the ecological classification system for the Chippewa National Forest.

Historic Vegetation within the Tamarack Swamp Forest NPC as described by public land surveyors within the Minnesota Drift and Lake Plain Section was primarily forested. Areas of windthrow were mentioned. Tamarack, white cedar, and spruce, were used frequently as bearing trees. Aspen, white birch, red pine, jack pine, balsam fir, and white pine were rarely used. The natural vegetation was strongly dominated by tamarack with white cedar on the nutrient rich shallow mucks often adjacent to uplands and black spruce or open bog on the nutrient poor peat often near the center of the peatlands.

Historic disturbance in the *Tamarack Swamp Forest NPC* was from fire, windthrow, and prolonged flooding. Windthrow was especially common because the trees are shallow rooted in very poorly drained organic soils. And the regional high water table and lack of relief make this LT particularly susceptible to flooding.

Current Vegetation in the Cass-Winnie Watershed for the *Tamarack Swamp Forest NPC* were derived from summaries of current vegetation from Forest Inventory Assessment (FIA) data and from compartment and stand inventory information from the Chippewa NF combined data system. These data show a change in the proportion of tamarack and black spruce. In the early 1900s the introduced European larch sawfly caused widespread mortality of tamarack. This resulted in a great shift to from tamarack to black spruce dominated communities. The very shade-intolerant tamarack does not compete well and requires moderate to severe disturbance for establishment.

What is the current wildland fire risk and fuels condition within the watersheds and what changes have occurred as a result of past management?

For the Cass-Winnie Watershed Area an analysis of current vegetation related to historic vegetation was completed as an overview risk assessment for wildland fire and wildland fuels management. Criteria for analysis utilized the recently implemented National Fire Plan, that divides wildland fuel into two categories, Fire Regime and Condition Class. These categories were developed on a national scale and put forward to give land managers a base line to determine Region and Forest specific standards for their own Fire Regime and Condition Classes. The Chippewa National Forest has developed a classification system that includes historic vegetation and fire history (Historic Fire Regimes for Province 212 in Northern Minnesota Shadis 6/6/2000). This system was used in developing Fire Regime and Condition Class for the Cass-Winnie document.

Fire Regime is expressed as a wildfire return interval and related fire severity. It is broken into Condition Class and categorizes current vegetative condition and it's departure from historic condition with respect to wildfire suppression activities. These two categories are then

interfaced to determine areas that are at risk to wildfire due to succeeding vegetation causing the stand to enter into a flammable condition, or stands altered by age deterioration or insect and disease infestation.

Land ownership and development was studied and will be used with vegetation analysis to facilitate the development of fuels management plans for areas within the Watershed.

Population densities vary and consist of the communities of Cass Lake and Bena, commercial businesses including resorts and outfitters, private residences, lake homes, state, county, and private timber lands, special management areas, heritage resource sites, and other unique features. The analysis area is also well roaded with state, county, township, private and Forest roads, snowmobile and bicycle trails, powerlines, railroad lines, and pipelines.

Approximately ninety percent of wildfires on the Chippewa National Forest are human caused. Access into lands and development, both residential and commercial, promote human interaction with the environment. Typically this shows a higher number of wildfire ignitions when compared with lands that are remote and undeveloped. Increased property development combined with diseased, damaged, altered, decadent, or overgrown vegetation creates an unacceptable condition that may produce undesirable effects from unwanted ignitions when wildfires occur. This is not in keeping with Forest Service Policy stated within the Chippewa National Forest Plan under Forest-wide Standards and Guidelines, 5100 Fire Management, Section IV (USDA Forest Service 1986); that calls for the protection of all land ownerships, public and private within the boundary of the Chippewa National Forest.

Fire Regime-Analysis of the Cass Winnie Watershed shows 62% or 126,036 acres of the landscape area in Fire Regime I, which is described as having a fire return interval of 5 –50 years with fires being low to moderate severity in nature. The Dry Pine and Dry Mesic Pine Oak NPC's predominate in this Fire Regime. Wildfires occurred frequently and burned on the surface of the forest floor and consumed a large percent of accumulated fuel. Fires also kept down competing brush and reduced organic matter thus exposed mineral soil creating spots for pine seeds to sprout. These stands were typically uneven aged and mosaic in nature.

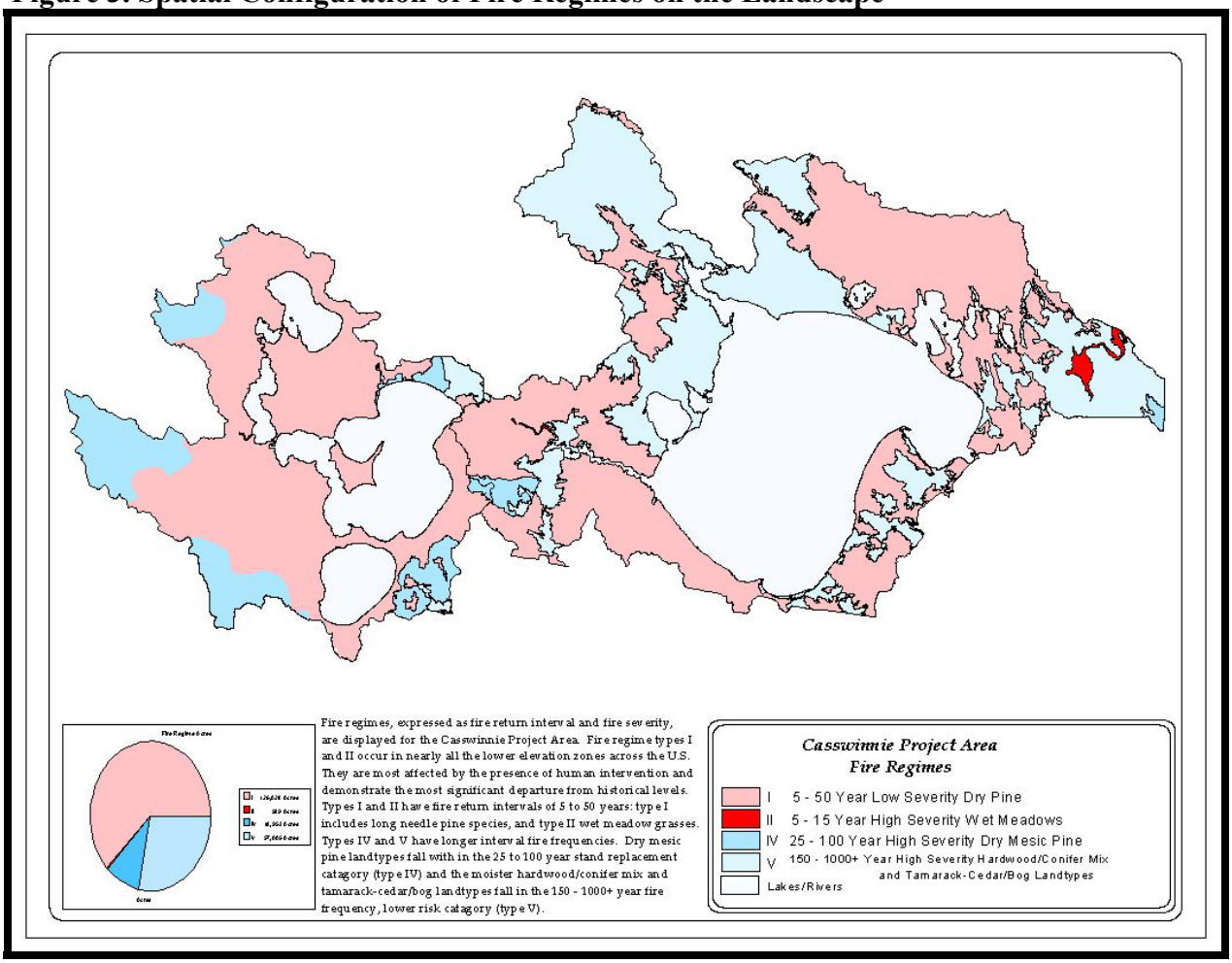
939 acres or 1% is described as Fire Regime II with high severity fires returning every 5 -15 years. The Wet Meadow NPC makes up this regime and would be typical of grasslands or pine barrens. Wildfires on these sites burned frequently enough to keep timber and brush in a young age class and poorly stocked across the landscape.

Fire Regime IV comprises 9% or 18,953 acres. This regime has a return interval of 25 to 100 year stand maintenance fires. Frequent high severity stand replacement fires within this interval killed all or mostly all overstory vegetation and regenerated the fire area. Fuel on the forest floor was mostly consumed and mineral soil was exposed providing for a good seed bed preparation for sprouting pine. The Dry Mesic Pine NPC best represents this regime.

Fire Regime V has a long fire return interval, 150 - 1000 years. Fires are stand replacement fires with high severity. Other wildfires do occur in small non-typical locations but are small in nature and ingreat at a landscape level. 28% or 57,000 acres of the Cass Winnie watershed are of

this regime. Typical Native Plant Community Types are Boreal Hardwood/ Conifer, Mesic Northern Hardwoods and Tamarack Swamp. Forests generally remain intact for many years and gradually deteriorate producing heavy accumulations of downed woody material. Insect and disease infestations occur, windstorms alter forest structure, and balsam fir, a flammable understory vegetation encroaches. Over a period of time substantial droughts occur that prepare the landscape for a large severe wildfire by drying fuels and organic soils to ignitable conditions.

Figure 3. Spatial Configuration of Fire Regimes on the Landscape *



*See larger map in Appendix A

Condition Class-Condition Classes describe a departure from normal for the ecosystem in terms of historical fire occurrence and how this departure has altered the species composition, structural stage, stand age, and canopy closure. Fire exclusion, timber harvest, introduction of non-native or non-typical plants, insect and disease, or other past management practices are the main contributors to this. The following describes the Condition Classes, gives examples of their attributes, and suggests some possible treatments to return the landscape to a more manageable level from the standpoint of wildfire management.

Table 6. Condition Class and Management Options

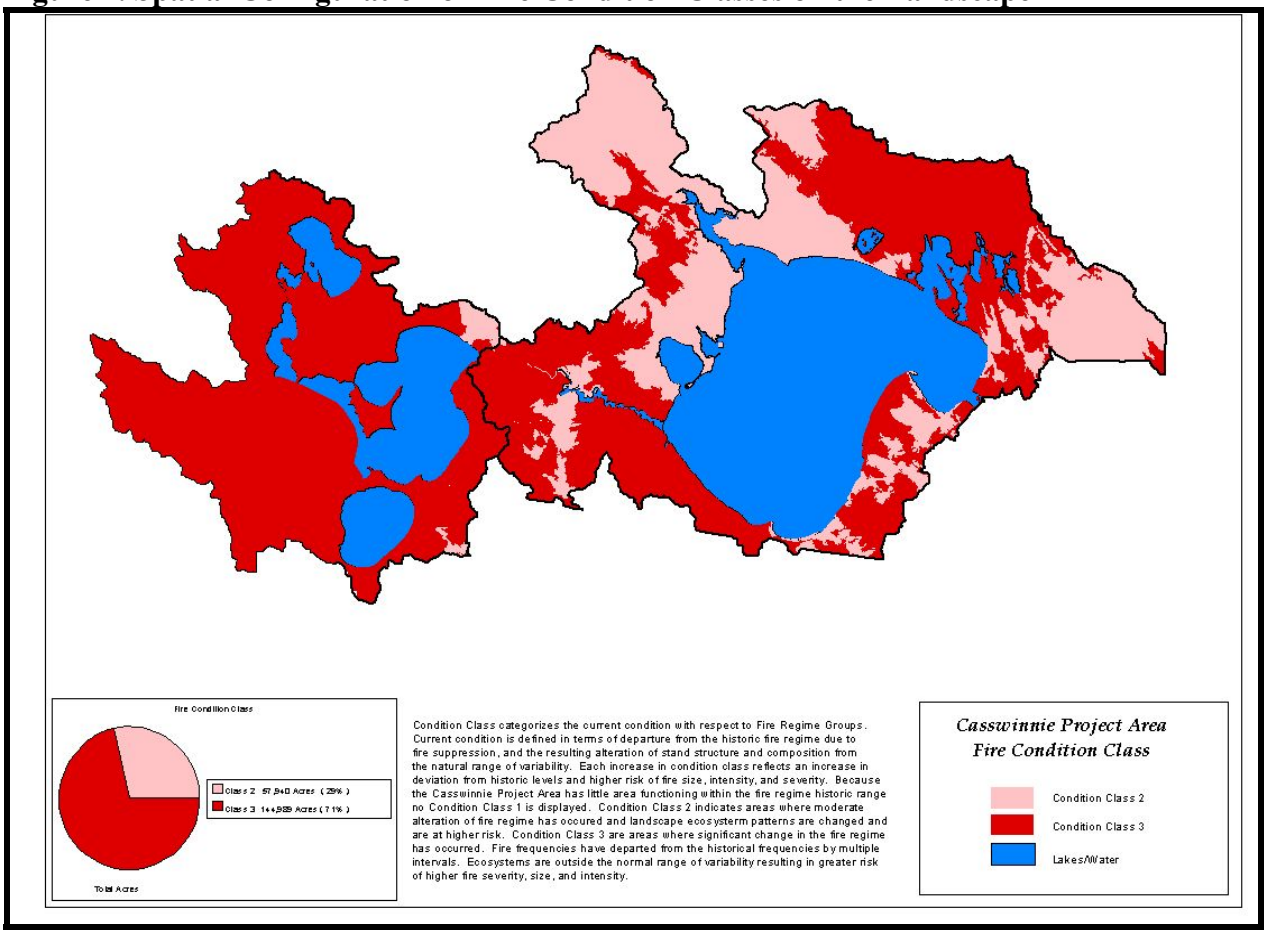
	Attributes	Example Management Options
1	* Fire Regimes are within or near a historical range. * The risk of losing key ecosystem components is low. * Fire frequencies have departed from historical frequency by no more than one return interval. * Species composition and vegetation structure are intact and is functioning within the historical range.	Maintain within the historical fire regime by fire use or prescribed fire where appropriate
2	* Fire regimes have been moderately altered from their historical range. * The risk of losing key ecosystem components has increased to moderate. * Fire frequencies show an increased or decreased departure from the historical average by one return interval with moderate changes to one or more of the following: fire size, frequency, intensity, severity or landscape patterns. * Vegetation attributes have been moderately altered from their historical range.	Moderate levels of restoration treatments may be needed such as prescribed fire, hand, or mechanical treatments to restore the historical fire regime.
3	* Fire regimes have been greatly altered from their historical range. * Risk of losing key ecosystem components is high. * Fire frequencies have departed from historical average by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. * Vegetation attributes have been greatly altered from their historical range.	High levels of restoration treatments may be needed. Mechanical or hand treatments may be needed before prescribed fire is used to restore historical fire regime.

Analysis of lands within the Cass Winnie Watershed indicated the entire area to be within Condition Classes 2 and 3.

Condition Class 2 consists of 57,941 acres or 29% of the Watershed having a moderate change to historical average and landscape ecosystems are at high risk to catastrophic wildfires.

Condition Class 3 involves 144,992 acres or 71% of the Watershed with a great change to historical average and landscape ecosystems are at great risk to wildfires of high severity, intensity and size.

Figure 4. Spatial Configuration of Fire Condition Classes on the Landscape*



*See larger map in Appendix A

Aggressive fire suppression combined with timber harvest and land development has removed the landscape from the historical range of wildfire activity and effects. Fires still occur but are suppressed before any landscape level size is reached and consequent effects can be produced. Prescribed fires have been conducted but mostly in lowland fire dependent systems and not in upland fire dependent systems. The amount of acreage burned is not proportionate to historic levels or in historic ecosystems. Most changes to vegetation occur through the implementation

of timber harvest and reforestation efforts. These changes cannot duplicate all of the effects of fire but can manage age class, structure and spatial aspects of vegetation and establishment of species. Landscape level prescribed fires 500 to 1500 acres in size would produce effects reminiscent or historical fire and reduce forest fragmentation. In addition, although restoring natural fire patterns may result a loss of commercial timber harvest opportunities it would provide for traditional gathering opportunities as well as provide habitat characteristics that would benefit some wildlife species. These prescribed fires should mimic natural disturbance and be conducted when vegetation and soil conditions are appropriate to do so. Mitigation measures would be implemented to ensure control of any management ignitions.

On the Chippewa National Forest, using wildfire as a tool to replicate landscape level disturbance, or Wildfire Use, has a limited chance for success due to the unpredictable nature of fire and the mixed land ownership of the Forest. Fires would have to be of short duration and ignitions would have to be very site specific to be successful. The political environment does not lend itself to a Wildfire Use program. Thus management activities need to be of a size that guarantees a high level of control involving planning and implementation. This size will be determined by the spatial arrangement and condition of vegetation, ownership, human made and natural barriers. As vegetation progresses in structure, Wildfire Use may be a consideration in future years. Future planning of silvicultural activites including timber harvest need to consider the spatial arrangement and fuels condition of fire dependent landscapes in order to work toward a goal of larger blocks of vegetation with similar fuel conditions.

Areas of the most concern to fire managers are the lands associated with an overlap between Fire Regimes 1 and 4 and Condition Class 3. These areas are prone to have fires that will produce devastating effects to ecosystems, cause great concern to public safety, and have high costs associated with suppression action. Communities of Cass Lake, Pennington and Bena are located within these areas. Also a large portion of rural development occurs here creating an urban interface challenge. Fuel treatments in these areas would help insure control over the intensity and severity of unwanted ignitions. The treatments themselves would have to be incremental to accomplish the objective of fuel hazard reduction and returning fire to the landscape. Prescribed fire would likely follow a mechanical or a hand treatment. This would limit fire intensity and ensure successful attainment of desired effects.

Within areas of Condition Class 2, fuel treatments would also need to occur to prohibit catastrophic effects to ecosystems and public safety. These stands may need treatments incremental in nature also to control the effects of fire. Prescribed fire may be utilized as a first treatment in specific areas that do not have heavy dead fuel accumulations but have undesirable or non-historic vegetation. Mechanical and hand treatments would be favorable methods of fuel treatment and are quite predictable.

Fire Regimes 2 and 5 are interfaced with Condition Class 2 and are at risk from high severity fire that will pose the same problems with ecosystem loss, threats to public safety, and cost. These areas need to be considered for fuel treatment in a site specific analysis. Where feasible prescribed fire, hand, or mechanical methods should be employed to attain objectives for restoration and protection.

How are current forest management practices affecting terrestrial habitat conditions and populations particularly TES species?

Changes in terrestrial habitat described in preceding sections were used to assess habitat for TES species that appear to be directly linked to community type conditions. Potential impacts on TES species are described where trends in existing conditions have departed from reference conditions.

Many TES species would appear to have no direct relationship to native plant community type, however may be limited by habitat features that tend to occur independently of landtype (e.g. proximity to water, snag occurrence, etc.). These relationships are described, particularly as they relate to trends in existing conditions.

Trends in Native Plant Community Type Vegetation- Pine-dominated communities (Dry Pine, Dry Mesic Pine, Dry Mesic Pine/Oak) account for 69% of the Cass-Winnie watershed analysis area. The trends within these forest communities from the reference period to present are relatively similar between communities. They all are generally lacking in the oldest age classes. Species composition has shifted, resulting in more red pine and less jack pine being present. Northern hardwoods have invaded as fire suppression has occurred. In addition, outside the Forest boundary land where these communities once resided have been converted to agricultural land.

A minor amount of the analysis area (10%) is comprised of the Boreal Hardwood/Conifer NPC's. These communities also lack older age classes, and the species composition has become less diverse, with an increase in aspen over other species such as white pine, spruce/fir, tamarack, birch, northern hardwoods, and red pine. The aspen in the Boreal Hardwood/Conifer community in this watershed is younger than elsewhere on the Forest, likely reflecting harvest activities.

The Tamarack Swamp NPC comprises the majority (19%) of the remainder of the watershed boundary. This community type exhibits less change due to logging than do those dominated by upland forests. The smaller diameter wood found in these forests attracted less attention from early loggers; nor is it heavily logged at present. Changes this community are primarily due to: impounding (from roads, beavers, dams or other sources) Approximately 7,000 acres of Tamarack swamp were extirpated as a result of dam construction at Lake Winniebigoshish. The European sawfly substantially reduced tamarack and resulted in species shifts towards white cedar and black spruce, depending on the site conditions; and nutrient enrichment during the dustbowl era. Age class distribution is likely within the range of natural variability, as wind is still the primary disturbance agent.

TES species status and habitat requirements
Caspian Tern *(Sterna caspia)*: Caspian terns are colony nesters that nest on islands in very large bodies of water. Islands must be well removed from the mainland, have areas of sparse or low growing vegetation, be free from disturbances from humans and other factors, and be free

from predators. Caspian terns are very sensitive to disturbance and will abandon nesting sites easily. (Casson 2000). Caspian terns are regular summer redidents on Winnie, Cass and Leech Lake however, these birds are thought to be immature, non-breeding individuals. Caspian terns nest on large lakes in Canada.

Common Tern *(Sterna hirundo):* Similar to Caspian terns, the common tern is a colony nester that nests on isolated, sparsely vegetated islands in large lakes and oceans, and also may use edges of sandy and gravelly beaches. Common terns regularly nest on Leech Lake. No nesting has been documented on Cass or Lake Winnie however these water bodies are used for foraging by migrating and non-breeding birds. Mass nesting failure can occur due to excessive disturbance, predation, weather, or competition from other species or flooding due to storms or water level changes from dams.

Piping Plover (*Charadrius melodus*): This species summers along sand beaches of the Great Lakes and across Southern Canada. Usually seen singly or in small flocks during migration in March or on nesting grounds. Nests usually occur will above the highwater mark of the upper beach or recent sand fill where no plants are growing. Nests in slight sand hollows sometimes lined with shells, bebbles or driftwood.

The largest lakes on the Forest are potential habitat for these three species. Caspian terns are regular residents on Leech Lake, however these birds are thought to be immature, non-breeding individuals. Caspian terns are thought to nest further north in the Lake Winnipeg area. Common terns regularly nest on Leech Lake. No nesting has been documented on Winnie and Cass Lakes for these species. There have been one or two sightings of the Piping Plover on Winnie and there are consistent migration records from Leech Lake.

The shorelines of Cass Lake and Lake Winnie have been substantially altered by dams. An increase in water levels transformed previously gentle shorelines formed by fluctuating water levels within a historic elevation range have now become much steeper slopes, more subject to erosion. Current management of water levels result in fewer low water periods, during which mud flats become important feeding sites for shore birds. The generally higher water levels and steeper slopes associated with shorelines likely result in less beach above the high watermark and more potential for nest flooding and failure to any shoreline-dwelling bird species.

It is possible that the Piping Plover, Caspian and Common Terns previously nested in conjunction with the shoreline of these two large lakes, but no longer find conditions suitable due to the effects of damming and water level manipulation. These conditions are not likely to change without major changes to the water levels and dam operations within the watershed.

Northern Goshawk (*Accipiter gentilis):* This forest raptor is considered a habitat generalist at range-wide spatial scales, but is more specialized in its choice of nesting and foraging habitat. The species uses deciduous, coniferous, and mixed deciduous-coniferous forests. In general, the goshawk uses mature forest conditions for nesting and foraging purposes.

The requirements of goshawks include suitable nesting, post-fledging, and foraging habitats (Reynolds et al. 1992). Mature forest conditions are important both to provide suitable nesting

structure (large trees to support large nests), and to provide adequate foraging cover (this species forages in mature forest stands with a moderately closed to closed canopy on upland landforms). Prey abundance (grouse, hare, squirrels, songbirds, etc.) may be great in shaping habitat use.

Important habitat components for foraging goshawks and the suite of prey important to them includes (Casson,2000):

* closed forest canopy conditions;
* large diameter trees;
* mature conifer forests;
* mixed species forest;
* defective live trees, primarily aspen;
* abundant dead trees, down logs, and woody debris;
* edge habitat;
* dense shrubs and forbs; and
* high stem densities.

Landscape conditions which provide stands with variable canopy conditions, from dense canopy to relatively open canopy, and which provide stands with these important habitat components are expected to supply habitat conditions for important prey species and thus for foraging goshawks.

At a landscape scale, there does not appear to be a clear relationship between community types and nest site locations. Current known goshawk nest sites are scattered across the Chippewa and found in a wide variety of native forest community types. It would appear that structural habitat aspects associated with nesting and foraging habitats are more important than landtype.

Risk factors for northern goshawk can include a variety of management activities and human uses. Timber harvest is a major factor influencing goshawk habitat conditions (Crocker-Bedford 1990, Peterson and Fichtel 1992). It can alter forest composition and structure at the stand level; and influence the patch size, composition, and spatial arrangement of stands at the landscape level. Forest management activities that simplify compositional and structural diversity within stands and across the landscape may have adverse effects on goshawk habitat and that of its prey species.

Detailed habitat definitions and analysis techniques used to evaluate project impacts on various aspects of goshawk habitat are not included in this document. These are most appropriately conducted at the project level, particularly when there are known goshawk nest sites and territories involved. However, it is useful at the watershed scale to take a broad look at suitable and potentially suitable habitat conditions across the analysis area, particularly for any insight that might be gained regarding concerns that may arise for future timber harvest opportunities. It is also useful to look for guiding principles that may help to define opportunities to enhance conditions conducive to goshawks.

Suitable habitat conditions are forested habitats that currently fulfill one or more of the goshawk's primary life requirements (nesting, post-fledging, foraging). Suitable habitat may or may not currently be occupied by goshawks. Upland forest stands in the mature or older stages of stand development may indicate suitable habitat. Within the Cass-Winnie watershed analysis

area there are 54,101 acres of suitable habitat: 45,636 acres National Forest lands, and 8,454 acres across all ownerships.

Potential, or future, habitat conditions are forested habitats which currently do not fulfill one of the goshawk's primary life requirements, but with age and the associated compositional and structural features which accompany stand development, are expected they will provide for these life requirements and become suitable habitat. These are the same upland forest communities as described above, less than 51 years of age. Within the Cass-Winnie watershed analysis area there are 39,555 acres of potential habitat: 31,229 acres National Forest lands, and 8,326 acres all other ownerships.

In the Cass-Winnie watersheds, 58% of the total upland forested acres currently constitutes suitable habitat; 42% constitutes potential habitat. Fifty-nine percent of National Forest upland forested acres constitutes suitable habitat within the watersheds. Forest-wide, 54% of the upland forested acres within the Chippewa National Forest currently constitute suitable habitat. Fifty-two percent of National Forest upland forested acres constitutes suitable habitat on a forest wide basis. These figures suggest the Cass-Winnie analysis area may provide better opportunities in general for goshawks than do a number of other areas on Chippewa National Forest, due to forest age.

There is a demonstrated high potential for goshawks to occur within the Cass-Winnie watershed analysis area, based on documented territory occurrence. Thirty-one percent (6) of the 19 known (current and historic) goshawk territories on Chippewa National Forest occur within or partly within this analysis area.

Forest stand size and continuity of canopy cover are less likely to be of concern in the Cass-Winnie analysis area than elsewhere on Chippewa National Forest. An analysis of patch size conducted in the Lake Winnibigoshish Sub-watershed Landscape Assessment (USFS 1997) indicated the Winnie watershed contains relatively well connected, relatively mature forest not typically encountered in other areas of Chippewa National Forest, due to land ownership and harvest patterns. This analysis should be conducted on the Cass Lake Watershed.

Gray Wolf:
The Chippewa National Forest is in Management Zone 4 (peripheral) of the Eastern Timber Wolf Recovery Plan. The Grey Wolf uses a broad spectrum of habitats with abundant ungulate prey. The population density objective is an average of one wolf per 50 square miles or 5 packs on the Forest. Trend data indicates a gradual long-term increase in wolves. A comprehensive survey to delineate current wolf distribution and population estimate was conducted during the winter of 1997-1998. The primary wolf range in Minnesota increased 47% since 1988-1989 and the population estimate of 2,450 wolves increased 50% during that same time period. Current population densities on the Chippewa National Forest exceed Recovery and Forest Plan objectives.

Bald Eagle: The Cass-Winnie watershed is unique with respect to its high concentration of nesting bald eagles. One-quarter of the eagle nests (74) documented in the TES database are within these watersheds. Of the 285 nests forest-wide, 44% are in Dry Mesic Pine/Oak

communities and 18% in Tamarack Swamp NPC's.

Structural characteristics important in eagle nest site location include supercanopy red and white pine and proximity to water. These factors are likely more important than landtype. Of the 74 nests within these watersheds, 65% are in Dry Mesic Pine/Oak NPC's and 24% are in Tamarack Swamp NPC's. These communities also comprise the majority of the landbase within the watersheds.

52% of the nest sites in this watershed are located proximate to Cass Lake (9 nests) and Winnie (30 nests) lakes. The proportion of privately held lake shoreline on Lake Winnie is extremely low; Cass Lake has a fair amount of shoreline in public ownership. This likely has been a major factor in influencing eagle nest placement, as privately owned lakeshore is rapidly developing as housing sites, and eagles tend to avoid areas of high human activity.

Black-throated blue warbler *(Dendroica caerulescens):* This warbler occurs in deciduous and mixed deciduous forests, and in lowland conifer forests. It appears to be more oriented towards mature northern hardwood forests in Minnesota (J. Hanowski, pers. comm.). Two conditions appear to limit this species' occurrence: forest patch size and understory development. Optimum forest patch size is about 7,413 acres. The probability of occurrence drops to 50% in patches of 2,471 acres, based on studies in fragmented forest landscapes (Robbins et. al 1989). Dense forest understories are required for this species.

No nesting has been documented for this species on the Chippewa National Forest, although singing males have been detected. These have been detected in hardwood stands, lowland conifer, and older red pine stands that have a dense understory of hazel.

The Cass-Winnie watersheds are likely to currently have a more contiguous mature forest cover than many other watersheds on Chippewa National Forest. One reason is the prevalence of pine types, which are typically managed on a longer rotation than forest types with a higher aspen component. Another reason is the consolidated nature of land ownership, with a relatively high proportion of National Forest and State lands. Parts of the Chippewa with higher proportions of private ownership tend to be more fragmented in nature than is the Cass-Winnie analysis area, as permanent changes in cover type due to farming or land development are often associated with private land ownership.

Based on the description of this species' current habitat preferences, it would appear likely that within the Cass-Winnie watershed analysis area, the predominant fire-dependent Dry Mesic Pine/Oak NPC's are more likely now to constitute potential habitat for this warbler than they would have during the reference period. This is due to fire suppression activities, which would tend to allow hardwoods to develop in the mesic landtype within this community (Land type 15) and hazel to develop in drier landtypes within this community (Landtypes 5 and 6). The development of a hardwood or hazel understory would tend to favor conditions for black-throated blue warblers. Patch size for these fire-dependent communities would likely have been larger during the reference period than presently, but increased fire frequency would have also tended to favor pine at the expense of hardwoods, and likely less hazel in the understory, as well.

The Tamarack Swamp NPC also comprises a great (19%) portion of the Cass-Winnie analysis area. The Forest-wide trends in this community have included an increase in stand age over reference conditions, and a general loss in tamarack as fire suppression has favored more shade-tolerant species. Patch size in conifer swamps has likely declined somewhat since the reference period, but still tends to be relatively large.

Spruce Grouse *(Dendragapus canadensis)*: This is a species of mature coniferous forests, including jack pine, black spruce, and tamarack (Jaakko Poyry 1992). Structural habitat characteristics are important to provide cover requirements. This bird requires trees with live branches extending to ground level. It also requires a short-needled conifer tree component as a major part of the diet. If jack pine and fir stands are used, it is at a stage prior to self-pruning (The Nature Conservency 2000), which would likely occur at about age 30-40 years (K. Matson, pers. comm..).
Native plant community types that historically have had high ecological potential to support spruce grouse, and which occur in the Cass-Winnie watershed, include Boreal Hardwood-Conifer and Tamarack Swamp. The Dry Pine Community, Dry Mesic Pine and Dry Mesic Pine/ Oak communities would also have had some potential due to short-needled conifer components (Cable 2000).

Some land management practices have tended to reduce the current potential for spruce grouse habitat in these communities, particularly those practices which systematically favor hardwoods over conifers. Clear-cut harvest in mixed pine/hardwood stands tends to favor those hardwood species which spread by suckering (e.g., aspen) or can maintain themselves through stump sprouting, generally at the expense of the conifers. Clear-cut harvest in mixed balsam fir/aspen stands may also tend to decrease the balsam component of these stands as aspen responds with vigorous suckering, and short rotation cycles can preclude the development of the fir. Loss of jack pine in the fire-dependent communities render these areas less conducive to spruce grouse, as long-needled conifers do not serve grouse dietary needs.

Fire suppression has resulted in a substantial decline in tamarack, particularly evident in the Tamarack Swamp NPC, as more shade-tolerant trees prevail. Conversely, extensive fire control across the Chippewa National Forest has resulted in increases in balsam fir components on several community types that historically would have burned on a frequent basis.

Connecticut Warbler *(Oporonis agilis):* This species' habitat varies through its range from wet coniferous bogs to well-drained deciduous woodlands (Dunn and Garrett 1997). The Connecticut warbler generally inhabits cold, damp black spruce and tamarack bogs, and prefers areas with scattered trees and grassy openings. At the extremes of the breeding range, it inhabits well-drained ridges or poplar and aspen woods (Degraff et. al 1991). The apparent breeding habitat in Minnesota is mature black spruce-tamarack bogs and jack pine barrens with a thick shrub understory (Jaakko Poyry 1992). Since there are not jack pine barrens on the Chippewa National Forest, it is presumed the primary habitat here is mature black spruce-tamarack bogs.

The Connecticut warbler shows an increasing population trend in the Great Lakes basin and

overall; its habitat is wide-spread and generally unthreatened. However, the species may have been considerably more numerous in the 19th Century. There are no clear reasons for a decline, as both the breeding and presumed wintering habitats have remained relatively intact. The species is common nowhere (Dunn and Garrett 1997). There is some speculation that historical range reductions in Minnesota are due to loss of suitable nesting habitat in the more southerly portions of this species' range (Jaakko Poyry 1992).

Within the Cass-Winnie watershed analysis area, the Tamarack Swamp NPC constitutes potential habitat for the Connecticut warbler. Fourteen percent (35,156 acres) of the watershed is comprised of this community, however, most of this is not in National Forest ownership. Current Tamarack Swamp forest communities are older than reference conditions, likely increasing habitat availability for the Connecticut warbler. Swamp conifer communities are the subject of relatively little current timber harvest activities on National Forest lands (Cable 2000a).

Black-backed Woodpecker *(Picoides arcticus):* This is a species of the northern coniferous forests. It uses habitats including tamarack/spruce bogs, mature white cedar, recently burned conifer stands, and upland spruce, balsam, and pine. This species exhibits irregular population irruptions related to disturbances such as fire, disease, and insect (e.g., spruce budworm). The bird feeds on wood-boring insect larvae in dead/dying conifer trees; also nests in conifer trees (cavity dependent). Management practices that decrease habitat include fire suppression and control of insect and disease outbreaks. (Jaakko Poyry 1992)

Suitable habitat includes mature conifer, including mixed deciduous-coniferous stands. Optimal habitat includes decadent conifer and insect-killed conifer stands. Wind events likely provide habitat opportunities for the short-term.

Multiple articles document the relationship between black-backed woodpeckers and large fires. Black-backed woodpeckers are capable of nesting immediately following fires. Typically a species that is rare throughout its range, the black-backed can increase markedly and rapidly following fire. It occupies an extremely specialized foraging niche, and may exploit outbreaks of wood-boring beetles in dying (not dead) conifers for only 2 - 3 years following large-scale fire. (Murphy and Lenhausen 1998). These authors speculate that black-backed woodpeckers may be particularly vulnerable to local and regional extirpation due to fire suppression and programs of intensive salvage logging post-fire, or salvage logging followed by fire that is sometimes used to regenerate some species.

In terms of native plant communities with highest ecological potential to support black-backed woodpecker within Cass-Winnie watershed, the irruptive biology of this species suggests it is adapted to stand replacement disturbance events. Historically, Dry Pine and Dry Mesic Pine/Oak communities were prone to frequent 5-50 year forest maintenance fires. The structure of the forest and relative abundance of species changed in response to the fire cycle. The Cass-Winnie watershed supports the majority of these fire-dependent communities. Other communities within Cass-Winnie watershed that could likely also have supported black-backed woodpeckers, due to their conifer components, are the Dry Mesic Pine and Boreal Hardwood Conifer.

Villard and Schieck (1996) suggest this species may be sensitive to forest management practices which alter the frequency or extent of disturbance events (e.g., fires, windfalls, or spruce budworm outbreaks) which leave sizeable patches of standing dying trees. Thompson et al. (1999) had concerns about rotation lengths, as that can define the potential for development of essential habitat characteristics. Goggans (1989) stated the species may be susceptible to local extirpation due to timber harvest and conversion of mature and overmature forest stands to young, vigorous stands with low densities of dead or decayed trees.

The black-backed woodpecker depends on large-scale death of trees for the necessary wood-boring beetle larvae on which it feeds. Although a forest managed primarily for young, healthy stands may support some limited numbers of black-backed woodpeckers, irruptions are not going to occur. Land management history of the Chippewa National Forest reflects a general tendency to truncate forest age by harvesting stands before or as they "break up", salvage logging those stands that do experience stand-scale mortality (through insects or wind), and effective fire control policies. These are all practices that would tend to preclude irruptions of black-backed woodpeckers.

A comparison of the condition of the fire-dependent forest communities currently present in Cass-Winnie watershed vs. those of the reference period reveals that forest communities are now mostly younger, and tend to have less jack pine. Likely these changes have resulted in far fewer opportunities for black-backed woodpeckers to exist in the watershed.

A Forest-wide age class distribution analysis of potentially suitable black-backed woodpecker habitat was recently conducted (Cable 2000b). This analysis revealed a predominantly younger age structure in most forest types, with the exception of short-rotation conifers (jack pine and fir-aspen-paper birch). Therefore, the most potentially suitable forest types do not occur in high proportions in age classes at or beyond normal rotation. Forest-wide, about 15% of the potentially suitable forest types are at or beyond normal rotation lengths. At this stage they are just entering into the stage at which habitat conditions most suitable for black-backed woodpeckers can develop. This suggests that the short-rotation conifers, with their high proportion of mature stands, may fill an important habitat requirement for black-backed woodpeckers, and should receive particular consideration in project planning. This also suggests the importance of providing for the retention of existing and future conifer snags throughout our harvest units.

Recent analysis (Cable 2000b) revealed a pattern of timber harvest across the landscape that reflects a tendency for clumping activities. Project sets frequently involve silvicultural prescriptions in multiple stands of proximate compartments (particularly in the upland pine types), in order to facilitate logging operations. This can result in simultaneous regeneration harvest and thinnings of potentially suitable habitat over relatively large areas. If these activities are not designed with the habitat requirements of black-backed woodpecker in mind, they can systematically reduce substantial amounts of potential habitat through removal of most dead and dying conifers, which would affect both present and future habitat.

This analysis effort also revealed an area of particular concern within the Cass-Winnie watershed area (Cable 2000b). This area is the Pine Flats project area. The concentrated nature of harvest

activities in this area was of concern for the black-backed woodpecker because 28% of the available potentially suitable habitat (jack pine) was being harvested. Special note was made that any new harvest plans considered for the Pine Flats area would require the careful consideration of this species.

Canada Lynx (*Lynx canadensis*): Canada lynx is a secretive species of cat inhabiting forests within northern portions of North America. The U.S. Fish and Wildlife Service (USFWS) listed the lynx as a federally threatened species in the contiguous United States in March, 2000 (USDI 2000). The primary threats to this species leading to this determination were human alteration of forests, low numbers as a result of overexploitation, expansion of the range of competitors (bobcats, coyotes), and elevated levels of human access into lynx habitat. Within the Great Lakes geographic region, the USFWS (1998) considers the lynx to have been historically resident within Michigan, Wisconsin, and Minnesota. Based on recent anecdotal information, the USFWS also concludes that a resident population possibly exists in Minnesota. The Minnesota Department of Natural Resources reports that the present lynx numbers in Minnesota are extremely low to non-existent, with only 1-2 reports (some anecdotal) per year (Bill Berg, personal communication).

Habitat needs and limiting factors: The *Canada Lynx Conservation Assessment and Strategy* (LCAS) was published by Ruediger et. al. (January 2000). This document was prepared by a 15-member Lynx Biology Team, and was based upon the information contained in *Ecology and Conservation of Lynx in the United States* by Ruggiero et al. (October 1999). Ruggiero et al. (1999) and Ruediger et al. (2000) summarized the ecology and habitat needs of lynx. In the United States, lynx inhabit conifer and conifer-hardwood habitats that support their primary prey, snowshoe hares. More specifically, lynx inhabit these habitats where snow accumulation and condition may limit travel of competing species providing the lynx with a competitive advantage in pursuit of prey. The lynx's proportionally long legs, snowshoe-like footpads, and great leaping ability make the lynx well suited for capturing prey in snowbound regions. According to the LCAS, lynx habitat in the Great Lakes geographical area is embedded within the ecotone between boreal and mixed deciduous forests, and occurs within boreal, coniferous, and mixed coniferous/deciduous vegetation types dominated by pine, balsam fir, black and white spruce, northern white cedar, tamarack, aspen, paper birch, conifer bogs and shrub swamps. Forest conditions providing foraging or denning opportunities in a spatial arrangement accommodating to lynx movements are the primary habitat components within its home range.

Risk Factors affecting Lynx in the Great Lakes area: The following landscape-scale factors were identified in the LCAS. The forest that resulted from the early logging and wildfires replaced most of the mature and old growth conifer and mixed conifer-hardwood forests with early successional mixtures of aspen, birch, mixed hardwoods, spruce and fir. Much of the timber management that followed has emphasized pulpwood production by maintaining much of the early successional aspen, and converting mixed stands with pine plantations. Most mixed northern hardwood forests have been managed toward sawtimber production.

These timber management practices also resulted in conditions that favored lynx competitors such as coyote and/or bobcats. It has probably reduced denning habitat, while increasing habitat

for lynx prey in some areas.

Loss of habitat due to conversion to agriculture has occurred across great areas within historical lynx range in northern Wisconsin, central Minnesota, and upper Michigan. Portions of this area remain in a non-forested condition. More recently, human encroachment in the form of summer homes and cabins has occurred in this region. In Cass Winnie, portions of the watersheds outside the Forest boundary are experiencing rapid growth. Forests are being converted for home sites. Within and outside the forest boundary, year-round homes and second home development along lakeshores is occurring on any remaining private holdings.

Major disturbance events created diverse, early successional forests that provided habitats preferred by snowshoe hare, and thus important foraging areas for lynx. The less intense, more frequent ground fires were an important factor in maintaining the conifer understory component throughout much of this area. The great decline of fire as a large-scale disturbance agent may have reduced habitat quality and quantity for lynx in some portions of this geographic area, as compared with historical conditions. The composition and spatial distribution of early successional habitats and the composition and structure of the mature forests of today are considerably different from those formed by the disturbances that occurred prior to European settlement (Agee 2000).

Due to relatively high road and highway densities, mortality due to vehicle collisions may be an important risk factor within the Great Lakes area and also within Cass Winnie.

On the Chippewa, the amount of potential lynx foraging habitat, i.e. snowshoe hare and red squirrel habitat, has been steady to increasing over the past 2-3 decades due primarily to relatively large amounts of mature lowland conifer types and early successional forests predominantly in the aspen forest type. The amount of cone producing species also remains relatively stable. Denning habitat forestwide remains relatively constant due in large part to the amount of mature conifer, both upland and lowland types. The miles of over-the-snow trails throughout the Forest has greatly increased over the past 2-3 decades, although recently this activity has begun to stabilize. Annual snow depth records along with the average number of thaw and freeze days suggest this area is questionable in its ability to give lynx a competitive advantage over bobcats and coyotes in the winter.

LAU's and Land Type/Community Type Relationships: According to the LCAS, lynx analysis units (LAUs) are intended to provide the fundamental or smallest scale with which to begin evaluation and monitoring the effects of management actions on lynx habitat. The LCAS further outlines the manner in which the effects of a project on National Forest System lands must be analyzed. The conservation measures supplied by the LCAS apply to LAU's. The Chippewa National Forest has developed a preliminary map of LAUs covering those portions of the CNF which have some potential for supporting lynx.

Detailed LAU-based analysis techniques used to evaluate project impacts on various aspects of lynx habitat are not included in this document, but are available elsewhere. These are most appropriately conducted at the project level. However, it is useful at the watershed scale to take a broad look at lynx habitat conditions across the analysis area, particularly for any insight that

might be gained regarding concerns that may arise for future activities.

The Cass-Winnie analysis area transects 7 different LAU's (known as LAU numbers 6, 10, 11, 12, 15, 16, 22). Most of the analysis area is included within an LAU, although the area north of Cass Lake is not, due to the high amount of private ownership. The area west of Cass Lake, outside the CNF boundary but inside the watershed boundary, is also not included within any LAU because it does not encompass National Forest lands.

LAU's are loosely based on landtypes/community types. Landtypes (LT's)/Community Types vary in their suitability as lynx habitat. The CNF biologists generally characterize the relationship between landtype and lynx habitat suitability as shown in the following table.

Table 7.Landtype/Community Type -Lynx Habitat Suitability Relationships

Landtype	Community Type	*Habitat Suitability
5 Jack Pine	Dry Pine	2
6 Red Pine	Dry Mesic Pine/Oak	2
15 Mixed Pine-Hardwoods	Dry Mesic Pine/Oak	2
20 Great Lakes Pine Forest	Dry Mesic Pine	2
25 White Pine-Hardwoods	Dry Mesic Pine	4
35 Boreal Hardwoods-Conifer	Mesic Boreal Hardwood/Conifer	4
40 Spruce-Fir	Mesic Boreal Hardwood/Conifer	4
45 Maple-Basswood	Mesic Northern Hardwoods	0
46 Northern Hardwood Forest	Mesic Northern Hardwoods	3
55 Northern Hardwood-Conifer	Mesic Boreal Hardwood/Conifer	4
70 Wet Meadow	Wet Meadow	0
75 Conifer Swamp	Tamarack Swamp	4

* Habitat suitability classes:
0 = unsuitable
1 = unsuitable-marginal
2 = marginal
3 = marginal-suitable
4 = suitable

In general, spruce and lowland conifer types rate high for habitat suitability; pure hardwoods are not considered to constitute habitat, and upland pine types constitute marginal habitat. Within the Cass-Winnie analysis area, the pine-dominated communities (LT's 5, 6, 15, 20, 25), with the exception of LT 25, generally are considered marginal lynx habitat. These areas contain red squirrels (an alternate source of prey), but are less suitable for snowshoe hare (the favored prey species). Pine-dominated communities are prevalent within the Cass-Winnie analysis area, suggesting that much of this area constitutes marginal lynx habitat**.**

Boreal Hardwood-Conifer communities and Tamarack Swamp communities constitute the most suitable lynx habitat in the Cass-Winnie analysis area. The Boreal Hardwood-Conifer LT has generally become less suitable as lynx habitat compared to the reference period due to shifts in

species composition, favoring aspen over spruce/fir and tamarack.

The Tamarack Swamp NPC serves as important refugia for snowshoe hare. Habitat suitability of this community for snowshoe hare and Canada lynx is likely relatively similar between current conditions and the reference period.

Wet Meadow NPC-associated Species: Three species are strongly associated with the Wet Meadow community: yellow rail, Nelson's sharp-tailed sparrow, and LeConte's sparrow. There is a limited amount of this NPC in the Cass-Winnie watershed: less than 1% of the watershed.

Sensitive Plants: In general, the assumption remains that providing for community type conditions that occur within the range of natural variability and are shaped by the natural disturbance agents under which these communities evolved will generally provide opportunities in which the various components of the associated plant communities can occur. Known locations of sensitive plants within the major communities including Dry Pine, Dry Mesic Pine/Oak and Tamarack NPC's (LT's 5, 6, 15, 75) represented in the Cass-Winnie analysis area were reviewed to evaluate sensitive plant-community type relationships. A number of sensitive plant species, some at multiple locations, currently are known in these communities (I. Shackleford, pers. communication).

Because community types represent landscape-scale conditions, and plants may be responding to site-level conditions not indicative of the community, there is not always a good correlation with existing plant locations. From this perspective, the coarse-filter approach that maintains community type conditions may not adequately provide for existing site-specific sensitive plant needs.

For example, because of changes in the fire cycle and creation of pine plantations, in LT 15(a mixed pine Boreal Hardwoods forest) within the Dry Mesic Pine/Oak community, we currently do not understand which rare plants may naturally favor this community. Seven species are known at 33 sites within the landtype. These are *Botrychium lanceolatum, B. minganense, B. mormo, B. oneidense, B. pallidum, B. simplex,* and *Taxus canadensis.* A majority of these sites are likely within maple-basswood habitat that has replaced the native mixed pine and boreal habitats.

Landtype 6 in the Dry Mesic Pine/Oak community contains a few sensitive plant populations. Two species (*Botrychium rugulosum, B. pallidum*) may occur in moist, mossy spots within red pine habitat. None of the listed sensitive plant species prefer jack pine habitat (LT 5 Jack Pine Forest) although the species that occur in landtype 6 may also occur in this Forest.

Eleven species may occur in Landtype 75 in the Tamarack Swamp community. These are *Calypso bulbosa, Cypripedium arietinum, Dryopteris goldiana, Gymnocarpium robertianum, Listera auriculata, Malaxis brachypoda, M. paludosa, Plantanthera clavellata, Polemonium occidentale, Taxus canadensis,* and *Torreyochloa pallida.*

How are current forest, lake, and stream management practices affecting aquatic habitat conditions and populations?

Effects of roads on aquatic habitats and communities-Roads affect aquatic communities via several different pathways including: 1) sedimentation through crossing erosion and road construction (Baxter et al. 1999), 2) obstructions to fish and invertebrate movement (Warren and Pardew 1998, Toepfer et al. 1999), and 3) alterations to flow regimes (Poff et al. 1997). Specifically, when riparian areas are disturbed during road building, large amounts of sediment can be introduced into streams. In addition, because Forest Service roads most often consist of natural or gravel surfaces, gullies are more likely to form during runoff events channeling sediments directly into streams. Fine sediments derived from roads reduce or degrade spawning habitat by filling interstitial spaces in course substrates required by lithophilous (i.e. fish that spawn on course substrates) spawning fishes for egg incubation (Berkman and Rabeni 1987). These interstitial spaces also provide habitat for invertebrates that many fish feed upon (reviewed by Watters 1996).

Roads can affect aquatic communities by restricting the movement of fish and invertebrates. In particular, undersized culverts can often act as impassable barriers to fish by restricting the natural width of stream channels, thereby greatly increasing flow velocity through them (Warren and Pardew 1998).

Finally, roads can affect flow regimes by increasing flashy and scouring stream flows produced by high densities of hardened road surfaces in a drainage basin which may result in mortality to both fishes and invertebrates (Resh et al. 1988). Together, sedimentation and scouring pose great threats to sedentary invertebrates such as mussels because their gills can become clogged by fine sediments (Box and Mossa 1999), or scouring flows can dislodge mussels (Waller et al. 1999), both of which often result in mortality.

Below we analyze how sedimentation from roads may be affecting aquatic communities within the Cass-Winnie watersheds. We analyze the effects of roads on fish and invertebrate passage in a later section (see "Biodiversity" sub-topic "Effects of barriers to aquatic communities").

Within the Cass-Winnie watersheds, there are approximately 118 miles of streams, 812 miles of paved or unpaved roads, and 92 road crossings, or one road crossing for every 1.28 miles of stream. Unfortunately, relatively few road crossings within the Cass-Winnie watershed have been evaluated. Of road crossings that may effect fish populations within the Cass-Winnie watershed, 8 are outside of the Cass Winnie Watershed in the Third or Turtle River watersheds. Only 24 of the road crossings in Cass Winnie have been evaluated thus far. Erosion was evident at 17 (71%) of 24 crossings evaluated (Table 8). Most crossings where erosion is occurring are concentrated near the Third River Flowage, Cut Foot Sioux, or along Kitchi Creek. All of these areas are identified by the MNDNR as important fish habitat for game fish spawning.

Table 8. Extent of erosion at crossings*

Erosion Extent	Extreme Erosion	Moderate Erosion	Minor Erosion	No Erosion	Number Evaluated	Total
Number of crossings	2	10	5	7	24	92

*A map of these locations can be found in Appendix A

Fish species most susceptible to erosion/sedimentation were determined using assigned tolerance values as well as trophic and reproductive information from various published references for all species present in the Cass-Winnie watersheds (Karr et al. 1986; Berkman and Rabeni 1987; Lyons 1992; Barbour et al. 1999). Lithophilous spawning fishes, or species rated as "intolerant" to degradation, such as carnivorous sight-feeders, herbivores, and some insectivores were considered sensitive to fine sedimentation. Twenty-two out of 57 (39%) fish species found within the watershed were determined to be sensitive to unnatural levels of fine sediments (Table 9). Walleye (*Stizostedion vitreum)* and muskellunge (*Esox masquinongy)*, both economically important species, and pugnose shiner (*Notropis anogenus)* and greater redhorse (*Moxostoma valenciennesi)*, Region 9 Forester Sensitive (RFS) species, were among those considered sensitive to sedimentation. Foraging efficiency of muskellunge and pugnose shiner is reduced in turbid waters, while the sedimentation of spawning habitats threatens walleye and greater redhorse populations. Seven species of mussels are also present in the Cass-Winnie watershed including the creek heelsplitter (*Lasmigona compressa)* and blacksandshell (*Ligumia recta)*, both of which are classified as RFS species. All mussel species present within the Cass-Winnie watersheds are considered sensitive to sedimentation.

Effects of barriers on aquatic communities-Obstructions in streams and rivers in watersheds impacted by humans often include dams, impoundments, water-control structures, road crossings (Warren and Pardew 1998; Toepfer et al. 1999), and beaver impoundments (Smith and Peterson 1988). Examples of the negative impacts of damming and impoundment of rivers on riverine organisms are exhaustive in the scientific literature (see Kanehl et al. 1997 for review). Interconnected, diverse habitats between and among lakes and streams are required for spawning, rearing, and dispersal (Lonzarich et al. 1998) for both fishes (Gorman and Karr 1978) and invertebrates such as freshwater mussels (Bogan 1993, Vaughn and Taylor 1999). Freshwater mussels may be particularly sensitive because they often require a narrow range of obligate fish host species for dispersal. Therefore, the fragmentation of rivers and streams threatens availability and quality of aquatic habitats, and thus species diversity.

Fishes present in the Cass-Winnie watershed that may be affected by barriers include walleye, yellow perch *Perca flavescens*, suckers and redhorses (Family: Catostomidae), and whitefishes (*Coregonus* spp.) Non-migratory fishes such as northern pike and muskellunge (*Esox* spp.), darters (*Etheostoma* or *Percina* spp.), minnows (Family: Cyprinidae), and sunfish and bass (Family: Centrarchidae), may not be considered migratory, but may require seasonal movements to access different habitats. For example, both walleyes (Paragamian 1989) and greater redhorse (Cooke and Bunt In press) have been found to move up to 15 and 34 km between seasonal

habitats. Many effected fishes are not only important in maintaining biodiversity, but are also economically and culturally important.

Several examples of barriers exist within the Cass-Winnie watershed including road crossings, artificial dams and impoundments, and beaver dams. The purpose of this analysis was to evaluate the extent to which all types of barriers may influence the biodiversity of fishes and mussels and their habitats within the watershed. Specific objectives were to: 1) quantify the number and type of barriers present, and 2) using GIS data, estimate the amount of steam habitat lost or altered due to barriers and identify the species potentially affected. Streams beyond the Cass-Winnie watershed are essential to migratory resident fishes for spawning and dispersal, so the scope of this analysis included portions of the Turtle and Third River watersheds in addition to the Cass-Winnie watershed.

Dams and Impoundments- Dams in or adjacent to the Cass-Winnie watershed include Knutson dam at the outlet of Cass Lake, Ottertail Powerdam upstream of Wolf Lake, and Winnie Dam at the outlet of Lake Winnibigoshish (see "Core Topic: Hydrology"). During the construction of these dams, no components for fish passage were installed except for Amik. Some fish passage may occur through Knutson Dam during low flows. In addition, impoundments such as the Sugar Lake, Morph Meadow, Pigeon River, Pigeon Dam and Ojibwe are currently in place to provide wildlife habitat. There are 10 of these impoundments within the two watersheds. It was determined more than 28 miles of stream habitat have been altered or impounded by these structures alone (Table 9). Two impoundments, Grass and Cub, are not directly connected to perennial stream channels. Three of the impoundments Amik and Pigeon impoundments have been recently inspected. Both Amik and Pigeon River impoundment were not functioning properly. Amik's outlet was plugged and the embankment on Pigeon River had a great seep that was discharging approximately 25 gallons per minute. This was probably caused by beaver activity. The impoundment was drawn down 1 foot to relieve stress on the compromised embankment. No management was evident at Pigeon Dam impoundment immediately downstream of Pigeon River.

Table 9. Potential stream habitat isolated from source populations by barriers to movement that may affect populations within the Cass-Winnie watershed.

River/Stream	Habitat Lost	Reason for loss	Species affected	Affected Population
Pigeon River & Pigeon Dam Impoundments	13.05 miles	Impoundment/beaver dam	Spawning fishes/mussels	Winnibigoshish
Third River	Unknown (annual beaver dam removal program in operation)	Beaver dams	Walleyes, catostomids, other river spawners, mussels	Winnibigoshish
First River-Two Mile Impoundment	4.85 miles	Impoundment/ Channelization	Walleyes, other river spawners	Little Cutfoot Sioux, Winnibigoshish
Castle Creek	5.24 miles	Beaver dam at road crossing	Northern pike, catostomids	Winnibigoshish
Kitchi Creek	13.02 miles	Multiple beaver dams	Walleye, northern pike, other river spawners, mussels	Cass/Kitchi Lakes
Ojibwe, East Pike Bay & Moss Impoundments	1 mile	Impoundment	Northern pike, others?	Pike Bay
Morph Meadow Impoundments	2.4 miles	Impoundment	Northern pike, others?	Winnibigoshish
Sugar Lake & Amik Impoundments	0.8 miles	Impoundment	Northern pike, others?	Winnibigoshish
Mississippi River	6 miles upstream of Ottertail, and many miles downstream of Winnie Dam	Hydropower or flood control dams	Spawning fishes, mussels	Wolf, Andrusia, Cass Lakes, Mississippi River, Winnie
Sucker Creek, Island Lake Creek, Raven Ck., other Un-named streams	2 miles	Impassable road crossings	Northern pike, walleyes, stream fishes, other river spawning fishes	Little Cut Foot Sioux, Cass Lake, Winnibigoshish
Total Stream habitat impacted/lost > 49 miles (not including Third R. or Miss. River downstream of Winnie Dam)				

Road or Trail Crossings- Of 92 crossings potentially affecting aquatic communities in or near the Cass-Winnie Watershed, only 24 have been evaluated. Eleven crossings (40 %) were found to obstruct fish passage (Table 10). Additionally, using data available from the National Forest Service Infrastructure (NFSI) database, 36 crossings within Cass-Winnie watershed consist of corrugated metal pipes, which are more likely to limit fish passage when compared to open box culverts or bridges, fords, or natural stream reaches (Warren and Pardew 1998). At least 2 miles of stream habitat are isolated due to crossings blocked within the watershed (Table 9).

Table 10. Results of stream crossing surveys for fish passage, and crossing types identified from the National Forest Service Infrastructure database.

Fish Passage	Obstructed	Not obstructed	Evaluated	Unknown	Total Cass-Winnie
	11	13	24	68	92
Crossing Type	Corrugated metal pipe	Timber/ Bridge			
	36	11	46	46	92

Beaver Dams-Although the distribution of beaver dams is temporally variable, using GIS data it was determined that 5.25 miles of stream habitat are impounded by beaver dams in the Cass-Winnie watershed, and an additional 13 miles of stream habitat distributed throughout Kitchi Creek in the Turtle River watershed are inaccessible for spawning of Cass Lake resident fishes (Table **9**). Although beaver dams are present on the Third River, an important spawning area for Lake Winnibigoshish walleyes and other fishes, it was difficult to determine where or how many beaver dams occur in the river based on available data. In addition, dikes and culverts associated with road crossings may encourage beaver activity, as they were present at 13 of 24 (52 %) road crossings surveyed. Beaver are native to this area and are keystone components of watershed ecosystems (Power et al. 1996). However, forest management practices have increased the production of aspen, beavers' preferred forage, throughout the CNF, and beaver (and hence beaver dams) are likely more abundant today than they were prior to European settlement.

Effects of flow alterations by dams on aquatic communities-Dams in the Cass-Winnie watershed have greatly modified the flow regime and habitat of rivers and streams (see "Core Topic: Hydrology"), probably resulting in changes in fish habitat and thus, fish communities. Fishes or life stages that were found to be most affected by high flow variability also present in the Cass-Winnie watershed included blacknose dace, bluegill, mimic shiner, small white suckers, pumpkinseeds, and rock bass (Bain et al. 1988). The altered flow regime produced by the operation of the Ottertail Power Dam, Knutson Dam, and Winnie Dam on the Mississippi River may have severe consequences for fluvial spawning fishes that are dependant on stream-flow cues to trigger spawning. For example, Cooke and Bunt 1999 and Jenkins et al. (1980) found high or variable flows to disrupt spawning activity of greater redhorse, and may even result in failed spawning for that year (C. Bunt , Biotactic, Inc., personal communication). Further, water level fluctuations may impact vegetated floodplain spawning habitats used by northern pike and muskellunge, possibly reducing reproductive success (Farrell 2001). Lower abundance of creek heelsplitter (*Lasmigona compressa)* and plain pocketbook (*Lampsilis cardium)* has been

observed in streams with variable flows when compared to hydrologically stable streams within a drainage, while giant floater (*Pyganodon grandis)*, the third most common species found in the watershed and second most common across the Forest, represented more variable streams (Di Maio and Corkum 1995). Although the pocketbook is common across the watershed, the creek heelsplitter is relatively rare and was absent in surveyed sites immediately downstream of 2 of the 3 dams on the Mississippi River (Winnie and Knutson dams). In addition to detrimental stream flow regimes caused by dams, habitats below them are sometimes less desirable for mussels due to streambed armoring, which results from the disruption of sediment transport (Vaughn and Taylor 1999).

Increased flows through stream channels as a result of dam operation may also act as a selective barrier to fish movement. Although some species may be able to pass areas with high flow, northern pike or muskellunge spawning movements may be particularly sensitive to higher flows due to their relatively slower sustained swimming speeds and lower endurance (Baker and Votapka 1990). Specifically, Ten Section Lake holds important spawning habitat for Pike Bay northern pike, and the channel between these two lakes provides a migration route between them. Depending on the elevation of Cass Lake and Pike Bay, which is regulated by Knutson and Ottertail dams, water may be flowing into or out of Ten Section Lake in varying magnitudes, influencing fish movement between the two (Steve Mortenson, LLBO, personal communication).

Are invasive aquatic exotic species present or in near proximity to these watersheds? Is it likely that invasive aquatic exotic species will become established within these watersheds?

Exotic invasions and probability of establishment- Exotic plant and animal invasions can have profound effects on biodiversity and ecosystem function (Lodge 1993, Drake et al. 1989). Within the Cass-Winnie watersheds several plant and animal species pose threats. Below, we briefly describe known occurrences of exotic species in these watersheds, their range and distribution, and identify habitats in this watershed that may be susceptible to their establishment. Habitat data for some terrestrial and aquatic habitats within the Cass-Winnie watersheds was not available therefore a general description of problem areas is included.

The introduction and spread of exotic plants and animals is simultaneously a biological problem and a social problem. It is a biological problem in the sense that exotic species are very competitive and opportunistic in disturbance habitats. These disturbance habitats abound on the landscape. Roads are not only disturbed areas and also provide avenues for the spread of exotic weeds. The river systems are also movers of seed as well as the animals and birds that utilize these waterways. The spread of exotic weeds and animals are social problems in the sense that human activities and needs are the primary areas that provide the disturbance habitat that the exotics are able to occupy.

The Chippewa National Forest maintains a list of exotic plant species (currently 21 species) and has established priorities for detection and management around three particularly aggressive species, Spotted Knapweed (*Centaurea maculosa*), Leafy Spurge (*Euphorbia esula*) and Purple

Loosestrife (*Lythrum salicaria*). During the summer of 2001, a roadside inventory was conducted to locate infestations of the top three species. The main highway corridors through the Forest (U. S. 2, MN 371, and MN 200 were surveyed. These roadside locations were all geographically located and mapped on the Forest Geographic Information System (GIS). Inventories of Purple Loosestrife and other aquatic exotic plant species were also added to the database, although these locations were plotted using legal descriptions and are not as accurate as the globally positioned roadside observations. There are purple loosestrife colonies located on Lake Bemidji,Cass Lake and the Mississippi River downstream of Cass. To date, of 224 locations, 176 aquatic locations (mostly purple loosestrife which were not acquired as part of the roadside study) and 48 terrestrial locations are in the Forest database. All of these are now considered active management areas and will be subject to various prevention or control strategies to eradicate the populations. Many of the populations are too large to hope for full eradication but their presence and documentation represents an excellent opportunity to evaluate various control techniques on mapped populations. It is also the nucleus for a regional database if an interagency group could be formed to establish standards for describing the sites. Expanded risk assessments on the species are needed to better focus priorities, prioritization of the weed sites based on risk to local healthy plant communities, identification of management options to focus only on achievable goals, and the grouping of known sites by natural plant community to better understand where management is possible.

Eurasian watermilfoil–this widespread submerged aquatic plant can displace native plant species and form mats of vegetation at the water's surface (Madsen et al. 1991) that can negatively affect fish and aquatic insects (Keast 1984, Lillie and Budd 1992) and impede recreation (Smith and Barko 1990). The primary mode of dispersal by Eurasian watermilfoil (*Myriophyllum spicatum*) is fragmentation (Smith and Barko 1990). Therefore, Eurasian watermilfoil can be easily fragmented and spread by boats, mechanical harvesters, and waterfowl. Although Eurasian watermilfoil has yet to be reported in any lakes in the Cass-Winnie watersheds, it has been found in lakes close in proximity (MN DNR 1999). Although Eurasian watermilfoil is not typically found in watersheds similar to the Cass-Winnie watersheds (e.g., forested watersheds; Buchan and Padilla 2000), several lakes within these watersheds could support abundant Eurasian watermilfoil populations if this species was introduced (Table 11). Specifically, lakes such as Andrusia and Little Cutfoot Sioux are moderately fertile lakes [Carlson's Trophic State Index (TSI; Carlson 1977) scores of 57 and 58 respectively]. Therefore, Eurasian watermilfoil could flourish in these lakes if it was introduced (Madsen 1999). Other lakes such as Big and Cass likely would not support abundant Eurasian watermilfoil, even if it was introduced.

Zebra mussels-Introduced into the Great Lakes during the mid 1980's, zebra mussels (*Dreissena polymorpha*) are now widespread throughout inland lakes and streams throughout the Great Lakes region. Zebra mussels can displace native mussel populations and disrupt lake food webs through their selective feeding on phytoplankton (Nalepa and Schloesser 1993). Furthermore, recent evidence suggests zebra mussels are linked to blooms of toxic bluegreen algae in oligotrophic (nutrient poor) inland lakes (O. Sarnelle, Michigan State University, Department of Fisheries and Wildlife, personal communication).

Although zebra mussels have not yet invaded Minnesota inland lakes, they are abundant in the Duluth harbor of Lake Superior and in the Mississippi R. downstream of St. Paul (MN DNR

1999). Zebra mussels can survive outside of water for up to 2 weeks, and are often spread to other waterbodies by attaching to hard surfaces on boats. Using pH and Calcium concentration (two water chemistry factors that affect zebra mussel shell construction) from lakes where zebra mussels were present and from lakes where zebra mussels were absent, Ramcharan et al. (1992) determined which lakes are susceptible to zebra mussel invasion. Accordingly, we assessed the potential for lakes within the Cass-Winnie watersheds to harbor zebra mussel populations given their introduction by inputting these water chemistry data into the model developed by Ramcharan et al. (1992). The model predicted that popular recreation lakes such as Andrusia, Cutfoot Sioux, and Lake Winnibigoshish, could support zebra mussel populations (Table 11).

Table 11. Presence/absence of suitable zebra mussel habitat and relative risk of Eurasian watermilfoil infestation where water quality data was available. na = data not available. Italics emphasize lakes that are highly susceptible both to zebra mussels and Eurasian watermilfoil.

Lake	Suitable zebra mussel habitat?*	Relative risk of Eurasian watermilfoil infestation**
Andrusia	Likely	High
Big	Na	Low
Biaswah	Unlikely	Na
Buck	Na	Low
Cass	Na	Low
Cutfoot Sioux	Likely	High
Dry Creek	Likely	Moderate
Grass	Unlikely	Na
Greeley	Unlikely	Low
Little Wolf	Na	High
Little Cutfoot Sioux	Unlikely	High
Lost	Unlikely	Moderate
Lower Pigeon	Unlikely	High
Middle Pigeon	Unlikely	High
Midge	Na	High
Pike Bay	Na	High
Sunken	Likely	Low
Upper Pigeon	Likely	High
Windigo	Likely	Moderate
Winnibigoshish	Likely	High
Wolf	Unlikely	Moderate

*Ramcharan et al. (1992) used pH and calcium concentration to predict the occurrence of zebra mussels in lakes. Lakes that were deemed "likely" were those that the model predicted the occurrence of zebra mussels.
**Madsen (1999) used Carlson's TSI to create a model that predicts the degree of dominance by Eurasian watermilfoil given its establishment.

Rusty crayfish–The rusty crayfish (*Orconectes rusticus*) is a species indigenous to Ohio, Kentucky, Michigan, southern Ontario, Indiana, and Tennessee, however, disjunct populations

have become established throughout the upper Midwest and western Ontario (Hobbs 1989). Although a comprehensive crayfish survey has not been completed, rusty crayfish have been found in several lakes throughout the Chippewa National Forest (Helgen 1990), including Cass Lake (Ekstrom 1999). Rusty crayfish can occur in varying densities (streams: 3 to 21/m^2, Charlebois and Lamberti 1996; lakes 1-15/m^2, Lodge et al. 1994) and the magnitude of their impact on aquatic ecosystems will depend on their density. Rusty crayfish affect aquatic foodwebs through multiple direct and indirect pathways. Specifically, they affect aquatic systems by: 1) reducing aquatic plant abundance and diversity (Lodge and Lorman 1987; Lodge et al. 1994), potentially affecting fish abundance and growth (Crowder and Cooper 1979), 2) competing with fish for invertebrate prey (Hepworth and Duffield 1987; Momot 1995; Charlebois and Lamberti 1996; Stelzer and Lamberti 1999), 3) increasing predation rates on benthic fishes by excluding them from cover (Rahel and Stein 1988; McNeelly et al. 1990), 4) preying upon small fishes and fish eggs (Rahel and Stein 1988; Guan and Wiles 1997), and 5) displacing native crayfishes (Olsen et al. 1991; Hill and Lodge 1999). Up to three native species of crayfish may be present in the Cass-Winnie watershed including (*Orconectes immunis)*, (*O. virili)*, and (*Cambarus diogenes)* (Helgen 1990). Although they are presently not at risk for extinction due to their large geographical ranges, they can be at risk locally given infestations of rusty crayfish.

Rusty crayfish are most often introduced to new waters by bait-bucket introductions, and although illegal in Minnesota, science classes continue to obtain live rusty crayfish from biological supply houses (J. Gunderson, Minnesota Sea Grant, personal communication). These specimens may invariably end up dumped in area waters when classes are through with them. Further, to support this notion, Capelli and Magnuson (1983) found lakes more geographically isolated from humans were less often infested with rusty crayfish in northern Wisconsin.

Given the high levels of human use and access to waterways within the Cass-Winnie watershed, the probability of further introductions of rusty crayfish into area lakes is high. Most importantly, the presence of rusty crayfish in Cass Lake, a large lake linked by water to numerous other lakes and rivers within the watershed, makes further range expansion inevitable. However, many abiotic and biotic factors influence the rate of rusty crayfish colonization (Olsen et al. 1991). Although rusty crayfish have been found to become extremely abundant on rocky substrate, they are also more successful on fine substrates than other species of crayfish (DiDonato and Lodge 1993), especially where cover such as wood or vegetation is present (Smily and Dibble 2000). Small streams are conducive to movements because of lower densities of large predatory fishes and abundance of invertebrate prey (Schlosser 1987). However, low levels of dissolved oxygen, periodic drying (Gunderson 1999), and the presence of beaver dams (W. Momot, Lakehead State University, personal communication) may limit the dispersal of rusty crayfish in streams.

The further expansion of the non-indigenous rusty crayfish throughout the Cass-Winnie watershed may have dire consequences for the aquatic ecosystem. Lacking comprehensive baseline data, it is unclear how rusty crayfish have impacted the watershed thus far, and will be difficult to quantify in the future. However, numerous socio-economic and environmental impacts can be expected to some degree across the watershed. The importance of the large lakes to the local economy and traditions of the Leech Lake Band of Ojibwe calls for further

examination of the potential for environmental damage by introduced crayfish. Specifically, the reduction of wild rice, decline of fish habitat due to decreased macrophyte abundance, and predation on fish eggs resulting in lower spawning success are all possible affects of rusty crayfish infestation in the watershed (Lodge et al. 2000).

Other exotic species found in the Great Lakes such as, spiny water flea (*Bythotrephes* sp.), Eurasian ruffe (*Gymnocephalus cernuus*), round goby (*Neogobius melanstomus*) have not been found in MN inland lakes but nevertheless require awareness to prevent their spread.

TES species status and habitat requirements-Above, we have discussed numerous factors that are affecting biodiversity in general. Later, in the Recommendations step, we outline general strategies to restore habitats, and thus improve biodiversity. A critical step in successful restoration/maintenance of habitats is monitoring species populations in areas where habitats are being manipulated. The Cass-Winnie watersheds harbor populations of several RFS species, and below, we identify the current status and habitat requirements of these species. Because RFS species are sensitive to ecosystem change, they will require monitoring when implementing actions that alter their habitats (whether positively or negatively). Few data exist regarding these species' historical status (only presence/absence), so evaluating long-term population trends is difficult.

Pugnose shiner (Notropis anogenus)-Pugnose shiners historically were collected in L. Andrusia, Big L., Cass L., Wolf L. and the Mississippi R. between Cass L. and Bemidji (Bailey 1959). A recent survey confirmed their presence in Cass L. (D. Cloutman; Bemidji State University; unpublished data). However, little information exists on their status in the Cass-Winnie watersheds. Pugnose shiners are herbivorous inhabits of shallow vegetated areas in lakes with high water clarity (Becker 1983). Increased turbidity has been found to threaten pugnose shiner populations (Trautman 1957).

Greater redhorse (Moxostoma valenciennesi)-The status of the greater redhorse in the Cass-Winnie watersheds is relatively uncertain; however, greater redhorse have been documented in the Mississippi R. and lakes along the Mississippi such as, L. Andrusia, and Cass L. They may also occur in L. Winnibigoshish (J. Albert, MN DNR Fisheries, personal communication). Greater redhorse is a migratory fish species in the sucker family (Catostomidae) that will often travel up to 10 miles between habitats (Bunt and Cooke in press). Threats include migration barriers, sedimentation, and altered flow regimes (see the above sections under "Biodiversity" for a summary of threats in the Cass-Winnie Watershed). Greater redhorse require rocky substrates and swift moving water for successful reproduction (Cooke and Bunt 1999). Frequent alterations to flow by dams throughout the spring and summer will likely negatively affect greater redhorse spawning and recruitment.

Sensitive mussel species-Recent qualitative mussel surveys (summer 2000) have been conducted on the Mississippi R. in the Cass-Winnie watersheds. Four out of seven sites on the Mississippi R. contained either, or both black sandshells (*Ligumia recta)* and creek heelsplitters (*Lasmigona compressa)*. During February 2000, a team of experts from the MN DNR, U of MN, USFS, and GLIFWC was assembled to assess the viability of populations of these three mussel species, and to discuss how the USFS can best manage watersheds to ensure their continued existence. Major

themes that emerged from this workshop were the importance of protecting riparian areas, maintaining a diversity of stream habitats (e.g., woody debris) and substrates (stable silt, sand, and/or gravel) that are conducive to diverse fish assemblages (fish act as hosts for parasitic larval mussels). Threats include migration barriers, sedimentation, and altered flow regimes, and beaver activity (see the above sections under "Biodiversity" for a summary of threats in the Cass-Winnie Watershed). However, the team recognized that beaver are natural components of the ecosystems within the Cass-Winnie watershed and should only cause concern if our timber practices (such as harvesting in riparian areas) are creating beaver habitat that promotes their overabundance. Detailed population viability analyses both for the creek heelsplitter and black sandshell in MN and WI national forests can be found summarized in Kitchell (1999). These analyses provide detailed descriptions of the aforementioned issues regarding these mussel species.

Core Topic: Hydrology

The hydrology of the Cass-Winnie watersheds has been greatly altered during the last century through various land-development activities. The most notable change occurred as a result of the Winnie dam that was constructed in 1884. The US Army Corps of Engineers constructed the dam to facilitate navigation of the Mississippi River and to promote commerce downstream. A change in historic water levels and its effect on shoreline erosion around lakes is well documented on Cass Lake, and Lake Winnibigoshish (Rossman 1992, USCOE 1990, Bemidji State College 1972). Less obvious are the effects that altered stream flows have on natural hydrologic processes. Several factors such as the placement of dams, manipulation of stream flows and lake levels, road construction and development can alter the timing and magnitude of peaks and flows (Poff et al 1997, Sparks 1992, need reference from Chris).

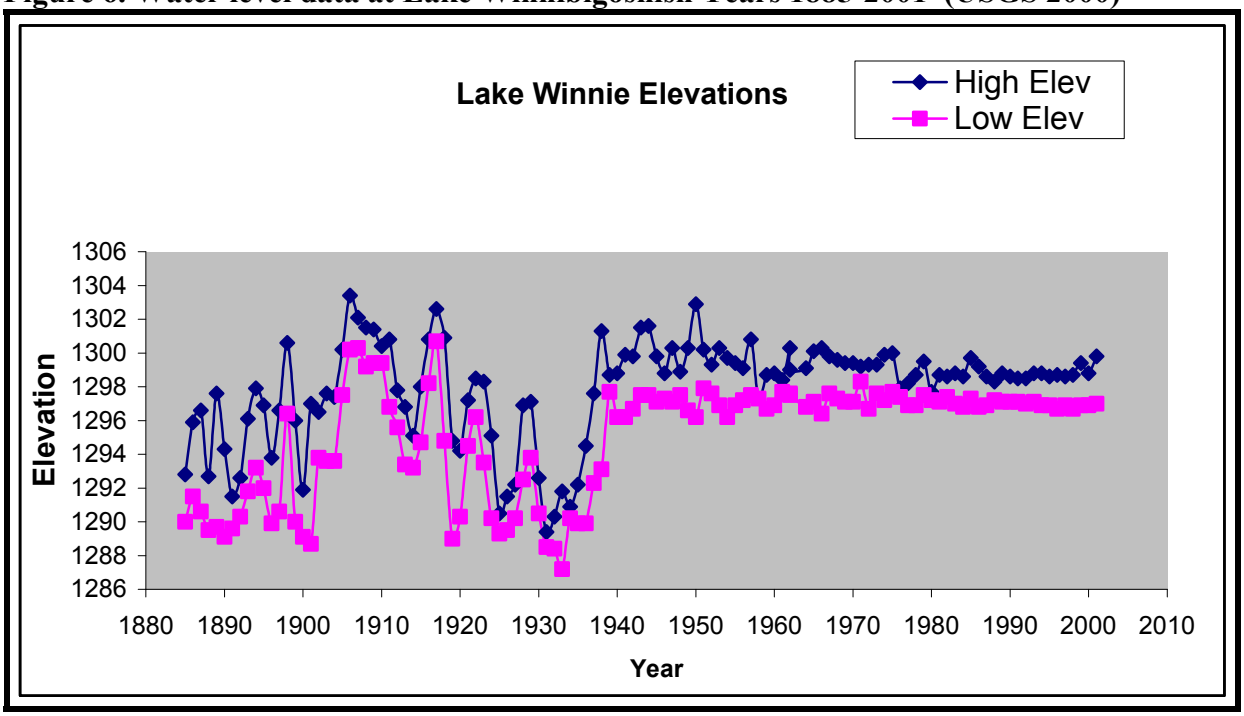
How have dams affected lake level fluctuations, stream flow, channel morphology and shoreline characteristics?

Lake level fluctuations-Winnibigoshish Dam was the first of six dams placed in the upper Mississippi River to aid in navigation as part of the Mississippi Headwaters Project (BSU 1973). This project was established and funded by Congress to provide for safe navigation between St Paul and Lake Pepin. Construction of the dam was started during the winter of 1881-1882. The dam was located approximately 170 miles downstream from Lake Itasca, the source of the Mississippi and raised the elevation of the lake approximately 9 feet. This not only altered the riparian vegetation around the lake but also changed the Mississippi River elevations and riparian areas as well. During the first fifty years of operation the dam was used to aid in navigation, and to a lesser extent, to control flooding downstream.

Figure 5. Construction of Winnie Dam 1884

During the 1930's and 1940's, demands by both resort and private owners on the reservoir resulted in several revisions of the operational regulations. During this time the most requested demand by owners was for a more stable lake level. These revisions resulted in a reduced usable storage capacity for flooding by limiting drawdown. Lake level elevations that fluctuated greatly from year to year from 1885 to 1940 began to become regulated more closely.

Figure 6. Water level data at Lake Winnibigoshish Years 1885-2001 (USGS 2000)



Knutson Dam was a rather crude dam constructed at the outlet to Cass Lake by the J. Neils Lumber Company. No date is given, it was probably constructed within a few years of establishing a sawmill on the southwest side of the lake. The dam would insure an adequate supply of logs being brought in to the saws. This dam had been described as "a brush dam" which was below the water in years of normal lake levels and acted as a wing dam that funneled the river into a narrower channel. By 1918 the J. Neils Lumber company constructed a small timber dam at this location. In 1924, with the closing of the Neils lumber mill, the dam was transferred to the Forest Service for maintenance and operation. In 1928, Representative Knutson secured an appropriation for the Forest Service to construct a new dam upstream of the original site by the Forest Service. This was completed in 1929 and the old dam was removed. The design of this structure was a stepped fixed weir structure. In 1964 the Forest Service reconstructed the dam with 6 adjustable gates. The structure that is in place does not allow operation parameters to be met. This is particularly a problem during extremely high and flashy flow conditions or when Lake Winnibigoshish elevations rise making the river stage differential less than 2 feet in the 12 mile river section between the lakes. (USACE 1959)

Figure 7. Knutson Dam, June 11, 2001

In the summer of 2001 Cass Lake's elevation was higher than in 1999 when extreme water levels caused extensive shoreline damage. The water level peaked at 1303.6 on June 11th and more shoreline damage was sustained.

Figure 8. Cass Lake Water Levels

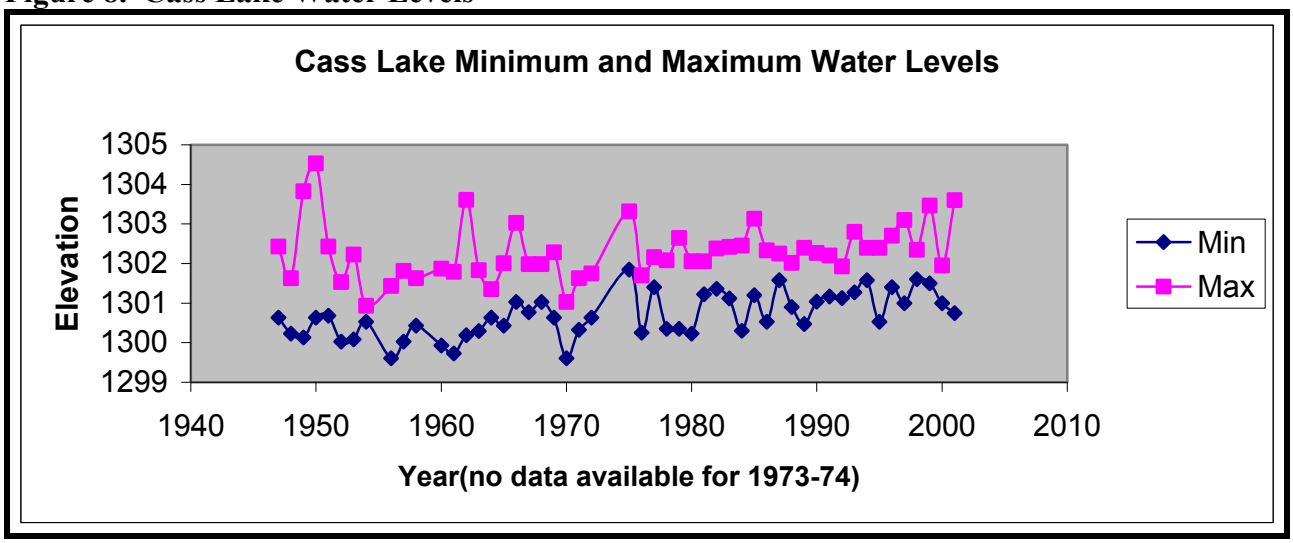
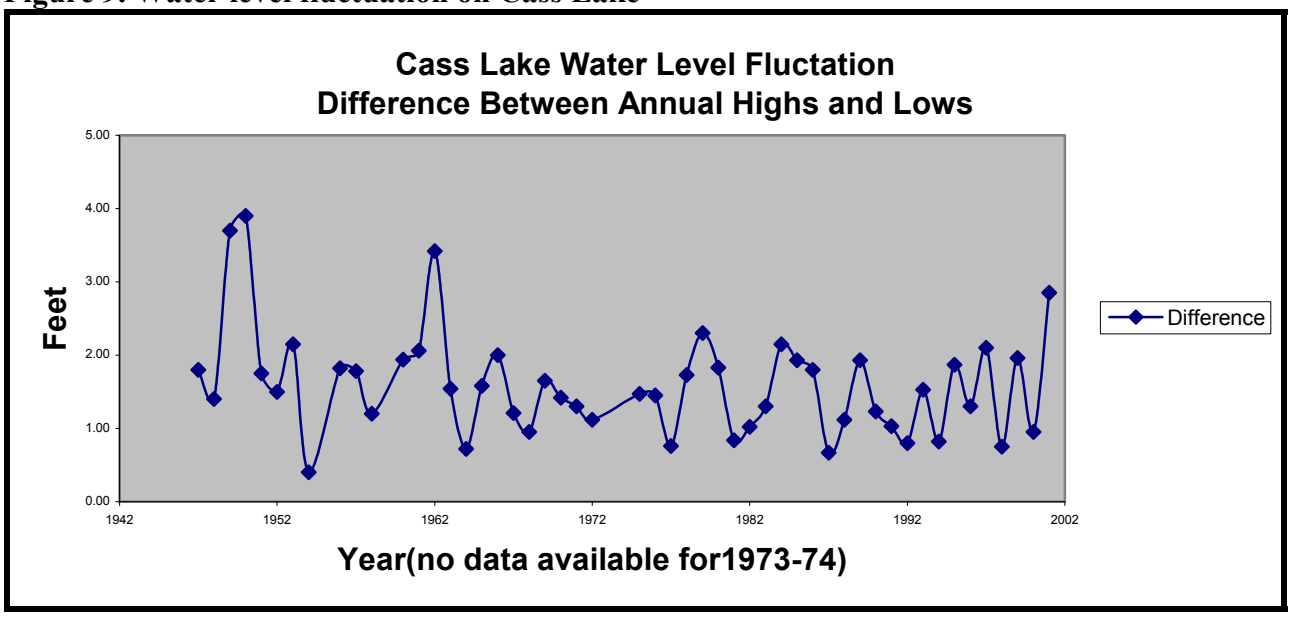


Figure 9. Water level fluctuation on Cass Lake



An analysis of annual water level fluctuations at ten-year intervals from 1947 to the present show a slight downward trend in elevation changes.

Table 12. Change in annual water surface elevations on Cass Lake

Ten Year Period	Average Elevation Change
1947- 1957	2.02 feet
1958-1968	1.66 feet
1969-1980	1.50 feet
1981-1990	1.39 feet
1991-2001	1.45 feet

Note: No data for 1973-74

Water quantity, flow and timing-Continuous flow monitoring is available for the Mississippi below Winnibigoshish Dam since the early 1900's and there is thirteen years of flow data below Ottertail Dam. No continuous flow data is available below Knutson Dam. The only data available on the main stem of the Mississippi river that is not below an artificial structure is just upstream of Lake Irving at the confluence of the Schoolcraft River and the Mississippi.

Flow data recorded at the Winnibigoshish Dam by the United States Geological Survey (USGS) shows a much greater variance of flow from 1937 to the present (See Figure 9). This is the result of striving to maintain more stable lake levels. Due to the addition of locks and dams from St. Paul and below, the Upper Mississippi Dams were no longer crucial to navigational purposes (USACOE 1990). In 1944 Congress added to the authorized project purposes the term "general public good."

Figure 10. Mean annual flow data recorded at Winnibigoshish Dam, years 1901-1993. (USGS)

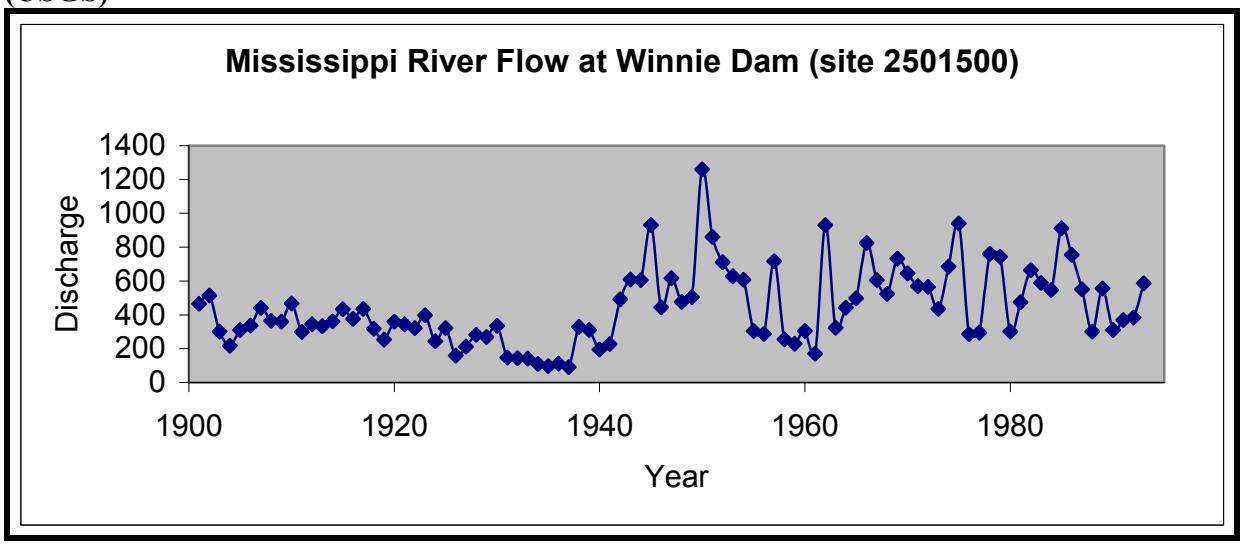


Figure 11. Mean monthly discharge from Lake Winnibigoshish

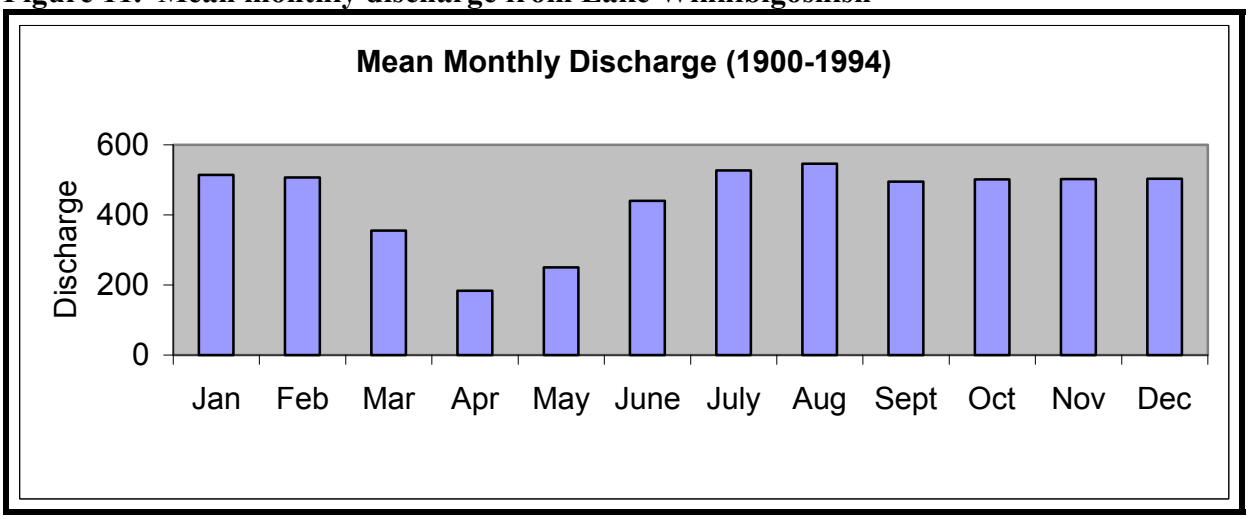


Table 13. Minimum and maximum monthly flows from Winnibigoshish

Discharge	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Min	97	24	10	9	6	6	0	50	21	50	71	91
Max	1269	1586	1172	712	1180	1981	2492	2437	1494	1231	1436	1237

The first dam on the Mississippi River, downstream of Lake Bemidji, was authorized by Congress in 1905 and completed in 1909. Andrew and Charles Warfield built the dam four miles from the outlet of Bemidji to power the need generated by at least 14 wood products plants

located in Bemidji as well as the city. During the drought between 1907 and 1910, the dam also served to regulate the level of Lake Bemidji. This enhanced timber production by making it easier to move log booms between the north and south basins of the lake and Lake Irving, allowing timber to be floated to the mills. Ottertail Power Company has owned and operated the dam since 1944. Although their original mission was power generation, power generation is less important at the present time (Given Amble, Drexler, Spiry; 1996).

Figure 12. Ottertail Dam

Figure 13. Flow data recorded on the Mississippi River below Ottertail Dam

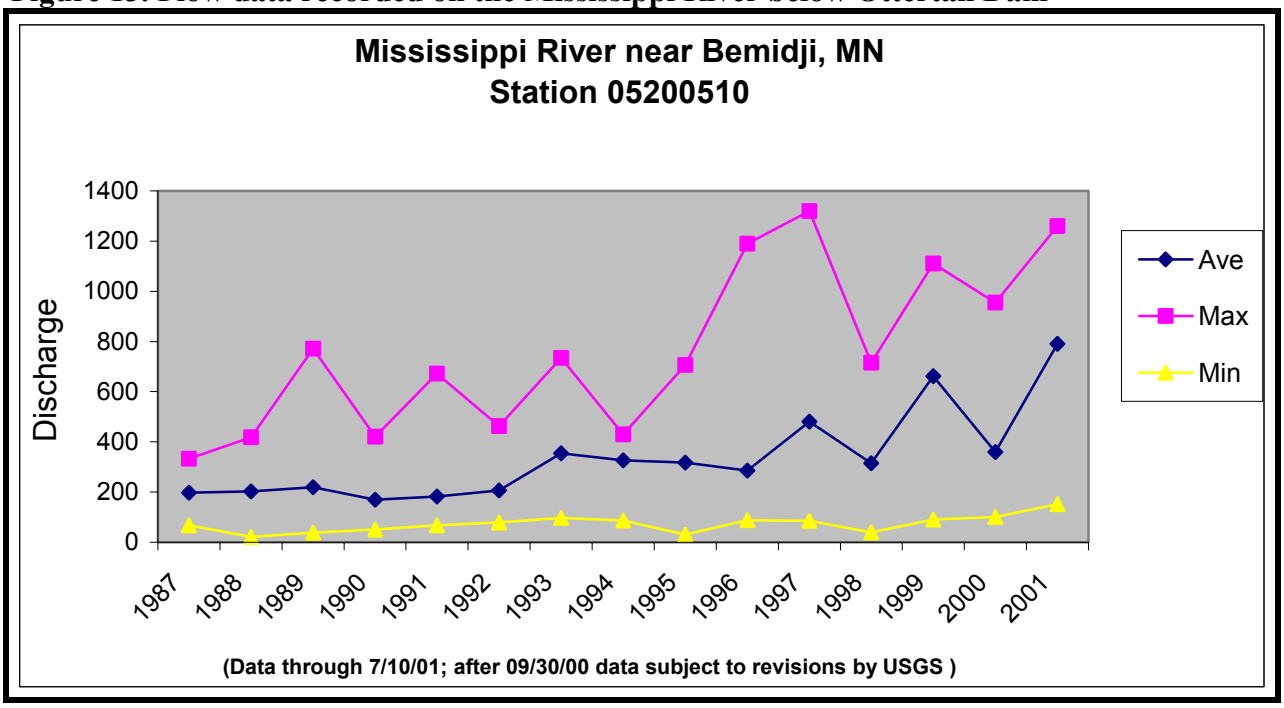


Figure 14. Mean flow on the Mississippi River below Ottertail Dam

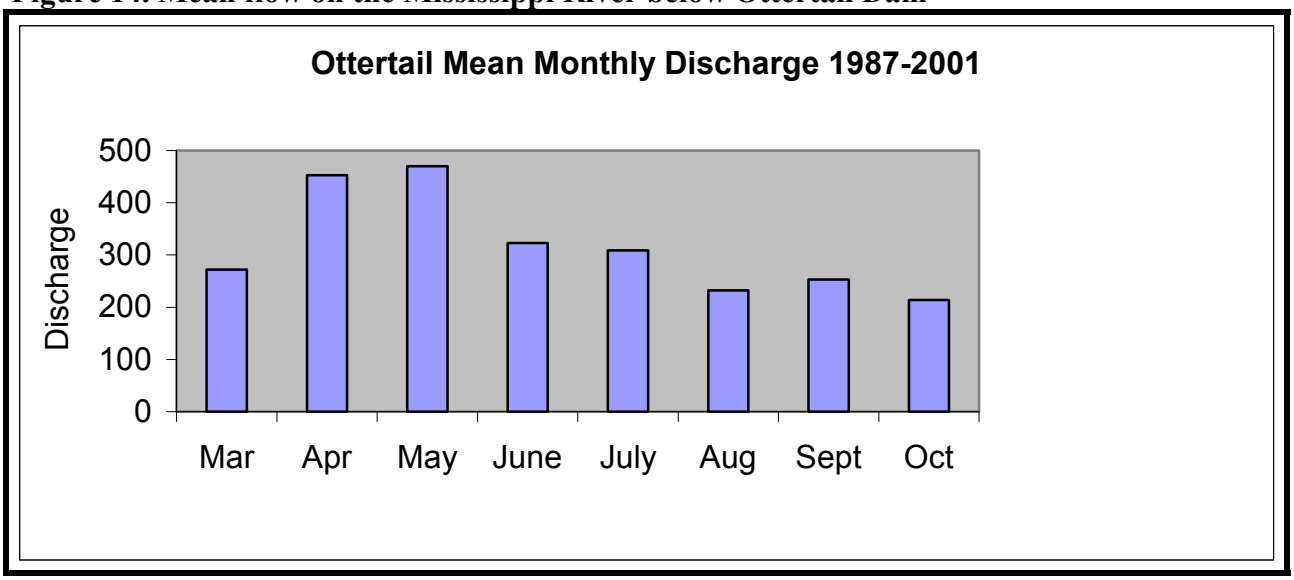


Table 14. Minimum and maximum flow –Ottertail Dam

Discharge	March	April	May	June	July	Aug	Sept	Oct
Min	117	148	181	104	62	62	62	76
Max	449	889	854	861	624	931	1134	468

Figure 15. Mississippi River flow upstream of Lake Bemidji

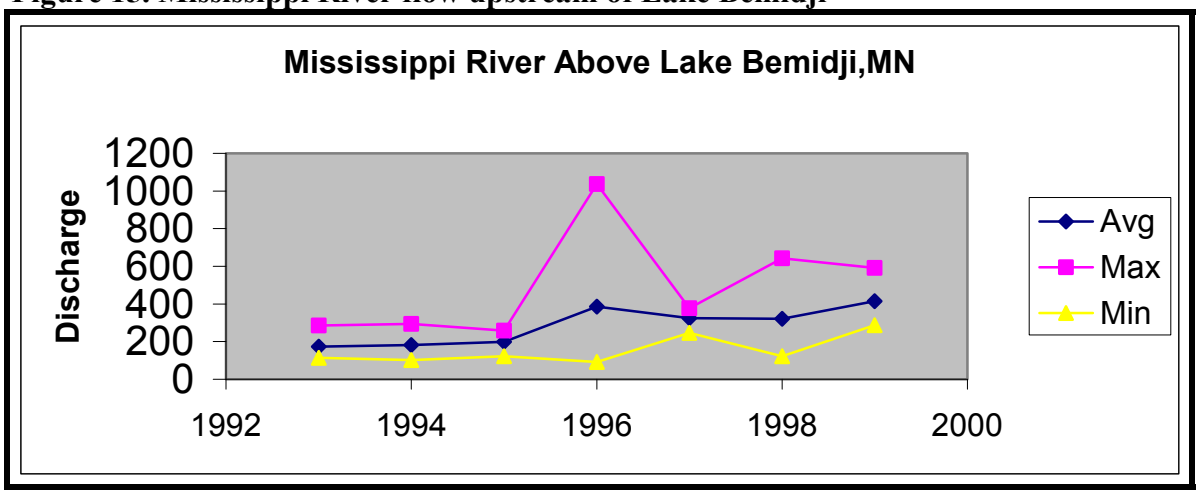


Figure 16. Mean monthly flow on the Mississisippi River above Lake Bemidji

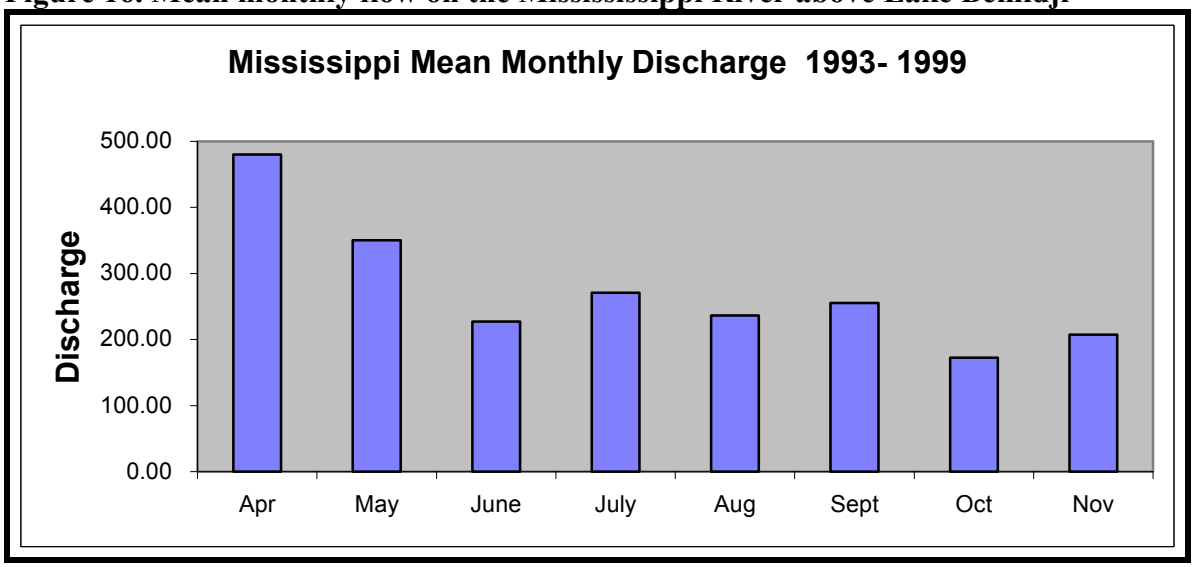


Table 15. Minimum and Maximum Monthly Flows from Mississippi River

Discharge	April	May	June	July	Aug	Sept	Oct
Min	75	62	73	95	66	74	66
Max	1198	863	608	681	509	585	384

Data presented indicates clearly that the timing of maximum mean monthly flow out of Winnie Dam is much different than that of an unregulated stream section upstream of Lake Bemidji. In the unregulated section of river, highest flows occur in April and May. Below Lake Winnibigoshish the months of April and May have the lowest flows. In turn some of the highest mean monthly flows occur in July through October when unregulated rivers are normally discharging lower volumes of water. This reversal in timing of flow has ramifications for species that are dependent on seasonal flows as triggers for life cycle processes or who are dependent on natural flow regimes and the temporal habitat it creates. On a monthly basis Ottertail operation mimics quite closely averages from the unregulated section of the Mississippi.

Monthly data does not display day-to-day variation in flow that may cause instantaneous flooding or dewatering of riverine habitats. A more detailed analysis needs to be done to assess differences between an unregulated natural condition and that created by managed river flows. Anecdotal evidence and observations below Ottertail document flow variations at times that have caused fish kills immediately below the dam as well as stranded fish and mussel species. See graph in Appendix B.

Figure 17. Extreme flow fluctuations may result in fish mortality

As of November 2001 the Corps of Engineers is proposing to study the upper Mississippi river within these watersheds to help prepare reservoir operating plans for Lake Winnibigohish as well as five other Corps managed reservoirs. The goal of this study is to provide data that could result in a comprehensive system-wide operation plan for all interconnected headwater lakes including Cass Lake. Hydrologic and habitat information will be collected and modeling will occur. The completed plan should be available in 2004.

Stream morphology-Channel morphology upstream of the three dams has changed as a result of the impoundment of Cass, Lake Winnie and Stump Lake. Although baseline habitat data were not collected prior to the construction of Ottertail Dam, based on soundings made by the Army Corps of Engineers in the late 1800's, much of the 6 mile reach of the Mississippi River which is currently impounded consisted of fairly shallow riffles (2-4 feet deep). The most dramatic change however was on the river between Cass Lake and Winnibigoshish due to the 9 foot rise in water levels after the construction of the dam. In the first 4 miles of the 12 mile stretch of the Mississippi between Cass Lake and Lake Winnibigoshish there is a well defined channel that is approximately 175 feet wide and 5 feet deep and has a slope of approximately 0.3 feet per mile. The bankfull capacity is approximately 900 cubic feet per second. In the lower 8-mile downstream section extending to Lake Winnibigoshish, the water is held at overbank stages by normal levels in the reservoir (USCOE 1959). The lower reaches of other tributaries to Lake Winnibigoshish such as the Third River, Pigeon River and First River are also held at over bank stages. Great amounts of vegetation are growing within the area above bankfull that reduce the velocity of water moving through the channel. Water flowing at the bankfull elevation has the highest velocity (more than 2-3 times the velocity occurring on the floodplain) and are better able to carry sediment. Bankfull flow is the flow that shapes the channel and occurs as the 1.5 year

event (Verry 2000) Given the low gradient of these rivers and streams, the ability to move sediment is limited under normal circumstances. Therefore, the absence of channel forming flows in these reaches has changed many habitat characteristics normally present under a natural flow pattern.

To what degree has the amount of impervious surfaces or open area changed within and upstream of the watershed?

The amount of young forest and open conditions within a sub-watershed is an important factor in stream flow and channel dynamics. Research shows that the mixture of land use can either synchronize or desynchronize snowmelt flow peaks (Verry E. 1986). Open land (cultivated/pasture/open, private/open, and transportation), recent clear cuts, and young stands up to 15 years of age all melt snow at two to three times the rate occurring in forests over 15 years of age. When too much of a stream's basin or a watershed is in a young or open condition, rapid snow melt coalesces in streams at flow rates up to three times the flow conditions of mixed land use conditions. The increased velocity increases the rate of in-channel erosion and sedimentation. The effect begins when the open and young condition exceeds 60 percent of the basin area. In watersheds where 30 percent of the land use can be considered in an "open" condition (includes such things as transportation, urban, agricultural land, permanent openings, upland brush, etc.), these conditions can easily be reached under sustained yield harvesting (2 percent per year harvest rate) on a 50-year rotation.

Historic logging-The first logging of timber within the watersheds was in 1890-1891. Provisions of the Nelson Act of 1889 allowed logging of dead and down timber. This timber had been "destroyed" by fires that swept through the area or other natural disasters. Sawmills, settlements and steamboats were built to transport and utilize millions of board feet of pine. There were mills on Cass Lake, and Lake Winnie and logs were floated down tributaries and towed across lakes to them. In June of 1902 the Morris Act replaced the Nelson Act and lumbermen had found a way to move into the reservation created for the Mississippi Bands of Indians. From November 1, 1903 to December 31, 1904 a total of 97,254,147 board feet of pine was harvested from the watersheds. The last selections of pine were sold in 1910 and harvested between 1911 and 1915. There is no doubt that during this era that the amount of young forest and open condition exceeded the threshold. The areas that did not regenerate naturally, were not replanted until the 1920's and 30's by the Civilian Conservation Corps (K.Matson, 2001).

Current condition-The scale most appropriate for analysis of open condition within a watershed is at the sixth code sub-watershed level. There are 22 sixth-code sub-watersheds within the Cass Winnie Watersheds. Five sixth code watersheds immediately upstream of Cass Lake were also analyzed. A unique Hydrologic Unit Code is assigned to each sub-watershed. This analysis utilized 1995 satellite imagery that was interpreted by the Natural Resource Research Institute.

Table 16. Open area by sixth-code sub-watershed

HUC[1]	Total Acres	% Young Open Land
050-071*	15,538	39
050-110*	15,928	63
050-113*	2,990	61

050-114*	7,468	71
050-115*	14,696	54
060-085*	14,106	43
060-086*	5,946	63
060-089*	8,855	29
060-090	36,310	19
060-101	15,338	22
060-122	13,121	12
060-175	3,159	57
060-021	3,561	14
100-022	7,773	11
100-024	106,294	8
100-025	11,000	16
100-026	5,325	24
100-034	9607	18
100-035	5,462	19
100-037	3,171	16
100-038	18,393	23
100-129	8,497	35
100-145	1,757	9
100-147	1,815	6
100-148	2,066	14
100-181	2,573	8
100-182	3,331	16

[1]The Cass Winnie Watershed identifier is 07010101. This identifier prefaces all of the HUC numbers for the 6th codes.
* Sixth code watersheds entirely or with most acreage outside the Forest boundary.

Four of the twenty-seven sub-watersheds are above the 60 percent threshold. Five have more than 30 percent open or young forests. These watersheds have a high likelihood of exceeding the threshold. Most of the sub-watersheds above the threshold are upstream of the forest boundary surrounding Bemidji. Bemidji has grown tremendously since the turn of the century. In 1900 dusty gravel streets of the town and residential areas were estimated from circa 1900 maps to cover less than one square mile. Today paved streets parking lots and sprawling residential areas cover more than 7 times that area. With more impervious surface within the watersheds water retention is diminished delivering precipitation events more quickly into tributaries and the main stem of the Mississippi.

Private lands are always subject to development and clearing and there will likely be some portions of these lands that move into the open category, though it is impossible to predict acreage.

Changes in shoreline characteristics-A comparison of historic maps of the Mississippi River and Lake Bemidji, Cass and Winnibigoshish reveal that the greatest water level change as a result of

the dams was at Lake Winnie. The shorelines of Cass and Bemidji have not undergone a great change as a result of dam construction.

Presently, the water level in Lake Winnie is approximately 9 feet above pre-dam levels. As a result, much of the lakes sandy shorelines are eroding at rapid rates. In some areas, banks have receded more than 100 feet and the lake is approximately 7,000 acres larger than it was prior to the dam (56,765 acres presently compared to the pre-dam size of 49,974). This has lead to dramatic effects on shoreline vegetation communities. Prior to the dam, vegetation communities were dominated by tamarack and northern white cedar (Figure 18). Tamarack and northern white cedar have since been extirpated by the high water levels. Presently, shoreline areas are dominated by severely eroding banks, lowland brush and open habitats (e.g., sedge meadows, cattail marshes).

Figure 18. Shoreline vegetation communities present in Lake Winnibigoshish prior to flooding by the dam.

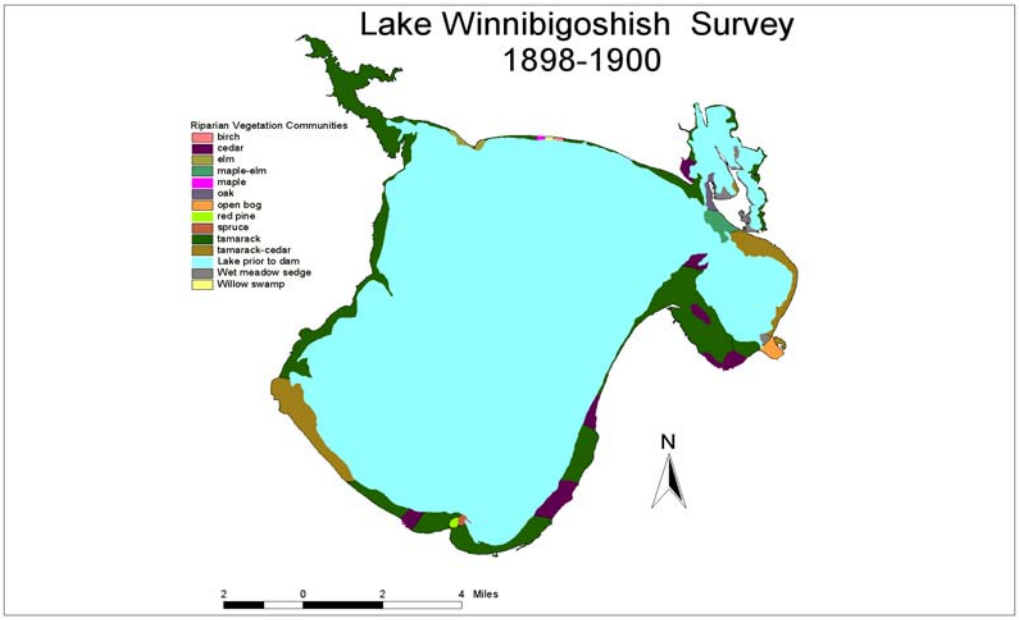


Table 17. Percent contribution of forest types within 150 feet of the present Lake Winnibigoshish shoreline.

Forest Type	% Contribution by Area
Open	66.6
Lowland Brush	9.8
Red Pine	6.0
B. Ash-Amer. Elm-R. Maple	4.1
Quaking Aspen	3.9
Paper Birch	3.0
Sugar Maple-Basswood	2.5
Burr Oak	1.3
Mixed Swamp Conifer	1.2
N. Red Oak	1.0
Balsam Fir-Aspen-P. Birch	0.2
N. White Cedar	0.2
Upland Brush	0.2

Based on the evidence that conifers were a major component of the riparian areas in the 1870's (Figure 18), it is likely that woody debris was more prevalent during this period. Given a higher historical occurrence of woody debris in the Mississippi R. than present, pools and riffles may have been more abundant.

What is the extent of Shoreline Erosion on Cass Lake and the Lake Winnibigoshish Chain of Lakes, and how have dams on Cass Lake and Lake Winnibigoshish affected shoreline erosion?

Knutson Dam on Cass Lake and the Lake Winnibigoshish dam are operated by the U.S. Forest Service and the U.S. Army Corps of Engineers primarily to provide recreation opportunities on the reservoirs. In general, the reservoir pools are lowered in the fall to provide storage capacity for normal spring run-off. However, unpredictable weather coupled with small, antiquated dams make it difficult to keep the reservoirs within the narrow operating bands. These fluctuations, in combination with storm events and easily eroded soils, have accelerated shoreline erosion.

Shoreline erosion on Cass Lake and Lake Winnibigoshish has been a problem for many years. In the 1960's, '70's and '80's, the Forest Service studied the extent of shoreline erosion on Lake Winnibigoshish and Cass Lake (Chippewa National Forest 1969, Goltz 1972, Chippewa National Forest 1988) and stabilized some of the worst erosion at developed recreation sites and leased resorts.

Lake Winnibigoshish

In 1988, an interagency task force was formed to address concerns over the rapidly accelerating shoreline erosion on Lake Winnibigoshish. The Task Force included representatives from the following agencies and organizations:

Table 18. Lake Winnie Task Force Members

Chippewa National Forest	Mississippi Headwaters Board
U.S. Army Corps of Engineers	Leech Lake Band of Ojibwe
Cass and Itasca County Soil and Water Conservation District	Private individuals – including summer home permittees, area resort owners, and sport fishing representative
Minnesota Dept. of Natural Resources	

The team evaluated issues and concerns regarding the erosion and proposed alternatives for protecting Lake Winnie and its resources. This analysis is documented in the Lake Winnie Fishery Habitat Management, Soil Stabilization, and Recreation Rehabilitation Project Environmental Assessment (Chippewa National Forest 1989). The Decision Notice and Finding of No Great Impact (DN and FONSI) for the project was signed by the Task Force partners on April 13, 1989. The selected alternative called for shoreline stabilization at 17 sites around the lake, totaling 59,300 ft. or 11.2 miles of shoreline, or 12% of the total shoreline miles. The EA also recommended rehabilitation of 20 recreation sites.

Since 1989, thirteen stabilization projects at 6 high and 1 medium priority sites have been completed by the partnership on Lake Winnibigoshish. These projects cover 29,456 ft. or 5.6 miles. The project is 50% complete (Table 19).

Table 19. Summary of active shoreline erosion and stabilization on Lake Winnibigoshish and Cut Foot Sioux Lake

Lake	Total Shoreline (mi)	Total Active Erosion (mi)	% of Shoreline Actively Eroding	Recently Stabilized (mi) within the last 10 years
Lake Winnibigoshish	66	5.62	8.6%	5.58
Cut Foot Sioux	25	0	0	.29

Cass Lake and Pike Bay

The rate of shoreline loss due to erosion on Cass Lake and Pike Bay is higher than that of Lake Winnibigoshish. In September and October 2001, an inventory of erosion on Cass Lake and Pike Bay was undertaken to determine the extent of shoreline erosion on Cass Lake and Pike Bay. Forest Service employees used a Global Positioning System to identify areas of shoreline that were either actively eroding or recently stabilized. The inventory revealed that although numerous stabilization projects have taken place over the years on public and private lands on Cass Lake, there is still active erosion. Approximately 9% of the total shoreline on Cass Lake and 11% of the total shoreline on Pike Bay are actively eroding (Table 20).

Table 20. Summary of active shoreline erosion and stabilization on Cass Lake and Pike Bay.

Lake	Total Shoreline (mi)	Total Active Erosion (mi)	% of Shoreline Eroding	Recently Stabilized (mi) within the last 5 years
Cass Lake	39	3.80	9.74%	0.76
Pike Bay	10.51	1.30	12.35%	0

The most great erosion is occurring on Federal lands (no State or County owned lands were identified as eroding). More than 2.7 miles of Federal shoreline on Cass Lake and 1.3 miles of Federal shoreline on Pike Bay are actively eroding. Over ½ mile of this erosion is occurring on shoreline that is currently under Special Use Permits for a resort and seasonal cabins.

Private landowners have been more aggressive about shoreline stabilization; however, there is still approximately 1.0 mile of shoreline in private ownership that is actively eroding (Table 21).

TABLE 21. Summary of active shoreline erosion on both Federal and private lands on Cass Lake and Pike Bay.

Lake	Undeveloped Lands with Active Erosion (mi)	Erosion on Lands Under Special Use Permit (mi)	Private Lands with Active Erosion
Cass Lake	2.46	.26	1.08
Pike Bay	1.01	.29	0

How many heritage sites are at risk as a result of shoreline erosion on the Cass Lake and Lake Winnibigoshish chain of lakes?

Dams at the outlets of Lake Winnigiboshish (completed in 1884) and Cass Lake (completed in 1928) hold surface water elevations at artificially high levels. Due to unpredictable amounts of precipitation and the inadequacy of the structures themselves, it is difficult to maintain these reservoirs within narrow operating bands. Fluctuations in pool elevation, great storm events, and sandy soils create a situation in which serious shoreline erosion continues to occur along approximately 10 miles of shoreline within these basins. In some areas heavy foot traffic down to lakeshores have worsened the erosion.

Among the resources affected by shoreline erosion are sites of past human activities including villages and campsites that are thousands of years old. As shorelines erode into the basin, the physical remains of these sites are also washed away or exposed and removed by artifact collectors. As these sites are destroyed, their cultural value or value as an aid to understanding past ways of life are also lost.

The identification and assessment of many heritage sites along these shorelines over the past 25 years allows an estimate to be made of minimum numbers of heritage sites that continue to be affected by erosion. Since most of the shoreline on the Cass Lake/Pike Bay basin and other lake basins in the watersheds has not been systematically surveyed, the exact number of sites at risk is unknown.

The only comprehensive and systematic study of heritage sites along shorelines within these watersheds was conducted by the University of Minnesota in 1976 at Lake Winnibigoshish (Johnson et al. 1977). That study documented 46 heritage sites along the shoreline of the Winnibigoshish/Cut Foot Sioux basin. Of these, 22 had such scant remains or had been so thoroughly eroded that their value and or physical integrity appeared very poor. Evidence of the remaining 24 sites had been more substantial. Of these, 7 were submerged, 5 were experiencing severe erosion, 3 had moderate erosion, 2 had slight erosion, and 2 were completely eroded. The remainder had no erosion or were stable.

Since that survey, many additional heritage sites have been identified and documented along lake shorelines within the watershed, but no other comprehensive shoreline surveys have been conducted.

The Chippewa National Forest heritage database currently lists approximately 140 verified heritage sites on all ownerships along the shores of the Winnibigoshish/Cut Foot Sioux and Cass/Pike Bay basins.

During the 2000 field season, the Chippewa National Forest and Leech Lake Heritage Sites Program conducted visual inspections of 46 previously documented sites located on National Forest system lands along the shorelines of these basins (Kluth and Kluth 2000)(CNF heritage file data). The purpose of these inspections was to document the current status of site areas relative to the risk of being damaged by shoreline erosion caused or exacerbated by the sustained periods of extremely high water levels in the reservoirs during 1999. Many of the sites that were inspected in the Winnibigoshish/Cut Foot Sioux basin were those that had been previously documented by the 1976 survey of the University of Minnesota.

The 2000 work demonstrated that shoreline erosion of some heritage sites had slowed or completely halted over the past 25 years due to vegetative growth or in some cases through artificial stabilization. Some sites that had yielded scant evidence in 1976 could not be verified in 2000 and may now be totally destroyed. Other sites were shown to have continued erosion problems caused by natural forces that in some cases is exacerbated by foot traffic associated with recreational use.

None of the sites inspected appeared to be in imminent danger of wholesale destruction due to erosion. The principal threat to these sites that continue to erode is incremental destruction through future years and decades. Nineteen sites were identified as having continued erosion problems that result in continued loss of site integrity (Table 22.) This number represents a minimum since not all of the shoreline in federal or other ownership has been completely surveyed for heritage resources. While some of the 19 would probably meet one or more of the criteria of significance established for eligibility to the National Register of Historic Places, the total number of eligible sites among this group is unknown.

Table 22. Numbers of heritage sites inventoried, assessed as potentially at risk from erosion and verified to be at risk from erosion.

Lake	HR Sites Inventoried to Date (all ownerships)	HR Sites Assessed for Risk Due to erosion (Federal only)	Minimum number of HR Sites Verified at Risk over Long-term (Federal only)
Winnigigoshish Cut Foot Sioux	100	29	12
Cass/ Pike Bay	40	18	7
Totals	140	47	19

Groundwater Resources in the Cass Winnie Watershed

What role does groundwater play in managing Lake Bemidji, Cass Lake and Winnibigoshish?

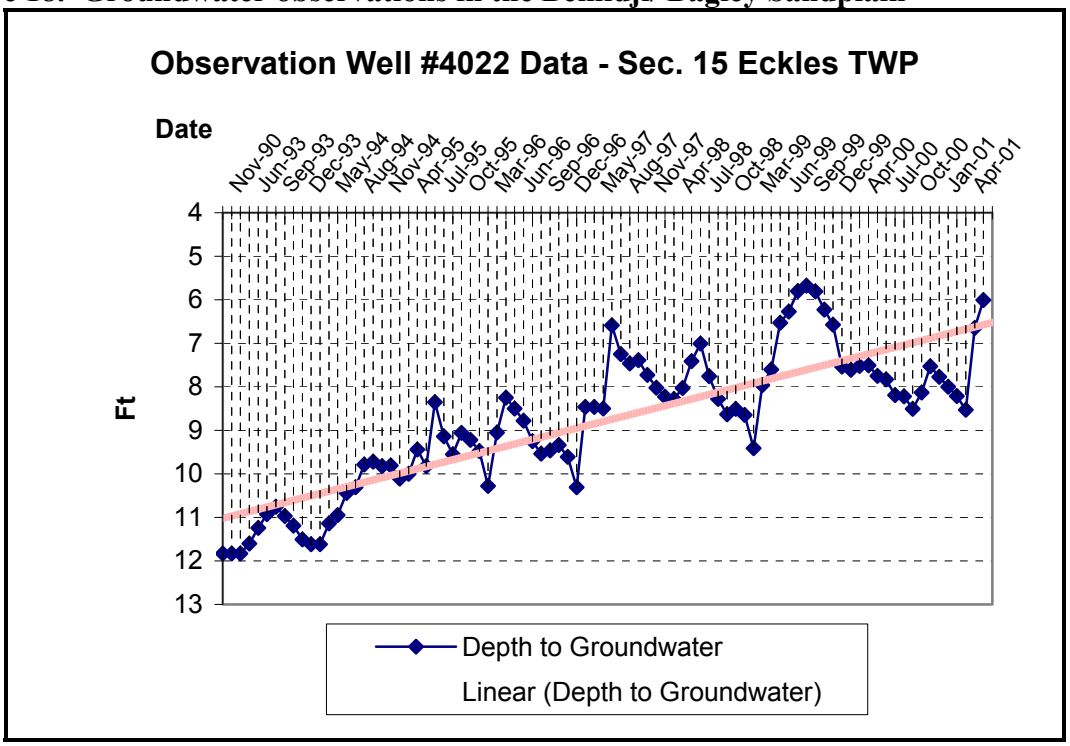
Cass Winnie watersheds contain rich groundwater resources because of thick glacial drift that is present over much of north central Minnesota. In 1991, the US Geological Survey conducted a study of an aquifer that intersects the Cass Winnie watersheds. The primary purpose of the study was to characterize ground water availability and quality in an area surrounding Bemidji and Cass Lake. (Stark, Busch and Deters, 1991)

There are two distinct aquifers underlying much of the Sand Plain within the Cass Winnie watersheds: an unconfined aquifer and an upper confined aquifer. The upper confined aquifer ranges from 0 to 60 feet in thickness and is overlain by clay or other less permeable soil material. Above this confining layer is the unconfined or surficial aquifer that ranges in thickness from 0 to 130 feet. Much of the water that is available for use and supports a base flow for the Mississippi River and its tributaries is derived from ground water within 0 to130 of the ground surface. Soil material is mainly coarse sand and gravel.

Underground watershed boundaries roughly coincide with surface watershed boundaries and much of the water within the aquifer that underlies the Cass Winnie watersheds is discharged to the Mississippi River, its tributaries and lakes. The wells within the aquifers can produce anywhere from 10 to 2,100 gallons per minute. Water from the aquifers is rich in calcium bicarbonate and is generally suitable for drinking although some local areas exceed recommended limits for drinking water.

Over the last 10 years the elevation of several groundwater wells in Beltrami County have been monitored. Below is a graph of ground water levels in one well that reflects the trends seen in most of the 53 wells that have been monitored (Figure 18). Since the wells have been monitored the trend in ground water levels have risen approximately 4.5 feet. This rise not only has affected developments that intersect the groundwater but also plays a role in water level management on lakes. As groundwater provides base flows for streams and rivers it also drives base elevations for lakes within the Sand Plain in Cass Winnie. Therefore reservoir management goals may not be possible to attain when groundwater is extremely high or depleted.

Figure 18. Groundwater observations in the Bemidji/ Bagley Sandplain



What historic agreements are still in place regarding reservoirs?
Historic agreements are still in place regarding flowage rights associated with the impoundment of Lake Winnibigoshish. The US Army Corps of Engineers retains flowage rights over lands in Cass, Beltrami, Itasca and Hubbard Counties (Table 23).

Table 23. Flood easements associated with Lake Winnibigoshish

Acquisition	Type	Net as of September 17th, 1959
County	Interest	Acreage
Beltrami	Easement Transferred	710.81 20,080.71
Cass	Easement Transferred Use Permit	30.70 19941.00 34.65
Hubbard	Fee Easement Transferred	 197.07 362.35
Itasca	Fee Easement Transferred Use Permit	 1400.65 39637.58 68.55
TOTAL		82464.07

Upon review of the maps it is evident that flowage rights were granted on many miles of shoreline on lakes upstream of Cass Lake. Most of these easements were granted on Indian lands in the late 1800's and on public domain lands in the early 1900's. Others were negotiated with private individuals on lakes outside the National Forest boundary. It is likely that current landowners are not aware of these previous agreements and improvements are constructed within these easements. See detailed maps in the project file.

Core Topic: Water Quality and Fisheries

Several lakes on the Mississippi River Chain starting with Wolf Lake through Cass Lake have been studied extensively over the last three decades. Prior to 1985 the wastewater plant located on Lake Bemidji was a great source of phosphorus, and thus may have accelerated eutrophication (i.e., lake "ageing"). In 1934 the first wastewater treatment plant was located on the Mississippi R. inlet to Lake Bemidji. In 1955 the plant was relocated to the outlet of L. Bemidji. From 1956 to 1978 effluent was pumped around the east side of L. Bemidji and discharged into the Mississippi River, approximately 700 ft downstream from the lake (Trihey 1981). During the years 1976-1978 the Minnesota Pollution Control Agency (MNPCA) conducted a study to "determine the effects of known or suspected point and non-point sources of pollution in the Upper Mississippi River Chain of Lakes including L. Bemidji" (MNPCA 1981; Halter-Glenn 1995). The information gathered from these studies led to new regulations to prevent or reduce lake eutrophication. Specifically, the City of Bemidji was ordered to relocate their wastewater treatment plant by June 1, 1978 and to provide interim phosphorus removal (Trihey 1981). The discharge plant was moved to the inlet of Lake Bemidji with an interim discharge limit of 1 ppm phosphorus (Halter-Glenn 1995). Trihey's study found improved water quality in several of the Upper Mississippi River Chain of Lakes after the relocation of the treatment plant. However, Lake Bemidji experienced a mild increase in mean annual total phosphrous and chlorophyll concentrations as a result of the relocation. Consequently, a state-of-the-art tertiary wastewater treatment plant was constructed in 1984 at the inlet to L. Bemidji that discharged only 0.3 ppm total phosphorus.

A second point source of discharge and phosphorus occurred on Fox Creek, a tributary to Pike Bay. Prior 1984, the City of Cass Lake discharged treated sewage into Fox Creek (Persell and Nordrum 2001). In 1984, Cass Lake converted their sewage treatment facility to land irrigation, thus eliminating discharge to surface water.

It is important to note there is one superfund within the watershed that is on the National Priorities List (NPL) established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The site was placed on the NPL because the site posed an "imminent and substantial threat to human health and the environment" due to hazardous substances released from the site (CERCLA). The site is located at the St. Regis Paper Company site, near the shore of Pike Bay and Pike Creek and was placed on the NPL on September 21, 1984. From 1957 to 1984 the site was a wood treatment operation and several chemicals including pentachlorophenol (PCP), creosote, fuel oil and copper-chromium arsenate (CCA) were used. During some years, nutrients were added to site pond waters in an effort to increase biological breakdown of organic wastes. Hazardous substances may have been released to ground and surface water into the Cass Lake/Pike Bay and Fox Creek systems. Champion International presently owns the land and they discharge charcoal treated effluent into Pike Bay Creek (Pike Bay Creek flows north into Cass L.). The effluent is from a groundwater pump and treat operation, which is part of the site reclamation effort (Persell and Nordrum 2001). The extent of adverse effects of the site is still being studied by the Leech Lake DRM, USFS, State of Minnesota and US EPA. There is concern that sediment within Pike Bay contains contaminants from this source, which could be a long-term source of contamination that could be a great threat to the health and welfare of Tribal members. Tribal members consume much greater quantities of fish and wild game than the general population. The Minnesota Department of

Health has not issued any great advisories (e.g., fish consumption) for Pike Bay although subsistence use of the fishery is not a basis for determining these advisories.

The Minnesota Environmental Quality Board summarized available pollutant data for the Upper Mississippi Basin and concluded that monitoring data upstream and downstream of these watersheds showed a decreased trend in pollutants such as total phosphorus, ammonia, biochemical oxygen demand, suspended solids and fecal coliform. The only exception was an increased trend in nitrogen. Likely sources are plant matter, wastewater treatment plants and fertilizer (Environmental Quality Board,2000). The Minnesota Pollution Control Agency also compiled a Basin Information Report for the Upper Mississippi Basin and has identified river reaches that not suitable or are partially suitable to support aquatic life or contact recreaton use. The portion of the Mississippi River from Lake Itasca to Lake Bemidji is on Minnesota's 303D, impaired waters list due to low dissolved oxygen. There are other sections of the river up and downstream of Cass Winnie that are non-supporting or partially supporting aquatic life (MPCA, 2000). In addition, the Forest collected water samples from 6 streams within the watersheds that had dissolved oxygen levels that were less than 4 parts per million.

Other ground water quality threats include the approximately 60 underground fuel storage tanks, many of which are located at resorts. In addition there are old community dumpsites on land managed by the Forest where household waste was disposed of for many years. Although these dumps are no longer in use, groundwater in the immediate area around the dump may not be suitable for domestic consumption and some may pose a risk to aquatic life (personal communication, Leech Lake DRM). Illegal dumping at various locations within the watershed are common along roads and trails that receive little use. A variety of scrap metal, household garbage, demolition debris and possible hazardous materials can be found in these dumping spots. The Leech Lake Band of Ojibwe has a database with these locations and a description and amount of waste at each site. A cooperative cleanup should be undertaken, and alternatives should be explored that will make this type of waste disposal less attractive.

Fish communities within the watershed are diverse. In addition to game fish such as walleye, northern pike, muskellunge and a variety of pan fish there are many species that inhabit lakes and streams. Big Lake and Cass Lake are designated as muskellunge lakes.

Through the Cass Lake and Winnibigoshish Clean Water Partnership, aquatic invertebrates have been characterized on at 18 locations within the watersheds (Ware, Oberg 2001).

What are the trends in water quality and what are the sources and amount of nutrient input to the watershed?

Water Quality
Trends in water clarity-Water clarity is the most common indicator of water quality. Frequent algal blooms is often a sign that that a lake is eutrophic (e.g., rich in nutrients such as phosphorus or nitrogen; Wetzel 1983). However, many lakes in Minnesota are naturally eutrophic. In the Cass-Winnie watersheds, lakes range from oligotrophic (nutrient poor) to eutrophic (Table 1; Carlson 1977). Determining whether a lake is naturally eutrophic or suffering from accelerated eutrophication (via excessive nutrient loading) is very difficult to determine and requires large, long-

term data sets. However, the inexpensive and easy-to-use Secchi disk is an invaluable water quality-monitoring tool that has been used by several agencies and public citizens across Minnesota to establish such water quality data sets (MNPCA 2000). Specifically, the Minnesota Pollution Control Agency (MNPCA 1984) established a program called the Citizen's Lake Monitoring Program (CLMP) in 1973. Lake associations and volunteers were provided Secchi disks to take water clarity measurements on a weekly or bi-weekly basis each year on their lake. Data collected was entered into a MNPCA water quality database for each lake involved. In 1999, 885 volunteers taking 13,392 Secchi disk readings sampled 767 lakes within the state of Minnesota. The MNPCA published a report in 2000 (MNPCA 2000) that summarized water clarity trends for all lakes involved in the program that had sufficiently large data sets. Within the Cass-Winnie watersheds, nine lakes are involved in the CLMP. To determine whether water quality has changed in Cass-Winnie watershed lakes since first records (typically in the 1970's), we analyzed water clarity data collected from lakes in the Cass-Winnie watershed by the CLMP along with data from federal, state and local agencies, available electronically through the EPA's STORET database (U.S. EPA's national computerized data system). Statistical methods used were adapted from MNPCA (1984, 2000). Specifically, we used a non-parametric statistical technique (Mann-Kendall; Gilbert 1987) that could identify which lakes have experienced great positive or negative trends in water clarity (Berryman et al. 1988). However, this method (along with all other statistical methods) is sensitive to sample size. Sample size, or in statistical terms, power, is critical to consider when concluding a lake is not experiencing changes in water clarity. Low power (i.e., four or less years of water clarity data) can lead to the conclusion that a lake is *not* experiencing changes in water clarity when it actually is (i.e., type II statistical error). Low sample size is less of a concern when concluding a lake *is* undergoing changes in water clarity (i.e., probability of committing a type I statistical error is lower than committing and type II error). Sufficient water clarity data (i.e., ≥ 4 years) was available for eight lakes in these watersheds (Table 2). Five lakes showed trends of increasing water clarity and clarity in lakes Andrusia and Wolf have greatly increased since 1976 and 1975 respectively. Coincidently, Andrusia and Wolf lakes have historic populations of pugnose shiners (species of special concern that are sensitive to poor water clarity; see TES analysis under topic: "Biodiversity"). Only three lakes showed trends of decreasing water clarity but none were great. The data suggest that at the watershed scale, water quality as measured by water clarity related to nutrient input, has not greatly increased during the last 30 years. However, water quality on individual lakes such as those identified as decreasing in water clarity may be influenced by local, non-point factors such as lakeshore development, timber harvest, or runoff from impervious areas and point sources such as septic systems. Continued monitoring of these lakes for several additional years is required in order to assess whether water quality is being greatly affected.

Table 24. Trophic status of sampled lakes within the Cass-Winnie Watershed.

Lake	Carlson TSI Score	Trophic Status	MNPCA *CLMP (Y/N)
Andrusia	57	Eutrophic	Y
Big	42	Mesotrophic	Y
Cass	40	Oligotrophic	Y
Cut Foot Sioux	60	Eutrophic	N
Deer	45	Mesotrophic	Y
Little Winnibigoshish	60	Eutrophic	N
Little Wolf	52	Eutrophic	Y
Lydick	46	Mesotrophic	Y
Midge	47	Mesotrophic	N
Pike Bay	48	Mesotrophic	Y
Sugar	43	Mesotrophic	N
Winnibigoshish	49	Mesotrophic	Y
Wolf	42	Mesotrophic	Y

*Citizens Lake Monitoring Program

Table 25. Cass-Winnie Lake Trends for Secchi Disk readings

Lake	Trend	Great	Years	N value (years)
Cass	Increasing	No	1972-1999	20
Winnibigoshish	Decreasing	No	1976-1999	4
Andrusia	Increasing	Yes	1976-1986	5
Cutfoot Sioux	Increasing	No	1970-1993	8
Grass	Decreasing	No	1970-1993	8
Pike Bay	Decreasing	No	1970-1979	8
Midge Lake	Increasing	No	1979-2000	5
Wolf Lake	Increasing	Yes	1975-1995	20

Trends in phosphorus levels-Phosphorus (P) is generally used as the indicator of nutrient pollution in north temperate lakes. Because most lakes in this area are P-limited, determining P loading is an important factor in developing management plans for lake quality. Phosphorus is a conservative element in that not all of it is available for uptake by plants. Phosphorus may remain in the sediment of a lake over a prolonged period of time until conditions allow for the release into the water column where it becomes available for uptake by the biota (Marsden 1989, Wetzel 1983).
The Leech Lake band of Ojibwe Division of Resource Management evaluated P levels of four lakes Big Wolf, Andrusia, Cass and Winnibigoshish within the Cass-Winnie watershed in 1991 and 2000 (Persell and Nordrum 2000; Persell 1991). All four lakes studied in Persell and Nordrum (2001) were P limited as measured by P to nitrogen ratios (Schlesinger 1997). Most sites showed an improvement in 2000. Improvements were attributed to the Bemidji sewage wastewater treatment plant and other best watershed management practices (BMP's). Comparisons between the 1991 and 2000 studies indicated that Cass Lake is retaining P and thus is a P sink. Persell and Nordrum

(2001) attribute this to Cass Lake's deep basins and a dam at the outlet. Knutson dam located at the outlet of Cass Lake has a narrow operational range and is dependent on the level of Lake Winnibigoshish (Enviroscience 1991).

What are the past and current amounts of contaminants in lakes and what is impact on ecosystem health and human health?

Presence of contaminants

Nine lakes (Andrusia, Big, Cass, Grace, Kitchi, Midge, Pike Bay, Winnibigoshish, and Wolf) and the Mississippi all have documented mercury contamination, and thus have fish consumption advisories (Minnesota Department of Health 2000). However, contamination levels in all fish species in these lakes tend to be low to moderate (i.e., ≤ 0.65 parts per million), and people consuming fish from these lakes at "normal rates" should not be greatly affected. Subsistence dietary use of fish however is worrisome for tribal members because of greater rates of consumption than normal. For further information, contact the Minnesota Department of Health or visit the MN DNR's lake finder web site to view fish consumption advisories for any of these lakes (http://www.dnr.state.mn.us/lakefind).

What are the trends in fish populations and fishing pressure within the watersheds?

Trends in fisheries populations and angling-Walleye are the primary fish species targeted by anglers in this watershed and Cass L. and L. Winnie. are among the most popular sport fisheries in MN. Both are large (Cass L. = 15,596 acres; L. Winnie = 58,544 acres) moderately productive lakes and walleye populations in both lakes are entirely supported through natural reproduction. Anglers harvested almost 190,000 pounds of walleye from Cass L. and L. Winnie combined and anglers invested over 1,000,000 hours of fishing on these lakes (MN DNR 1997). Specifically, walleye harvest in Cass L. has remained relatively constant since 1971 (when creel data were first available on this lake); however, the average angler in 1996 caught fewer than half the number of walleye they caught in 1971 (i.e., effort more than doubled). Walleye abundance and size has not decreased and has actually increased slightly since 1971 (from 1.09 lbs in 1971 to 1.21 lbs in 1998).
Northern pike are also popular sport fish in this lake and the average size of northern pike was almost one pound greater in 1998 (3.39 lbs) than it was in 1971 (2.44 lbs; MN DNR, unpublished data). However, anglers caught fewer northern pike in 1996 compared to 1971. Cass L. also supports an increasing popular Muskellunge fishery and Cass L. is regarded as a trophy fishery for this species (MN DNR 1997). Despite increased levels of effort, compared to other lakes in MN, Cass L. remains an above average fishery, presumably because of the increased popularity of catch and release (MN DNR 1997).
More historical fisheries data are available for L. Winnie, dating back to 1939. From 1939 to 1995, walleye harvest (by numbers) almost tripled and angling effort increased 11 fold (MN DNR 1997). In 1995, anglers caught four times fewer walleye than in 1939. The average size of walleye since 1939 has decreased as well (from 2.2 lbs in 1939 to 1.30 in 1998). However, based on 1998 survey data, walleye size and abundance remains within the normal range for the state (MN DNR unpublished data). In order to restore walleye size and abundance closer to historical levels, the DNR imposed experimental slot-limit regulations for walleye in 2001 (MN DNR 2001).
Despite increases in effort and harvest and habitat alterations (See "Core topic Biodiversity"), L. Winnie remains an above average fishery compared to most other lakes in MN. However, continued

productivity of the walleye fishery in this lake requires managing effort, harvest, and habitat protection/restoration.

Effects of habitat alterations on fisheries- Earlier we discussed the effects of aquatic habitat alterations on biodiversity (See core topic: "Biodiversity"). For example, we demonstrated that migration barriers and alterations in flows caused by dams and roads, alterations to riparian habitats, and increased sedimentation from erosion are all factors that are affecting aquatic habitats, and thus biodiversity in the Cass-Winnie watersheds. These alterations have undoubtedly affected sportfish production. See "Core topic: Biodiversity" for discussion of these effects. However, because of the lack of baseline data, we cannot determine the relative degree of impact of these alterations.

Core Topic: Recreation

Recreation opportunities within the Cass Winnie watersheds capitalize on the vast water resources in the area. Public recreation facilities that support these recreation opportunities include developed recreation areas such as campgrounds, boat accesses, picnic areas, and trailheads. Privately developed resorts and campgrounds also support the number and quality of recreation opportunities available. In addition to the developed recreation facilities within the watersheds there is an abundance of recreation opportunities available in the general recreation areas including dispersed camping sites, scenic byways, unique areas, and undeveloped portions of the Forest. The majority of the recreation use is associated with water related activities on the area lakes and large rivers. The scenic qualities of the shorelines and the surrounding forest in combination with the lakes and rivers provide a quality recreation setting that continues to attract an increasing number of recreation visitors.

Fishing and boating are the two most popular recreation activities.. Lake Winnibigoshish, the fourth largest lake in Minnesota, is a destination area fishing and boating area and receives moderate to high levels of use throughout the summer. Fishing opener on the Cut Foot Sioux Lakes, a chain of lakes connected to Lake Winnie, has historically been a major area event. Increasing fishing pressure on Winnie and Cut Foot Lakes has led the Department of Natural Resources to enact slot limits for walleye on these lakes. The Cass Lake chain including Wolf Lake, Lake Andrusia and Pike Bay receives a moderate amount of boating and fishing pressure. Use on these lakes can increase greatly also if fishing success improves during the season.

Recreation activities associated with the many motorized and non-motorized trails within the watersheds are also very popular. Snowmobile trails located throughout the area support the growing number of winter recreationists. The bike trails around Cass Lake and the horse trails located in the Cutfoot Souix area are also receiving increasing use.

Other outdoor recreation activities that continue to be popular within these two watersheds include deer and grouse hunting, ice fishing, swimming and berry picking.

Issue: Recreation development and use has changed over time in terms of the types of amenities provided and numbers of visitors and their preferences. Some recreational uses and development may result in conflicts with other forest resources and conflicts may also occur between recreationists who participate in various legitimate uses within the watershed.

What are the current uses and how has recreation use changed over time?

Outdoor recreation has grown along with the general population, although growth has slowed in the last decade. In the early years of the Forest Service, the public was encouraged to use the National Forests as a means of recreating. During that time many accommodations were made. During the early 1930's, the Civilian Conservation Corps, constructed many recreational facilities. Most of these included picnic shelters, overlook areas, and some large structures such as the Supervisor's Office Building and Norway Beach Visitor Center. In the 1930's, the Forest also allowed private individuals to build summer cabins on National Forest land. From 1930 to 1950 many of the current

special use recreation residence tracts were established. In the 1960's, campgrounds on the Forest across the country were developed.

Hunting and fishing in the early part of the 20th century was primarily a means of subsistence but was also a recreational pursuit. Fishing and hunting today are principally leisure activities oriented around other family recreation activities. As a result of a decrease in leisure time available and the aging population, hunting and fishing have decreased slightly over the years.

A State of Minnesota-DNR study entitled," *Boating in North Central Minnesota: Status in 1998 and Trends Since 1985*," found that although boat registrations have gone up 20 percent in this 15-year period, boat numbers surveyed on the water have remained stable, suggesting, on average, more people have a boat, but do not use them as much today as they did 15 years ago.

Other great findings of the DNR status report and trends since 1985 are: 1) average boat length has increased from 16 to 18 feet; 2) average horsepower has increased from 46 to 93; 3) fishing as the main boating activity has decreased from 61 to 48 percent; 4) perception of boaters is that the lakes are more crowded, even though, as stated above, the numbers of boats on lakes is unchanged. This suggests that pleasure boating or other activities boating activities are becoming more popular. The perception that lakes are more crowded may be due in part to larger boats and motors or because there are watercraft uses that conflict.

Recreation use at Forest Service campgrounds has grown an average of one percent per year. This is comparable to other recreation uses that have remained stable. Campground use numbers are easily quantified for camping in developed campgrounds. The average seasonal occupancy of all the campgrounds within the two watersheds is approximately 35% . Use totals for each campground in the Cass and Winnie watersheds are shown in Table 26. Other recreation uses are more difficult to quantify because of their dispersed nature. Qualitative observations are used to judge the amount of recreation use in these cases.

Use on most hiking trails within the watersheds is considered low as noted through periodic checks. Also the amount of vegetation that is present on the trail surface and at the trail edge is an indicator of relatively low use. The Mi-Ge-Zi Bike Trail is receiving great use during the non-snow periods. Snowmobile trails receive moderate use depending on annual snow conditions. The horse trails also receive moderate use in the spring and fall and low use at other times of the year.

Campgrounds

There are eighteen Forest Service maintained developed campgrounds within these two watersheds. Seven of these are in the Cass Lake Watershed. These include the four campgrounds in the Norway Beach Recreation Area: Chippewa, Norway, Wanaki, and Cass Lake. Knutson Dam and Nushka Group Campsites on Cass Lake and South Pike Bay Campground are also within Cass Lake Watershed. There are eleven developed Forest Service campgrounds in the Winnibigoshish Watershed. These include Winnie Campground on the west shore of Lake Winnibigoshish, and Tamarack and Plug Hat Point near the Winnie Dam area. Also on Cut Foot Sioux Lake and Little Cut Foot Sioux Lake are North Deer, South Deer, West Seelye, East Seelye, Mosomo, Williams

Narrows, and Onegume Campgrounds. Cutfoot Sioux Horse Camp is near Greeley Lake north of Lake Winnibigoshish.

Table 26. Forest Service campgrounds in Cass and Winnie Watersheds available for public use with occupancy and % change.

National Forest Campground	Sites Available	1990 Occupied Sites	2000 Occupied Sites	% Change 1990 -2000	Year Developed
Chippewa	46	931	1985	147%	Late 1950's
Norway Beach	55	1256	1413	13%	Prior to 1947
Wanaki	46	1088	1586	32%	Late 1950's
Cass Lake	23	1225	1005	-22%	Prior to 1947
Knutson Dam	14	618	408	-34%	Prior to 1947
Nushka	2 (group)	Not tracked	48	NA	Prior to 1947
South Pike Bay	24	1613	1438	-12%	Prior to 1947
Winnie	35	832	1028	19%	Prior to 1947
Tamarack	32	488	780	38%	1960's
Plug Hat Point	8	57	79	28%	Prior to 1947
North and South Deer	48	2945	2749	-3%	1960's
West Seelye	22	208	554	63%	1960's
East Seelye	13	1096	1044	-4%	1950's
Mosomo	23	1046	930	-12%	1950's
Williams Narrows	17	479	536	12%	Prior to 1947
Onegume	48	1595	1897	16%	1960's
Cut Foot Horse Camp	23	NA	210	NA	1998
Star Island					Prior to 1926
Total change				**+12.6%**	

Campgrounds use varies greatly on the Chippewa National Forest. Campgrounds which are situated on good fishing lakes and those which offer higher development amenities have experienced tremendous growth in use. Chippewa Campground is an example of a Campground experiencing a tremendous increase in use due to the addition of electricity at the campsites, flush toilets and showers, and the campground's proximity to the Mi-Ge-Zi bike trail.

Developed recreation changes approved in 2001 in the Winnie Watershed will take place at Onegume Campground and at the Cut Foot Horse Camp. On Little Cut Foot Sioux Lake, the Forest Service will rehabilitate Onegume Campground with the addition of running water and electricity for camper use. This is the first campground on the east side of the Forest to provide these amenities. An accessible hiking trail linking the campground to the Cut Foot Visitor Center and the Accessible Fishing Pier is also under construction.

Construction of a second camping loop at Cut Foot Horse Camp will occur in late 2001. This project is in partnership with the Minnesota Horse Council and the Cut Foot Experimental Forest

and was approved to meet equestrian use needs now and in the future. Although overall use is still relatively low, in the early summer and fall when the fly population is down, the campground fills up quickly with group campers.

While overall developed campground use continues to grow, some campgrounds have been closed over the years. Campgrounds at Ojibwe on Pike Bay, Seelye Point, Richards Townsite, and Birches, as well as an organization camp were constructed in the 1930's and 1940's and have been closed due to low use and/or severe erosion.

Resorts

There are several resorts currently under Forest Service special use permit in the Cass and Winnie Watershed areas. These include Cut Foot Sioux Inn, Eagle Nest Lodge, Highbanks Resort, The Pines, Tamarack, Northland Lodge, and the access area at Bowen's Lodge in the Winnie Watershed, and Norway Beach Lodge and Ojibway Resort in the Cass Watershed.

There are also many private resorts operating in these two watersheds. These offer a wide variety of amenities to the public and many recreationists return year after year, developing traditions of use. Some are open year round. Most are open during the May-October high use season.

There are many resorts on the lakes within the watershed that cater to summer and some winter visitors.

Table 27. Resorts within the watersheds

Lake Name	Number of Resorts
Big Lake	1
Lake Andrusia	3
Wolf Lake	3
Little Wolf Lake	1
Pike Bay	1
Cass Lake	15
Lake Winnie	7
Cut Foot Sioux	3

Many of the resorts were developed in the early nineteen hundreds and have undergone renovation to bring them up to modern standards expected by the recreating community.

Table 28. Land ownership and initial year of resort construction

Resorts	Land Ownership	Year Developed
Andrusia	private	unknown
Wolf	private	unknown
Little Wolf	private	unknown
Big Lake	private	unknown
Cass Lake	private	unknown
Star Island Lodge	NF (burned, not rebuilt)	1912
Norway Beach	NF	1917
Stony Point	private land	prior to 1947
Horace Lydick (Pug Hole)	private land	1925
Knutson Dam (Chippewa Paws)	private land	prior to 1947
Pike Bay		
Ojibway	NF	1925
Lake Winnibigoshish		
Haubrick's	private land	1945
The Pines	NF	1910
Northland	NF	1919
Tamarack	NF	1916
High Banks	NF	1932
Bowen's	private land	unknown
Denny's	private land	unknown
NoDak	private land	unknown
Judd's	private land	unknown
Schmirler's (McArdles)	private land	unknown
Ted's (Four Seasons)	private land	unknown
Cutfoot Sioux		
Eagle Nest	NF	1922
Williams Narrows	private land	1925
Cutfoot Sioux Inn	NF	1916

Boat Accesses

There are fifty-four public boat accesses in the Cass and Winnie Watersheds. Fifty of these boat accesses are owned and managed by the Chippewa National Forest. Many are closely situated to Forest Service campgrounds, picnic areas, and other developed areas. Others were placed to provide recreational public access to state waters where other access options did not exist. The State of Minnesota manages three accesses and Cass County manages one. See the Map in Appendix A for details on where the accesses are located.

Table 29. Boat Accesses Maintained by Public Agency

Maintained by	Cass	Winnibigoshish
USDA Forest Service	10	40
State of Minnesota	1	2
Cass County	1	0

Private accesses are also available at resorts and campgrounds. These are usually a convenience for their guests, although most also allow day use of these accesses for a fee.

This area is known as a regional walleye fishery that draws anglers from the surrounding states of Minnesota, Wisconsin, Iowa, North Dakota, and South Dakota. Waterfowl hunting, pleasure boating, and ricing would be secondary water-based activities. Minnesota ranks first in the country for numbers of recreational watercraft per capita, one for every six residents (MN-DNR). Angling is the primary water based recreation active occurring on these bodies of water.

Increases in use and increases in average boat size has precipitated the rehabilitation of existing boat accesses to meet this need. The table below shows how many access locations have changed to meet these demands. The parking available at these boat access sites increased by an average of thirty-six percent.

Table 30. Cass Winnie Watershed Area Boat Ramp Improvements in Years 1990-2001.

Access Name	Year improved	Improvement Made	Parking sites Added	Parking Now Available
Plughat	2001	Add a new parking lot	12	20
Wm.Narrows	1995	New cement ramp, added parking barriers	0	8
Mosomo	1993	Improved ramp to a double ramp, installed a dock, and increased parking capacity	12	24
Deer Lake	1995	Put in a new ramp	0	8
East Seelye	1993	Put in a new dock	0	10
Birches	1993	Increased the available parking, put in cement ramp	10	20
Little Cut Foot	2002	Improved parking design and put in cement ramp	0	5

Picnic Areas and Public Beaches

There are seven Forest Service picnic areas in the Cass and Winnie Watersheds area. These include: Norway Beach on Cass Lake, South Pike Bay on Pike Bay and Birches, East Seelye Bay, Richard's Townsite, Williams Narrows, and Onegume Accessible Fishing Pier on Lake Winnie. In addition, the state provides a picnic area on Cass Lake near Highway 2.

Public beaches are often associated with Forest Service picnic areas and campgrounds. Currently, the Forest Service provides managed beaches at the picnic areas at Norway Beach on Cass Lake, South Pike Bay on Pike Bay , and North Deer Lake and East Seelye Bay on Lake Winnie.

Dispersed Sites

There are sixty-three Forest Service maintained dispersed recreation campsites in the Cass and Winnie Watershed Areas. See the map in Appendix A for site locations. Most dispersed sites are related to water-based recreation. A few former developed campgrounds have been closed and currently are used for dispersed site camping. These campgrounds were underutilized and the cost of maintenance could not be justified. One former campground in the Cass watershed is the former Ojibway Campground on Pike Bay.

Star Island, Battle Point, and the Cut Foot Sioux area include dispersed sites camping opportunities which are very popular during the early part of the fishing season. The Forest Service has done a great amount of work in the last ten years to protect the riparian ecosystem and manage this use. Approximately eighty percent of the sixty-three known dispersed sites have been changed to better meet visitor needs and protect shoreline values with the addition of fire rings, wilderness type toilets, and steps and other erosion control methods. Because use of these sites declines greatly after the fishing opener rush and poison ivy becomes established, there are no plans to develop new sites. At the more popular dispersed areas, use picks up to a lesser extent in the fall.

Recreation Residences

The Cass and Winnie Watersheds provide the highest number of recreation residence opportunities on the forest. Most recreation residences were developed in the 1930's and provide a lakeshore lot that a family can use for recreation purposes up to six months of the year. Recreation Residence Groups in these watersheds include: Little Cut Foot, Winnie Dam, North and South Highbanks, South Winnie, East Beach, Sandy Beach, and Norway Point on Star Island, East Seelye, East McCavity Bay, Mississippi River, Knutson Dam, Takagami, Ojibway, West Pike Bay, Strawberry Point and the North Sioux Recreation Residence group. Together, these groups provide 226 recreation residence lots for family use. A twenty-year permit is issued for this use. All of the special use permits will expire and be up for renewal in 2007.

Table 31. Recreation Residence groups and dates of inception

Summer Home Group	Inception	No. of Lots
Winnibigoshish		
Mississippi River	1954	9 lots
Lake Winnibigoshish	1951	12 lots
North Highbanks	1933	12 lots
South Highbanks	1951	11 lots
Sugar Bush	1942	3 lots (closed in 1955)
Winnie Dam	1954	16 lots
Cass Lake		
Knutson Dam	1934	17 lots (13 let)
Norway Beach	1915	18 lots
Strawberry Point	1926	11 lots
Star Island		
East Beach	1918	16 lots
Norway Bluff	1926	23 lots (16 let)
Sandy Beach	1909	15 lots
Pike Bay		
Ojibway	1923	31 lots
Takagami	1935	14 lots
West Pike Bay	1932	16 lots
Cut Foot		
Seelye Bay (closed in 1930s)	1922	12 lots
East McAvity Bay	1946	5 lots
East Seelye Bay	1932	5 lots
Little Cutfoot Sioux	1950	15 lots
North Sioux	1946	12 lots

Non-motorized trails

There are many trailheads that provide maps and access to trails in the Cass and Winnie watershed areas. Cut Foot Sioux Trail, Cut Foot Accessible Trail, Simpson Creek Trail, Cut Foot Horse Trails, Mi-Ge-Zi Bike Trail, Star Island Trails, Soo Line Trails, and the Norway Beach Interpretive Trail provide a wide variety of experiences for the visiting public.

In the Cass Watershed, the Mi-Ge-Zi Bike Trail beginning at the Norway Beach Complex connects to the City of Cass Lake where it hooks into the Heartland Trail. It provides an excellent paved trail for non-motorized uses such as biking, rollerblading, and jogging. Phase two of the Mi-Ge-Zi Trail Project will extend the trail around the east and south sides of Pike Bay Lake. This project is planned in the year 2002

and is a partnership with three other government agencies. Phase Three of the Mi-Ge-Zi will connect Norway Beach Recreation area with Knutson Dam Campground.

Other non-motorized trail opportunities in the Cass Watershed include a 1.73 mile loop interpretive trail near the Norway Beach Visitor Center and a 12.33 mile hiking trail system on Star Island in Cass Lake.

In the Winnibigoshish Watershed, the Cut Foot Sioux National Recreation Trail (18.62 miles in length), and Simpson Creek Trail Systems (13.47 miles in length) have their main trailhead at the Visitor Information Center at Cut Foot. Both of these trails connect to the Cut Foot Accessible Fishing Pier via the Cut Foot Paved Trail. A new trail from Onegume Campground to the fishing pier was constructed this fall.

A trail system that includes 110 miles of Forest Service roads and trails was developed near Cut Foot Horse Camp in the early 1990's. New trail signs will be installed in Spring 2002. The Cut Foot Sioux Trail is also available for equestrian use.

Motorized Trails

Currently, there is one designated recreational motor vehicle trail, the Soo Line Trail that is twenty-one miles long and travels on the north end of Pike Bay. Recreational vehicles may travel along all Forest Service roads and old logging roads not closed or signed otherwise. There are many miles of roads available for motorized vehicles in this area. Motorized vehicles may not travel cross-country. The issue of motorized recreational vehicles is being considered during Forest Plan Revision. There is potential to have one or more designated motorized trails in these two watersheds.

Snowmobile Trails

There are three snowmobile trails traversing through the Cass and Winnie Watersheds. These are the Winnie Trail on the south side of Lake Winnibigoshish, the Avenue of the Pines Trail running near Hwy. 46, and the Soo Line Trail traveling between Cass and Pike Bay.

Scenic Byways

There are two State Scenic Byways traveling through these watersheds. In 1998, the Chippewa National Forest received State Scenic Byways designation for State Highway 46 – Avenue of the Pines Scenic Byway in the Winnie watershed and for County Highway 10/39 – The Scenic Highway in the Cass Lake Watershed. The Avenue of the Pines Scenic Byway begins approximately one mile west of the community of Deer River, MN and travels north to the community of Northome, MN, a distance of 46 miles. The route is characterized by stands of red and white pine that line the highway as it bisects the Chippewa National Forest. The byway passes close to the Little Cut Foot Boat Access and serves as the access for the boat launch area and parking. A 10 mile portion of 46, from the junction of County Road 9 to US2, is part of the Great River Road that follows the Mississippi River from its source to the Gulf of Mexico.

The Scenic Highway 10/39, travels from its intersection at Highway 2 to Blackduck. This 28 mile road is currently designated as a National Scenic Byway by the Forest Service and includes eight miles of the nationally designated Great River Road. The road has scenic diversity that includes a variety of tree species, lakes, bogs and forested wetlands. The route also crosses the Mississippi River near Knutson Dam Campground. There are several recreation areas that are accessible from this route as well as the historic CCC Camp Rabideau.

Both Scenic Byway applications (USFS 1999) contain further information about the routes and potential enhancement activities that could take place in order to benefit users, local communities and the environment.

The Great River Road, a regionally designated route following the Mississippi River, also travels through a great portion of the Cass and Winnie Watersheds. The route begins west of the Forest on Beltrami County 33 and intersects with Beltrami County 12. In Pennington, the route heads south on County 39 to Forest Road 2171 and Cass County 91 to US 2. From US2, the route diverges on County Road 9 through the Winnie Dam Area, and south along Hwy. 46, where it rejoins US 2.

Unique Areas

Many unique areas are offered in these watersheds. These are areas of historical significance or contain ecological factors making them unique. In these two watersheds, these include:

Chippewa National Forest Supervisor's Office – Located in Cass Lake and listed on the National Register of Historic Places, these historic log buildings were constructed in the 1930's by the Civilian Conservation Corps. They are now used as the main Forest Service Offices and include several interpretive displays.

Ten Section Area – Old growth red and white pine trees grace this area withheld from cutting during the logging era of the early 1900's. Interest in this area by conservationists at the turn of the century initiated the formation of the Chippewa

Cut Foot Sioux Ranger Station – The oldest remaining ranger station building in the Forest Service's Eastern Region. Listed in the National Register of Historic Places. Tours arranged through the Cut Foot Sioux Visitor Information Center.

Star Island - This island within Cass Lake is unique because Lake Windigo is the largest lake within an island within North America. The island has dispersed campsites, many designated and user developed trails and three summer home groups and private summer residences. The portage to Windigo Lake is on the north side of the island and has had problems with erosion. Sewage treatment is an issue with the summer cabins in that there is not a contract septic pumping service available and the summer recreationists on Windigo need sanitation facilities for public health and environmental reasons. There are two wells that need to be abandoned one at the campsite on the south side of the island and one on the north side of Lake Windigo.

Mississippi River – This river bisects the two watersheds for approximately 10 miles between Cass Lake and Lake Winnibigoshish. The first 400 miles of the river were recommended in 1980 for inclusion in the National Wild and Scenic River System. The National Park Service agreed in

November 1980 to hold in abeyance its conceptual master plan for the river if the Mississippi Headwaters Board managed the river for its unique cultural, historic, scenic and environmental qualities. (MHB, July 1992). In 1998 the Mississippi River from its source to the Gulf of Mexico was designated as one of 14 American Heritage Rivers. Fifty-six miles of the river traverse the Chippewa National Forest.

Visitor Centers/On Site Programs

There are three National Forest Visitor Centers located in the two watersheds. These include the Forest Supervisor's office, Norway Beach Visitor Center, and Cut Foot Sioux Visitor Center. Programs are offered throughout the summer at Norway Beach and Cut Foot along with school programs in the spring season.

Partnerships

The Chippewa National Forest participates in several partnerships and encourages new ones if in the best interests of the general public. Lake stabilization work with the State Department of Natural Resources (DNR); Mi-Ge-Zi Bike Trail construction with the DNR, National Forest Foundation, and counties; and campground construction with the Minnesota Horse Council and DNR are just a few that have occurred in the last five years.

What is the relationship between public and private recreation opportunities?

The Forest Service strives to not directly compete with private sector recreation businesses. In some cases, where both public and private offer a similar experience, this is not entirely possible. However, in most cases, the Forest Service provides less developed amenities as compared to the private business sector.

For example, the Forest Service and private resorts both offer campgrounds to the recreating public. In order to ensure the resort economy is not weakened due to the presence of federal campgrounds, the Forest Service develops an assessment every other year which rates the amenities provided among Forest Service Campgrounds and a sample of the private resort campgrounds. A rating and corresponding price index is then used to ensure fair market pricing in this area.

Although most private resorts charge a fee to non-guests for use of their boat accesses, there are no user fees charged at Forest Service managed public accesses. Some resort owners feel the Forest Service should charge for access use. These resort owners feel the government is unfairly competing against private business in this way and they would receive more business if the Forest Service also charged. Most access ramps are built in partnership with the State of Minnesota. The State's policy is to not charge for state access sites or for other governmental access sites where they provided financial or in-kind support for construction. Current Forest Service policy has been to support the State's position.

Boaters who pay to use the resort access locations do so for several reasons. The resorts offer a higher degree of security and additional amenities such as bait, grocery stores, and help with the boat.

Is the current mix of public and private recreation opportunities meeting current demand? What opportunities are needed to meet future demand?

Overall, the Forest Service and private enterprise are meeting most of the recreation needs of the public. During certain times of the year, such as fishing opener and holiday weekends, developed site campgrounds and boat access parking sites are full or at near full capacity. Campground overflow areas are then opened and used to meet the over capacity needs. Though they do not offer the same type of camping experience and amenities visitors prefer such as fire rings and tent pads, most campers are appreciative to have a spot to stay.

Developed campground use overall is at about 35% in the Cass and Winnie watersheds. This is considered near optimal, as use increases to 80-90% on weekends and holidays and is around 30% during the week. In the developed recreation areas, when use drops below a certain point, campgrounds are considered for closure. Underutilized campgrounds on the Chippewa can be considered for closure or a reduction in services when use is less than 20%. No campgrounds in the Cass and Winnie Watersheds are currently being considered for closure. The Ojibway Campground on the east shore of Pike Bay was closed in the late 1980's. Also, Nushka campground was changed to two group sites instead of a full-service campground. Richard's Townsite also was at one time a campground and has been changed to a boat access and picnic area.

National Forests strive to offer a range of opportunities in forest campgrounds. Some campgrounds will always be on the lower end of development, while some will tend to be more developed in scale. Trends in developed camping use encourage providers to offer more amenities such as electricity and running water. Campgrounds on the Chippewa, which supply these services, have the highest use on the forest. Each campground should receive consideration for additional amenities when due for rehabilitation, although the overall picture should show the range of different amenities.

Dispersed sites currently known and maintained seem to do a sufficient job at meeting this need. Dispersed site areas were user developed in most cases. The Forest Service manages their use to protect the shoreline and centralize toilet facilities and fire pits. Some dispersed sites where use is low often receive less maintenance. Over time, a decrease in use leads to de-listing of the site on the public recreation maps. Other user-developed areas that are discovered are looked at for possible inclusion to the inventory. Most sites are used by groups during a specific period of time and do not receive great environmental impacts.

Boat accesses are the subject of a separate current Forest Plan analysis effort. Currently use levels and lake capacity are used to determine if a new or larger access is necessary on a particular lake. In the 1990's, many access locations were improved in the Cass and Winnie Watersheds. Overall, it appears the current availability of boat accesses is meeting the needs of the boating public. There are a about a dozen lakes that have carry-in access within these watersheds for those who want to have a less developed and less chance of seeing other people experience.
No accesses in the Cass or Winnie Watersheds have been closed in the last ten years.

All available trails on the Chippewa National Forest are under capacity during most times of the year. With the growth of bike trail riding, the Mi-Ge-Zi Trail is being extended to loop around Pike Bay. This construction should take place in 2002. Eventually, the plan is to connect the Norway Beach area to Knutson Dam also. The public has made request for additional recreation opportunities for consideration on the Forest. Most of these requests in the past ten years involve trail uses of all types.

There has been a great expansion of the Snowmobile trail network available in the last fifteen years. The State of Minnesota's Snowmobile Grant-In-Aid System provides maintenance funding and support for these trails. The current system of snowmobile trails in the Cass and Winnie watersheds should sufficiently meet the existing and future needs in this area.

Horse Trails are a recent addition to the Forest on the north end of the Winnie Watershed, designated in the mid 1990's. With 110+ miles of roads and trails to ride, there should be enough diversity in trail riding areas at the horse camp.

Off-road vehicle use is a recreation trail component for which no specific opportunities are currently available. There are many miles of Forest Service system roads that could be used by OHV riders. Most Forest Service system roads, unless posted closed to this use, may be ridden on. There are safety considerations in allowing off-road riding on roads that also allow other types of vehicles. Although there are currently no specifically designated OHV trails on the forest, this issue is under consideration in the new Forest Plan (2001). There may be opportunities in these watershed areas to provide for a designated trail for this use.

How has recreation pressure affected resources?

Recreation use has had effects on resources, and these effects have caused the state to regulate fishing limits on several species of fish. Some lakes, including Winnibigoshish and Cut Foot in the Winnie Watershed, have slot limits in place now to regulate the size of fish taken.

Recreation use and development has had an effect on shorelines and riparian areas, causing a certain amount of erosion, sedimentation, and loss of natural shoreline. Use of DDT in the 1950's to reduce the mosquito population for recreation user benefits affected the egg thickness of bald eagles, as did the installation of the Lake Winnie and Knutson Dams. Bald eagles are now back in sufficient numbers, and any current or future Forest Service projects will be sufficiently analyzed to ensure ecosystem protection.

The historic excellent fishing results in the Winnie and Cut Foot Sioux area has attracted large numbers of sportspeople over the years. Pictures of years past show incredible numbers of boats in the Cut Foot Area, enough to practically step from boat to boat. Although the area does not see that kind of recreational fishing pressure anymore, there has been enough great fishing effects on the fisheries resource in the Winnie and Cut Foot Area to lead the Minnesota DNR to establish slot limits as a means to control the size and numbers of fish caught to ensure a fisheries resource is available in the future.

How have limits and special regulations affected recreation use?

The DNR recently enacted special regulations for walleye on Lake Winnibigoshish and Cut Foot Sioux lakes. These measures were taken because there has been a documented decrease in the number of fish between 17 and 26 inches. This regulation will eventually increase the percentage of fish greater than 19 inches. (See Water Quality and Fisheries Section) All fish between 17inches and 30 inches must be immediately returned to the water and only 1 fish over 26 inches is allowed in possession. It is too early to tell if these regulations have affected recreational fishing use of the Winnie and Cut Foot area. Last season, the DNR noticed a definite decrease in fishing use during the months of May and June, then an increase in July, August, and September. (Chris Kavanaugh, pers. communication)

A similar statewide regulation exists for yellow perch. The limit was reduced before last winter's ice fishing season from a 100 daily limit to a 20 daily limit, with 40 in possession.

Forest Service personnel noted that during the months of May and June 2000 (the first season the new regulations took effect), there was a noticeable decrease in use of the Winnie area campgrounds. Use was back to normal levels throughout the rest of the summer, consistent with DNR findings. Campground use in mid to late summer is centered on family camping and boating activities as opposed to fishing.

How can the Forest Service affect shoreline management change as it relates to Special Use Permittees?

The privilege of occupancy for resorts and recreational residences is granted by special use permit authorizing construction of the recreation residence and limited square footage of other structures within the lot boundaries. The area between the lot boundary and shoreline is excluded from the permit, and is open to use by the general public. Exclusive use of certain privileges within this area may be permitted, where warranted, for such improvements as a trail, steps or stairs necessary to prevent soil erosion when accessing the lake, small, well-secured motor lockers for lots with high or steep banks, placement of removable boat docks (either floatable or stationary types are acceptable), boat lifts, benches, and pump houses.

Beaching more than three watercraft may be permitted, if public use of the beach is not impaired. The permittee must protect all areas where shoreline stabilization has been done. Damage as a result of the permittee's use or operation will be repaired by the permittee.

Selective removal of vegetation between the lot line and the shoreline may be permitted to achieve some measure of insect control and to permit a view of the water, commensurate with screening of developments from offshore view. However, the establishment and maintenance of vegetation along the banks is paramount in the prevention of erosion. Vegetative removal from lakes will comply with State and County standards. (FSH 2709.11, Special Uses Handbook, Chippewa Supplement No. 2709.11-98-1)

Within the Cass/Winnie watersheds there are 226 permitted recreation residences and 8 permitted resort facilities. Of the 226 homes an analysis of riparian condition indicates that 66% of the lots have heavily or moderately managed vegetation within riparian areas and and 34% are minimally managed.

Table 32. Riparian management at lakeshore recreation residences

Lakeshore Special Uses	Heavy/Moderate Management	Minimal Management	Total Special Uses
Number of Permits	149	77	226
Percent	66%	34%	100%
Miles of Shoreline	3.8 miles	2.6 miles	6.4miles

Figure 19. Heavily managed riparian Area

Figure 20. Minimally managed riparian area

Forest Service personnel need to continue working with permittees to ensure riparian area protection. A goal might be to send materials on shoreline vegetation management to each permittee, and visit with them on site, detailing the public use strip, environmental protection advances available, and actions they might take to improve the shoreline area. It would be optimal to have participation and ownership of shoreline protection by the permittees. Where great improvements to the shoreline are feasible, the Forest Service has authority, especially in the public use strip, to take what actions are necessary to ensure riparian area protection.

Certain shorelines have been stabilized through partnership with the Department of Natural Resources, The Corps of Engineers, the permittees, and the Forest Service. These include the Winnie Dam, North and South Highbanks, and Star Island Summer Home Groups. Work was recently completed near Bowen's Lodge Resort, which has their boat launch area under permit. Stabilization has been necessary due to high waters causing eroding shorelines. Costs have been shared through the partnerships.

Core Topic: Social and Traditional Resources

Question: What are the major human uses and characteristics influencing the watersheds?

Social Setting- The social setting is described in four parts: general information, forest specific information, demographic and economic trends, the effects of trends in the Cass-Winnie watersheds. Much of the information presented in this section is by the three counties of Beltrami, Cass, and Itasca as a whole. Watershed specific information such as population and economic resources is generally not available at this time, but county information can be applied to the area.

Historic Settlement and Resource Use-The Cass-Winnie watershed is distinctive from a historic perspective due to several factors. Following deglaciation that occurred about 12,000 years ago, the Cass -Winnie watershed was a focal point for human settlement. Archaeological sites within the watershed reveal Native American presence, as early as about 9,000 years ago and there is some evidence of even earlier occupations. From that time forward, humans have affected their surroundings in a variety of ways and the extent and intensity of the human impacts has increased through time. People that have called the Cass-Winnie watershed their home have utilized the abundant food staples from land and water resources. The aquatic systems included a vast fishery, extensive wild rice beds, and the advantages of unhindered water transport. The land-based values were and are related to the proximity of resources offered by both prairie and forested ecosystems.

As European settlement occurred, natural resource use and extraction became greater with the larger numbers of people attempting to live in the area. The forest became increasingly economically valuable to the growing country, providing trees to build much of the infrastructure. Farming was tried, resulting in some success and also many failures in part due to the poorer soils and short growing season. Commercial fishing provided some with a means of living.

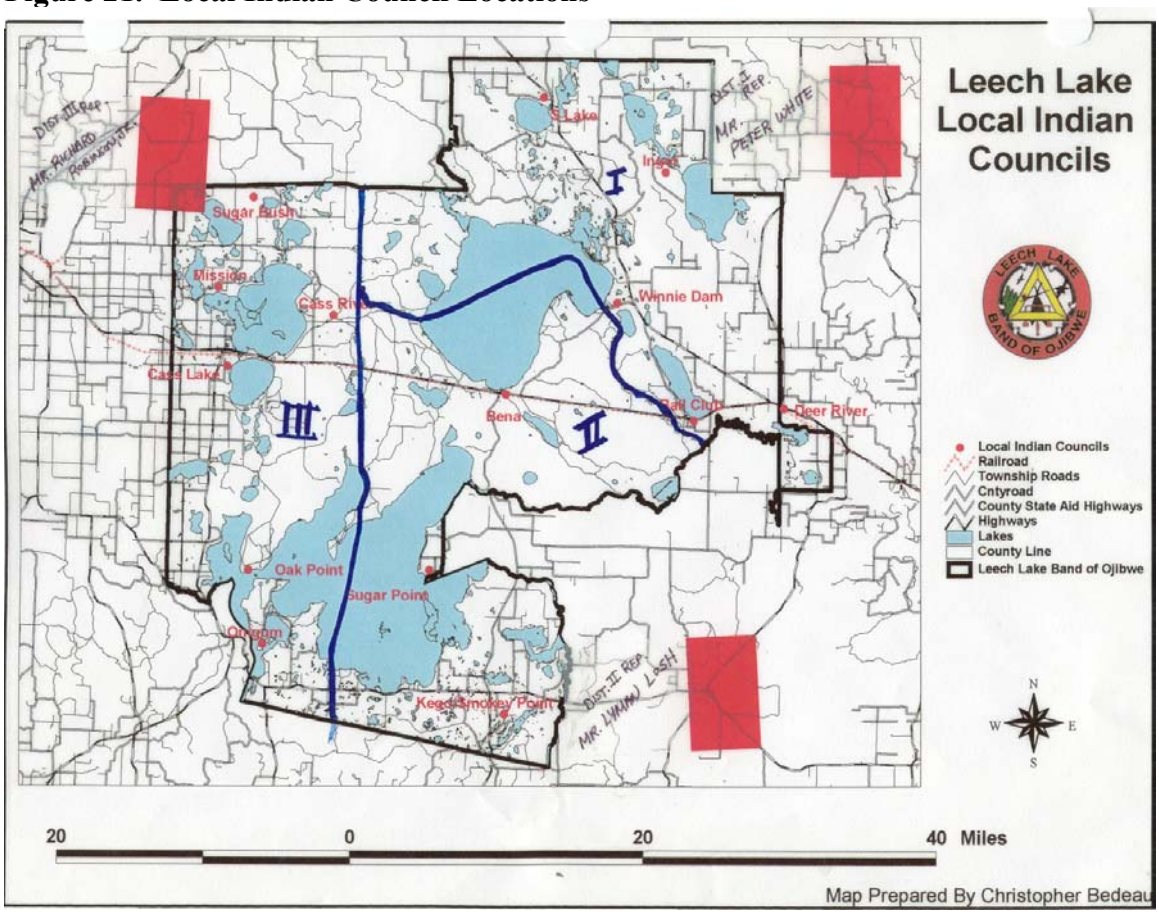
The emphasis on the variety of values people associate with the Cass-Winnie watershed evolve and change with time. The forests, rivers, and lakes continue to provide people, their cultures and their communities with the spiritual, economic, and social reasons to live in the area.

Leech Lake Band of Ojibwe-The Cass-Winnie watersheds are, for the most part, within the boundaries of the Leech Lake Reservation and are currently and historically home to the Leech Lake Band of Ojibwe. The tribal government consists of a Tribal Council and includes a Tribal Chair, District representatives, a treasurer and a secretary. The LL Reservation is divided into three Districts, which represent Leech Lake Local Indian Councils. Within Cass-Winnie watersheds, there are four local Indian Councils, Sugar Bush, Mission, Cass River, and Cass Lake.

The Band supports a Division of Resource Management and employs resource management professionals to manage the fishery, lands, vegetation, timbered lands and other natural resources. They also have their own housing division, social services division, law enforcement agency and tribal court system. The Band manages two educational facilities, Bug-o-ne-gee-shig, a K-12 school, located between Cass Lake and Bena; and the Leech Lake Tribal College located in Cass

Lake. Cass Lake also has an Indian hospital and Indian Health Service, which is a department of the federal government. Almost all tribal government offices are located in Cass Lake.

Figure 21. Local Indian Council Locations



Communities and Their Resources-Community resources represent the nature of assets in and around the community. Access to resources by the population is influenced by the quantity and quality of federal land resources and can be affected by land management decisions.

Local communities and businesses were established and continue to exist because of the rich water and forest resources within the Cass–Winnie watersheds. There are several local communities within and adjacent to the watersheds. These include the City of Cass Lake, Pennington, and Bena; also closely associated are City of Deer River, Inger and Ball Club. There are a few unincorporated communities within the watershed that are usually located on or near water. These communities are Cutfoot Sioux, Winnie Dam, and Mission, Sugar Bush and Cass River.

The City of Cass Lake celebrated its centennial year in 1998. The population is approximately 1000 people. The public school system provides for grades K-12. There is a clinic, public library, post office and restaurants in addition to retail stores downtown and a strip of retail stores, restaurants,

motels and movie theater on US Highway 2. Cass Forest Products, a sawmill is located on the south edge of town near the railroad tracks. The major industries are retail, non-gambling tourism, government or forestry and logging. Most of the non-gambling tourism is water-related because of the exceptional fishing and boating on area lakes. Many people who shop in Cass Lake have second homes on lakes in the area or stay at resorts in the area. Many of the year-round residents work for the Leech Lake Indian Reservation, the federal government, the tourism industry, the retail stores or the forestry and logging industry, or drive to Bemidji or Walker to work in businesses in those towns.

A USDA National Forest Supervisor's Office is located on the west edge of Cass Lake. This is the administrative office of the Chippewa National Forest, a majority landowner in the combined Cass-Winnie watershed. The Minnesota Department of Natural Resources (MN DNR) has a small forestry field office, located next to the Forest Service office.

Bena is located just south of Lake Winnie along US Hwy 2. It is a small community with very few retail services. There are two businesses along US Hwy 2 between Cass Lake and Winnie- a sawmill and seasonally opened restaurant.

Pennington, located north of MN State Highway 2, is another very small community, with few associated retail services, including a gas/food station and post office.

There are also many facilities scattered throughout the watershed that are generally tied to tourism. There are nearly 40 resorts; over 15 developed recreation areas (campgrounds, picnic areas, trails), 53 boat accesses and 3 visitor information centers. The local economy is also tied to forest products ranging from supplying building materials to supplying other products such as balsam boughs, birch bark, maple syrup, wild rice and a variety of berries.

Employment and Income Information-Employment in the area is dominated by two sectors, the wage and salary (manufacturing, trades, etc.) sectors and the government sector, as outlined in the following tables. The employment by industry, the next table, indicates health care, education and retail contribute the largest employment pool available to the counties.

Table 33. Employment Sectors for Workers by County*

Sector	Beltrami	Cass	Itasca
Self-employed	11.4%	16.2%	9.2%
Wage and Salary	59.5%	58.9%	69.9%
Federal Gov	4.7%	4.7%	2.6%
State Gov	10.6%	8.1%	5.5%
Local Gov	13.2%	11.3%	12.4%
Unpaid Household	0.6%	0.9%	0.4%

*Data from 1990 Census

Table 34. Employment by Industry*

Industry	Beltrami	Cass	Itasca
Farming, fisheries, forestry, mining,	10%	13.7%	10.5%
Construction	10.2%	15.0%	9.9%
Manufactured, nondurable	5.5%	5.1%	15.2%
Manufactured, Durable	12.8%	13.8%	13.1%
Transportation	5.8%	6.3%	6.2%
Communication & Public Utilities	3.9%	3.5%	4.7%
Wholesales trade	4.2%	3.9%	4.0%
Retail	40.7%	31.5%	30.4%
Finance, insurance Real estate	6.9%	7.1%	6.0%
Business and Repair services	8.0%	6.8%	9.2%
Personal, entertainment recreation services	10.1%	18.0%	10.9%
Health care	21.8%	24.6%	24.3%
Education	36.4%	21.7%	26.1%
Other professional services	13.3%	13.8%	17.7%
Public administration	10.5%	15.1%	11.8%

*Data from 1990 Census

Specific larger employers in the three counties are summarized in this paragraph. Major employers in Itasca County include: Blandin, Potlatch, and Rajala timber companies, National Steel and other mining-centered companies, tourism, educational and medical facilities, and governmental agencies. Major employers in Cass County include Potlatch, Leech Lake Tribe, school districts, medical facilities, and tourism. Major employers in Beltrami County include the State of Minnesota with Bemidji State University, Department of Natural Resources, Crime Lab and other offices; school districts, Anderson Fabrics, local government, and medical facilities.

The Leech Lake Indian Reservation (LLIR) supports three gambling casinos and one of them, The Palace, is located on County Road 150 just west of the town of Cass Lake within the Cass Watershed. It is a major employer in the watershed. The other two Reservation casinos are Northern Lights Casino located south of Walker on Hwy 200 in Cass County and White Oak casino located west of Deer River on US Hwy 2 in Itasca County. The casinos provide employment for Indians and non-Indians. Proceeds from these businesses are used to improve infrastructure on the Reservation and provide for the needs of members of the Leech Lake Band. Like many businesses, the casino's sponsor and support a variety of non-profit organizations and events throughout the reservation.

The local economy is also tied to forest products ranging from supplying building materials, paper and pulp; to supplying other products such as balsam boughs birch bark, maple syrup, wild rice and a variety of berries.

Tourism provides for a large economic contribution within the watershed. The area's extensive undeveloped forest of hardwoods and pine combined with the vast amount of lakes, streams and rivers create the northwoods character so many people value and travel to visit. Resorts, campgrounds, restaurants, shopping, and other associated services all contribute to and benefit from year-round visitation. An indicator of total employment used by the Headwaters Regional Development Commission is that of Gross sales for lodging places. The following table indicates receipts and % change from 1996 and 1998.

Table 35. Tourism Revenue

Lodging Receipts	1998	% Change from 1996 to 1998
Beltrami	$10,782,211	10.1%
Cass	$19,713,828	14.7%
Itasca	$15,647,020	39.1%

Area wages and the economic well being of the average person in the three county area have improved over the past decade. In 1990 the average annual wage earned was $17,274 and in 1999 it was $22,631. Area incomes are still below the state and national per capita figures as shown on the following table.

Table 36. Personal Income 1999*

County	Total Income per Capita	Total Income per Capita
Beltrami	$20,537	
Cass	$20,170	
Itasca	$20,861	
Statewide		$30,742
United States		$28,546

*US Bureau of Economic Analysis

Poverty continues to plague the three county area, as indicated on the following table, with rates double the state average.

Table 37. Percent of Total Population Below Poverty Level by County and State

County	Percent Population below Poverty Level
Beltrami	18.9%
Cass	15.3%
Itasca	12.3%
Statewide	8.9%

There are great minority populations within Beltrami and Cass Counties earning less than $24,999 per year. The 1990 census data on income indicates that approximately 74% of American Indian families in Beltrami County; 81% in Cass County and 86% in Itasca earned less than $24,999 per year.

The Economic Research Service (ERS), USDA, has developed a rural typology that provides a way to identify geographically groups of U.S. nonmetropolitan counties sharing important economic and policy traits. The typology is based on the assumption that knowledge and understanding of different types of rural economies and their distinctive economic and soci-demographic profiles can aid rural policymaking.

In 1993, ERS classified counties into one of six non-overlapping economic types, and into five overlapping policy types. The following table indicates these types for the watershed counties and are defined after the table.

Table 38. ERS County Classification

	Beltrami	**Cass**	**Itasca**
Economic Types:	Government dependant	Government dependant	Nonspecialized
Rural/Urban continuum code	7	9	6
Policy Type	N/A	Transfers dependant	N/A

The Economic Types of Beltrami and Cass Counties Government dependant indicates that government contributed a weighted annual average of 25 percent or more of total labor and proprietor income over the three years from 1987 to 1989. Nonspecialized counties are not classified as a specific economic type over the three years from 1987 to 1989. Even though this is old information, review of the labor and industry information presented elsewhere in the economic section implies this interpretation continues to be correct.

The rural-urban continuum code indicates each of the counties are nonmetro counties, metro defined as including 1 million or more people within a county or counties adjacent with large populations. The scale at the time indicates that Cass was a rural county, while the other two contained urban populations similar in size, differing by proximity to metro areas. Today, using the 2000 population figures, all three counties would be considered urban.

The policy types are unfortunately not available for Beltrami and Itasca counties, but is considered transfer dependant in Cass. Transfer-dependant indicates income from transfer payments (Federal, State, and Local) contribute a weighted average of 25 percent or more of total personal income over the three years from 1987 to 1989.

Population-Population characteristics are a description of the population of interest, including Beltrami, Cass and Itasca Counties. The population of these counties and subsequently the Chippewa National Forest has grown over the past ten years and will continue to grow. The statewide population trends indicate the Forest is located in a high amenity corridor that extends north out of the metro area into the Lakes and pines region of North Central Minnesota. The 2000 census data for those counties in that corridor indicates a 15 to 25% gain in population between 1990 and 2000.

Information from the tables below indicates that each of the three counties of the watershed are experiencing population growth. However, most of the growth has been in and around Bemidji in Beltrami County just west of the area in the watersheds, in and around Walker in Cass County just south of the area in the watersheds and in and around Grand Rapids in Itasca County southeast of the area in the watersheds. The Cass-Winnie watersheds remain predominately rural with the exception of the area in and around the town of Cass Lake.

Housing counts are also slowly increasing in response to population growth. Information on home ownership (vs. renting) in 2000 indicates that 74.6 to 80% of families own homes in Beltrami County; 80 to 85% own in Itasca and 85 to 87% families own in Cass County. The average homeownership rates on American Indian reservations in Minnesota average 76.3%, slightly higher than the 1990 average of 75.8%. The overall Minnesota average of home ownership in 2000 is 74.6% ownership. (2000 Census)

Table 39. Population and Housing Counts: 1970 – 2000

County	1970	1980	1990	2000	90 – 2000 Change
Cass					
Population	17,323	21,050	21,791	27,150	25%
Housing counts	11,044	17,586	18,863	*	
Beltrami					
Population	26,373	30,982	34,384	39,650	15%
Housing counts	9,590	13,099	14,670	*	
Itasca					
Population	35,530	43,069	40,863	43,992	8%
Housing counts	14,994	21,221	22,294	*	

*These specific numbers are not yet available from the 2000 Census.

Minority Populations-Native Americans are the largest minority in the area. This segment of the population is experiencing great growth. The Native American population has increased by 35.5% between 1990 and 2000. Most of the gain occurred in Beltrami County where the Native American population increased by 2,430 persons. Cass County experienced an increase of 737 Native American persons. The main contributor to this growth is the increasing economic opportunities on the Leech and Red Lake Reservations (HRDC social assessment).

Table 40. Race Population by County: Census 2000*

County	Total Population	All others**	White	American Indian and Alaska Native
Beltrami	39,650	3%	77%	20%
Cass	27,150	1%	87%	11%
Itasca	43,992	2%	95%	3%

*Census 2000 data

**All others include Black or African American, Asian, Native Hawaiian and other Pacific Islanders

Seasonal Population-The area's seasonal population has a great affect on the area's social and economic character. Although making estimates for the number of seasonal residents is difficult, a "best guess" is that the population doubles in the summer due to the influx of seasonal residents and tourists. The number of seasonal housing is one indicator of the number of seasonal residents. The table displays the number of seasonal housing units relative to non-seasonal housing units.*

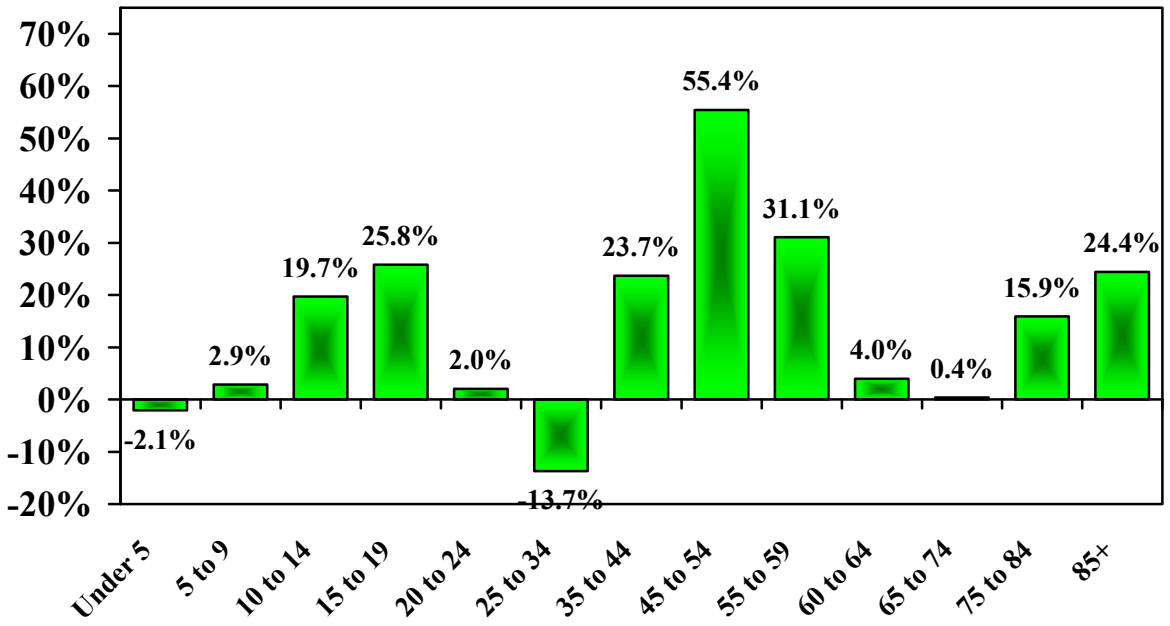
Table 41. Seasonal Population:

County	Non-seasonal	Seasonal
Beltrami	16,989	1,974
Cass	21,286	9,582
Itasca	24,528	5,747

*HRDC Social Analysis

Population Age Distribution-There are a large number of "baby boomers" ages 40 to 59, as compared to the rest of the population in the three-country area. Out migration of young adults ages 20-34 and declining birth rates has decreased the population expected to replace boomer retirees. The following chart demonstrates the percent population change by age group over the last decade.

Figure 22. Minnesota Change By Age Group 1990 to 2000



2000 Census

National Forest Visitors and Uses-Forest area residents comprise a great portion of the user base in the watershed. The remaining user base is distributed between other Minnesota residents and individuals from the surrounding states of Wisconsin, Iowa, North Dakota, and South Dakota.

Uses of the Chippewa National Forest are varied, and include, subsistence, recreational, resource harvesting, and traditional uses. Subsistence use includes hunting, fishing, and firewood harvesting. Recreation opportunities hunting, fishing, hiking, snowmobiling, camping, boating, driving for pleasure, bird watching, ATV riding, and bike riding. Resource harvesting includes forest products such as timber, birch bark, and balsam boughs. Traditional uses include sugar bush gathering areas, hunting camps, and medicinal plant gathering.

Chippewa National Forest Access-Visitors and residents of the area value access into the National Forest by a variety of means and for many purposes. There are no NF managed broad areas of land within the watersheds that are have been designated as non-motorized. There are trails that are designated as non-motorized such as the Mi-Ge-Zi Bike Trail and hiking trails within the campgrounds. There are designated motorized trails such as the Soo Line and snowmobile trails.

Access provides opportunities for people to visit sites and larger areas within the forest for pleasure, for economic opportunities, for traditional use purposes, and for cultural reasons. Barriers to access include seasonal restrictions on road and trail use; and permanently closed and/or obliterated roads.

Special Places-There are a number of known special places within the watershed that are special to people, (local, or non-local, forest staff, etc.) regardless of what use of designation those lands have, whose ownership they are in, or whether they are formally named and known places. There is currently an inventory of special places across the Forest being done by the Headwaters Regional Development Commission, and will be available within by March 2002.

The range of special places is diverse as the people that use the Forest and can include berry harvesting sites, an area of old trees, deer camps, traditional use sites, small ponds, rapids in a river and/or a picnic site.

Federal Lands Related Payments-There are two payments made to counties based on the quantity of federal National Forest lands and/or revenues within the counties.

The first is the *25 percent fund*. This payment is made annually to counties. Under existing law, 25 percent of most FS receipts are paid to the States for distribution to the counties in which the forests are located for financing roads and schools. About 800 counties across the Nation receive such payments. Historically, the largest source of receipts is from the sale of timber on the National Forests. Timber receipts and hence payments to states/counties have declined in recent years due to a variety of circumstances on the Chippewa NF and also nationally.

In 2000, the 'Secure Rural Schools and Community Self-Determination Act of 2000' legislation was passed which would provide all county governments an opportunity to select a funding process of the 25 percent fund that provides a predictable and equitable level of payments for the national forest land within the county. The Secure Schools and Community Self Determination Act of 2000 requires that 15-20% of the payments are required to be set-aside for a fairly limited range of special projects determined by the county or a resource advisory committee. That amount would not be available for distribution to the county highway department or to the school districts in the county.

This past year, counties had a choice under which format to receive funding. Itasca opted for the full payment option under the “Secure Rural Schools and Community Self-Determination Act of 2000’ which ties their payments for the next five years to the high three average of the payments between 1986 and 1999. Beltrami and Cass elected to stay with the old formula, which ties their payment the Chippewa NF receipts on a year-by-year basis. Their decision holds for two years, then they may get another chance to opt for the new formula. Itasca County cannot change their option; even the CNF receipts go up beyond the high-three average. The following table indicates recent 25% payments.

Table 42. 25% Payments for Revenues Received by County

County	FY 2000	FY 2001	Change
Beltrami	$109,587	$79,465	-40%
Cass	$491,916	$356,880	-38%
Itasca	$526,704	$550,667	+4%

Typically 85-90% of the CNF revenues are timber receipts, and the amount received in any year is tied to the actual value of timber harvested, not to the value of timber sales sold. In 2001 the third and fourth quarter timber receipts were lower than anticipated, due likely to soft timber demand at the mills and purchasers holding off on harvesting the FS timber they had under contract. Projections for 2002 are around a 20% drop in payments from 2001, depending partly on timber markets, which are still down.

The second source of federal payments to counties with National Forest lands is the *Payment in Lieu of Taxes (PILT)* program. The PILT program was conceived in 1976, and the appropriated funding level had remained static for many years. PILT funds are used to offset costs incurred by counties for services provided to federal employees and families, and to the users of the public lands. These include items like education, solid waste disposal, law enforcement, search and rescue, health care, environmental compliance, fire fighting, parks and recreation.

The PILT Funds are affected in part by the 25% payments. Congress appropriates PILT payments based on a complex formula developed at a national scale using population and acreage of federal lands and the value of other federal revenues as key factors. The final annual PILT appropriation is not only based on the formula but is also sensitive to politics and other national funding priorities from year to year. Because the formula takes into account the amount of money each county receives in other Federal payments, including the 25% payments, Beltrami and Cass Counties should see a higher PILT payment per acre than Itasca County, because of the difference in 25% payments.

When the effect of the changed 25% fund payments is taken into account in calculating next year's PILT payments, the increase in Itasca County's 25% payment will result in a decrease in their PILT payment, and vice versa for Beltrami and Cass Counties

Table 43. PILT Program

County	Fiscal Year 2000	Fiscal Year 2001	% Change
Beltrami	$23,376	$38,376	+64%
Cass	$107,802	$176,802	+64%
Itasca	$116,431	$191,431	+64%

Land Ownership, Use and Management-Federally owned lands of the Chippewa National Forest comprise most of the watershed. The USDA Forest Service is responsible for managing these lands, for social, economic and resource benefits using the direction as indicated in the 1986 Forest Plan. Within that plan, the watersheds are divided into several “Management Areas” that provide management direction. There are twelve management areas within the watershed. Approximately 55,604 acres are primarily managed for pulpwood production and 72,007 acres are managed for saw timber-sized conifers and aspen. There are also 2,525 acres dedicated to recreation areas and 11,118 acres assigned to unique historic, biotic, aquatic or geologic areas and research areas.

Other ownership includes the State of Minnesota; Cass, Beltrami and Itasca Counties. The Department of Natural Resources (DNR) manages the State Forest lands and management emphasizes providing for vegetation harvest and associated recreational opportunities. The County Land Departments also manage their lands for similar economic and social benefits.

The Leech Lake Band of Ojibwe owns and manages land within the watershed. Interests of the Tribe include natural resource management, providing for traditional activities, providing space for housing, and accumulating additional lands within the reservation.

Other ownership is held private, with associated private benefits and future plans as varied as the owners.

The Mississippi Headwaters Board is a joint powers board (representatives from eight counties), and regulates activities within ¼ mile along the Mississippi River, Lake Andrusia, Cass Lake, Pike Bay and Lake Winnibigoshish. Sections of the river and headwater lakes within the National Forest Boundary are classified in the Mississippi 1992 Management Plan as wild, or " having unique and great natural, cultural and scenic, scientific and recreational values and are generally considered remote."

Question: What are the demographic, economic and governmental trends that are currently occurring within the watersheds?

Demographic Trends- Population change through 2025 is estimated to increase. Most of the watershed area is rural with the exception of the area in and around the town of Cass Lake. Each of the three counties of the watershed are experiencing population growth. However, most of the growth has been in and around Bemidji in Beltrami County just west of the area in the watersheds, in and around Walker in Cass County just south of the area in the watersheds and in and around Grand Rapids in Itasca County southeast of the area in the watersheds. The reason for limited population growth within the watersheds is that much of the area is in public ownership and employment opportunities are associated with larger town and there are few private parcels available for development.

There is a trend toward an increase in the average age of the population. The overall age of Minnesota residents is also increasing due to lower birth rates. People who have vacationed here enjoy the beauty and peace of the lakes and woodlands intend to convert their seasonal residence into year-round homes. Already there are many new, retirement-aged residents as a result of this trend, and with the baby boom generation soon to be retiring, it is likely many more new residents will be retirees.

Census data show that this area has a higher percentage of people living below the poverty level than the statewide average. There is no data that indicates long-term changes, however, in the short term, the poverty level continues to be higher than the state average.

Existing and trend information for demand and corresponding development near highly desired lakeshore areas is especially high. As demand for lakeshore has increased, so have corresponding lakeshore values due to the limited supply. There is great amount of National Forest undeveloped lakeshore. There is continuing resident and visitor demand that reflects a diversity of interests, uses and associated benefits (recreational, economic, traditional, cultural, and access opportunities) that the Chippewa NF may provide.

Governmental Trends-Trends indicate a continuing interest in cooperatively and collaboratively working with the Leech Lake Band of Ojibwe, the Minnesota Department of Natural Resources and Counties. Fluctuating revenues in the form of Payment in Lieu of Taxes to the Counties,affects their ability to plan for out-years, and also influences the range of services they can provide to residents on a regular basis.

Economic Trends- There has been interest and attempts to diversify the economic base of the area. Examples include the Bingo Palace Casino, Cass Lake Movie Theater, and the expansion of the tourism season to year-round opportunities. This diversification will likely continue as the area grows in population.

Effect of Trends in the Cass-Winnie Watersheds- There is increased demand for social and economic opportunities and benefits associated with publicly owned lands. This could result in a wider diversity of opinion on appropriate forest management and increased demand for access opportunities into the Forest. As the resident and non-resident population ages more time will be available to recreate resulting in increasing recreational opportunity and benefit demand and an increase in non-market related benefits demands. It also may increase year-round recreational opportunity markets and a greater demand for less "extreme" sports. This segment of the population influence the public decision-making process in terms of fees charged for use of the National Forest and of the quantity of revenue generating resource management activities conducted.

As the minority population increases, expectations of benefits and the methods of program benefit delivery will change.

Public land is increasingly valuable in responding to non-owner (visitors and residents) demand and uses. Aesthetics of private lakeshores will change to a more developed appearance. There will be an increase in economic resources and revenue through the development of private ownership for the communities. Special use recreation residences will become very valuable and highly desirable asset for individuals. Questions will be raised about recreation residences in terms of the highest and best use of public lands and how private development on public lands fulfills public expectations.

Continuing interest by the Leech Lake Band of Ojibwe and Chippewa National Forest to explore managing lands within the LLIR within the interests of the Tribe and people of the United States
Continued Forest management emphasis to meet Tribal needs and desires

The Chippewa and Superior NF are currently revising their 1986 Forest Land Management Plans. The revision process includes public participation, creation of alternatives to address great issues, effects analysis, and the selection of one alternative. The alternatives under analysis address providing diverse social and economic benefits (recreational, economic, traditional, cultural, and access opportunities) that the Chippewa NF should provide by quality, quantity, and spatial arrangement.

What are the key watershed factors that are important in maintaining a vital outdoor recreation economy, forest products economy and community viability?

There are common characteristics within the recreation and forest products economies and community viability as influenced by the Cass-Winnie Watershed. The communities within and adjacent to the watersheds are dependant on a diversity of opportunities and benefits as provided by the Chippewa NF.

The key watershed factor needed to maintain viable and diverse local economies is a healthy ecosystem.

Specific to recreation additional factors influenced by potential management of the watersheds are: healthy fish and wildlife populations, both game and non-game species such as walleye, deer, song birds and waterfowl; attractive landscape; clean air and water; variety of recreation opportunities and benefits; opportunities to access and use public lands for water and land based recreation.

The forest products economy relies on a continuing even supply of wood and other forest products such as boughs and birch bark. It also must rely on the proximity of markets, related to the watershed by land development practices of adjacent landowners.

Community viability is directly related to jobs in the area and lifestyles that make an area desirable to live in. National Forests are usually thought to be an asset to a community near the forest as a prime area to work, live and recreate. The stability and diversity of the resource supply and recreational opportunities in light of increasing local demand is important to community viability.

What collaborative management opportunities exist with local communities including the Leech Lake Band of Ojibwe?

There are many collaborative management opportunities that exist with local communities, including the Leech Lake Band of Ojibwe. There are existing and long-term opportunities to work toward common goals such as the partnership at the Cass Lake Visitor Center; leasing of federally owned facilities; sharing of professional expertise; and creation of the Mi-Ge-Zi Bike Trail.

There is the opportunity to focus management of the NF to meet not only national and regional needs and expectations, but also the desires of the local population in terms of sugar bush, berry picking, birch bark, firewood, etc.

Heritage resources and management are an area of future growth in collaboration.

Interpretation of the cultures, land, and heritage for area residents and visitors is an opportunity.

The expansion of tourism and recreation related opportunities exist.

Sharing professional knowledge between agencies, communities, governments and individuals for specific projects, concepts and land management is an opportunity.

How does access affect the collection of traditional resources within the watershed?

Quantity of access and the method of access to traditional resources are important. The means of access is at the time variable, with the range being from driving directly to the site to walking a couple of miles.

The type of access available directly affects who and how many can access a site. The effects of use at a site depend on the site's sensitivity and ease of accessibility. Those sites people can drive to maybe more effected by use than those sites one must walk to. At the same time, minimal use of sites that are very sensitive can have great resource effects.

The demand for collection of traditional resources must be understood in order to monitor the successfulness of access opportunities.

What level of infrastructure is needed to maintain economic viability of the communities within the watersheds while protecting and enhancing unique watershed features?

Communities must be adaptable to possible changes in resource availability and focus of resource management in order to maintain viability.

The forest plan revision will analyze effects of a variety of management emphasis goals and opportunities in terms of economic viability. Until that analysis is complete, maintaining the current condition with gradual modifications to meet current and future needs is likely the best route to follow.

Specific infrastructure needs which could be implemented include closing low standard roads which are no longer needed; accommodating tourism growth provided there is not a negative impact on the watershed; continuing development of the Mi-Ge-Ze Bike trail, and maintenance of campgrounds, trails and dispersed sites.

How does the existing vegetative composition within the watershed match up with the desired future condition as defined in the Forest Plan? What activities are occurring within the watershed as a result of implementing the Forest Plan?

The 1986 Forest Land and Resource Management Plan (Forest Plan) does not designate management activities or desired future condition by watersheds. Instead, the Forest Plan defines land management goals and schedules activities that lead to a desired future condition either Forest wide or by management area (MA). This broad scale direction leaves a certain level of flexibility to managers in implementing management activities. The Forest Plan also specifies condition specific standard and guidelines that apply to many activities that have the potential to negatively affect forest resources. The standards and guides are designed to mitigate the effects of commonly implemented forest management practices.

The use of historic conditions and RNV as analysis tools is relevant and consistent with the Chippewa Forest Plan in that both address diversity by retaining vegetation types, age classes, and successional stages. The Forest Plan provides the following direction:

Manage habitat to maintain populations of vertebrate species at levels higher than their minimum viable populations (IV-1).

At a minimum, habitats will be maintained and improved to maintain viable populations of all existing native vertebrate species on the Forest. Habitat improvement will occur on the Forest in accordance with the selected management direction, with an emphasis on the management indicator species (IV-56).

The objectives of habitat improvement and maintenance will be accomplished through improvement of habitat diversity based on the suitability and capability of specific land areas. The concept of diversity emphasizes the management of habitat for all species (i.e., species richness) rather than for a few selected species. A forest with a mixture of different vegetation communities, moderate stand size, a range of ages between forest stands, and specific habitat components (e.g., snags, reserve trees, old growth, permanent openings) is needed to assure diversity (IV –56, 57). This will be accomplished through integrated Forest management and coordination between all resources being managed on the Chippewa National Forest. (IV-56, 57)

Increase diversity of plant and animal communities and tree species consistent with overall multiple use objectives of the planning area (IV-1).

Maintain diversity within stands to be harvested, retain inclusions of conifer in deciduous stands, and vice versa. (IV-15).

Retain snags and residual trees in sale areas for diversity. (IV-15).

Old growth, regeneration rates and rotation ages are also discussed on pages IV-14 and 15 and on pages IV-96 through 100 for MA 1.1, IV-109-113 for MA 1.2, and pages IV-135 through 139 for MA 1.4.

For sensitive species -- Depending on the needs of each species, and available knowledge on their distribution and habitat requirements, management will range from protection of specific habitats to provision of plant communities suitable for habitats. (IV-63a)

For sensitive species that do not have specific standards and guidelines, habitat suitable for providing their life requirements and maintaining viable populations will occur on the Forest…(IV-65)

Emphasis will be placed on accomplishing habitat objectives on uplands through coordination with timber management programs (IV-56).

The Forest Plan uses the same approach to biodiversity as presented in the Minnesota Generic Environmental Impact Statement (Biodiversity: A Technical Paper for the Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota, Jaakko Poyry, 1992) on Timber Harvesting and Forest Management. This approach assumes that maintaining the natural

plant communities upon which all species of plants and animals depend may best preserve biodiversity. Reasons for this strategy are cited as:

· "The high number of species in Minnesota makes individual species management hopelessly confusing."

· "Knowledge of habitat preferences and responses to logging of most plant species is very rudimentary.

· "Biodiversity was maintained for thousands of years under natural disturbance regimes that created a pattern of plant communities on the landscape."

· "Management of forests to maintain all natural cover types in reasonable proportions on the landscape will allow avoidance of future crisis by crisis management which requires the implementation of recovery plans for a growing number of endangered species."

The Forest Plan lists vegetative composition objectives for uplands within most Management Areas. Composition objectives vary by visual quality objective within each management area. Areas with a visual quality objective of retention or partial retention are designated as separate corridors and have guidelines that direct management activities for such things as apparent opening size, landings, residue treatment and others.

The following tables display composition objectives by Management Area as designated in the Forest Plan for the year 2000 and the existing conditions. Not all management areas designate composition objectives and the percentages of Forest Groups for current condition do not necessarily add up to 100% as some forest groups (ie lowland conifer) are not represented. Numbers in bold represent a difference between the objective and the existing condition of 50% or greater. Percentages are included for permanent openings but no conclusions were drawn as it is unclear what constitutes an “opening” in the Forest Plan composition objectives. Management Areas 4.4, 7.1,7.2,8.1,8.2 and 8.3 also occur within the watershed but they are either less than 1000 acres or the Plan does not designate composition objectives for them, so they are not considered below.

Table 44. Management Areas 1.1 and 1.5

	Retention % of Corridor			Partial Retention % of Corridor			Modification % of MA		
	M.A.	**1.1**	**1.5**		**1.1**	**1.5**		**1.1**	**1.5**
Forest Group	Forest Plan	Current		Forest Plan	Current		Forest Plan	Current	
Aspen	20	**31**	**9**	41	40	25	56	38	31
Paper Birch	9	**3**	**0**	10	**1**	**3**	9	**3**	5
Northern Hardwoods	36	**15**	39	23	23	20	10	**18**	**19**
White Spruce	8	5	**0**	5	**2**	**0**	9	5	**3**
Red and White Pine	12	7	**2**	8	**3**	**16**	7	7	6
Jack Pine/Balsam Fir	5	**0**	**0**	5	10	8	5	4	2
Permanent Openings	10	30*	45	8	12	15	10	14	18

* includes wetlands

There are approximately 23,500 acres within Management Areas 1.1 and 1.5 within the watershed. There are 466,410 acres of these management areas across the Forest. The acreage in MA 1.1 and 1.5 within the watersheds represents 5% of the total Forest wide. The majority of the acreage is in MA 1.1. The composition objectives are the same for these two MAs. Aspen is over represented within the retention areas and under represented in modification areas. Paper birch is under represented in all corridors. White Spruce is largely under represented. Northern hardwoods are over represented in modification areas and under represented in retention corridors within MA 1.1. Red and white pine is under represented in retention and modification areas and over represented in Management Area 1.5.

Table 45. Management Area 1.2

	Retention % of Corridor		Partial Retention % of Corridor		Modification % of MA	
Forest Group	Forest Plan	Current*	Forest Plan	Current*	Forest Plan	Current
Aspen	31	0	50	31	72	45
Paper Birch	2	0	2	**4**	4	3
Northern Hardwoods	36	0	25	**49**	5	**24**
White Spruce	7	0	4	**1**	1	0
Red and White Pine	7	0	5	**0**	2	**0**
Jack Pine/Balsam Fir	7	0	6	**0**	6	3
Permanent Openings	10	100**	8	6	10	8

*Based on only 7 acres Retention in MA 1.2 within the watersheds
** includes wetlands

There are approximately 5,500 acres of MA 1.2 within the watershed. There are 230,954 acres of these management areas across the Forest. The acreage in MA 1.2 within the watershed represents 2% of the total Forest wide. There are only seven acres of retention. This is an inadequate amount

for valid comparisons. Northern hardwoods are over represented in both partial retention and in modification.

Table 46. Management Area 4.1

	Retention % of Corridor		Partial Retention % of Corridor		Modification % of MA	
Forest Group	Forest Plan	Current	Forest Plan	Current	Forest Plan	Current
Aspen	8	**22**	9	**2**	9	8
Paper Birch	10	**4**	7	**0**	4	3
Northern Hardwoods	11	7	11	**0**	5	**0**
White Spruce	5	**0**	5	**0**	21	**0**
Red and White Pine	46	47	41	57	56	63
Jack Pine/Balsam Fir	16	12	16	**39**	4	**18**
Permanent Openings	4	4*	4	3	1	**5**

* includes wetlands

There are approximately 4,700 acres of MA 4.1 within the watershed. There are 6,012 acres of this management area across the Forest. The acreage in 4.1 within the watersheds represents 78% of the total Forest wide. Aspen is over represented in retention corridors and under represented in partial retention. Jack Pine and Balsam fir are over represented both in partial retention and in modification. White spruce is under represented in all corridors.

Table 47. Management Area 4.2 and 4.5

	Retention % of Corridor			Partial Retention % of Corridor			Modification % of MA		
	M.A.	**4.2**	**4.5**		**4.2**	**4.5**		**4.2**	**4.5**
Forest Group	Forest Plan	Current		Forest Plan	Current		Forest Plan	Current	
Aspen	8	12	12	16	21	13	26	18	17
Paper Birch	10	8	5	9	9	**0**	7	9	**0**
Northern Hardwoods	11	8	4	8	25	**8**	4	6	**0**
White Spruce	5	**0**	**0**	5	**0**	**0**	5	**0**	**1**
Red and White Pine	46	37	42	41	27	**45**	40	31	43
Jack Pine/Balsam Fir	16	**4**	21	16	9	**27**	16	**5**	29
Permanent Openings	4	20*	12	4	12	7	1	9	6

* includes wetlands

There are approximately 56,000 acres in MA 4.2 and 4.5 within the watershed. There are 282,052 acres of these management areas across the Forest. The acreage in MA 4.2 and 4.5 within the

watersheds represents 20% of the total Forest wide. The composition objectives are the same for these two MAs. Paper birch is under represented in Partial Retention and Modification. Northern Hardwoods are under represented in MA 4.5. White spruce is under represented in all corridors.

Table 48. Management Area 8.4 – Ten Section Area

	Percent of MA	
Forest Group	Forest Plan	Current*
Aspen	10	9
Paper Birch	13	16
Northern Hardwoods	10	10
White Spruce	2	1
Red and White Pine	57	44
Jack Pine/Balsam Fir	3	6
Permanent Openings	5	13

There are approximately 3,800 acres of the Ten Section Area within the watershed. There are 8,351 acres of these management areas across the Forest. The acreage in MA 8.4 within the watersheds represents 46% of the total Forest wide. The composition objectives are the same for all visual quality objectives. All Forest Groups are currently within 50% of the planned objectives.

The Forest Plan also predicts what the age class and vegetative composition would be in the year 2000 as a result of fully implementing the plan. These are forest wide predictions and are not specific to the watershed.

Table 49. Comparison of predicted Forest Plan composition with current condition

Veg. Group	AgeClass	Acres in Watershed	% Forest Plan Predicted '00	% Existing in Watershed	% Existing across Forest '00	% of Type by Age Class in Watershed
Aspen	0-10	3749	9.5	4	8	18
FTs: 91,93,94,95	11-20	4620	10.3	5	8	22
	21-30	3847	7	4	7	19
	31-40	1391	5.5	2	3	7
	41-50	687	<1	1	1	3
	51-60	786	0	1	2	4
	61-70	2234	7.6	3	5	11
	71+	3428	3	4	**6**	17
Total		20,742				

Hardwoods	0-20	908	1.1	1	1	5
FTs: 54,55,71,82,85,89,92	21-40	193	<1	0	<1	1
	41-60	830	0	1	1	5
	61-80	5665	16.5	6	11	32
	81-100	5912	<1	**7**	**6**	34
	101-120	3174	6.3	4	**3**	18
	121+	884	<1	1	1	5
Total		17,566				
Long Rot. Conifer	0-20	4546	1.4	5	2	15
FTs:2,3	21-40	6076	2.9	7	**6**	21
	41-60	2311	7.5	3	**1**	8
	61-80	3902	<1	4	2	13
	81-100	7519	<1	8	2	25
	101-120	3608	2.4	4	2	12
	121-140	1029	0	1	<1	3
	141-160	257	<1	0	<1	<1
	161+	304	0	0	<1	<1
Total		29,552				

Lowland Conifer	0-20	338	1.1	0	<1	3
FTs:12,14,15, 18,19	21-40	608	<1	1	<1	6
	41-60	669	<1	1	1	6
	61-80	866	3.6	1	2	8
	81-100	2612	<1	3	4	25
	101-120	4203	3.4	5	4	40
	121+	1149	<1	1	2	11
Total		10,445				
Short Rot.Conifer	0-20	3826	1.8	4	2	39
FTs:1,11,16,1 7	21-40	1153	<1	1	<1	12
	41-60	730	<1	1	<1	7
	61-80	2957	4.4	3	**2**	30
	80+	1104	1	<1	<1	11
Total		12,286				

Comparisons between forest wide predictions and existing conditions within a particular watershed can only be used in very general terms as actual objectives would vary depending on the mix of management areas found within the watershed. The Cass Winnie Watershed has a high percentage of acres in Management Areas other than 1.1, 1.2,1.3 which emphasize aspen production. A useful comparison that can be made from Table 48 may be to look at areas where the forest wide percentage for an age class/veg. type that currently exists (column 6 from the above table) varies by greater than 50% from that predicted in the Plan. Then look to the percent currently existing within the watershed (column 5 in the table above) to see if there are opportunities to correct the skew. Numbers in bold represent a difference between the objective and the existing condition of 50% or greater.

The Forest Plan predicted that there would be more aspen and it would be in a younger age class than is currently found in the watershed. However forest wide the objectives for young aspen are being met.

There is currently more aspen forest wide in the +71 age class than the plan would have predicted. Older aspen is also slightly over represented in the watershed. Once some of the aspen in the watershed moves out of the 0 –10 age class, there would likely be opportunities to regenerate the aspen in the +71 age class.

Hardwoods in the 81-100 year age class are over represented forest wide and in the watershed. However they are under represented in the next age class (101-120). This skew takes care of itself by allowing the 81–100 age class to age into the next class. There may be opportunities for harvest

in the oldest age class though existing percentages forest wide or within the watershed are not greatly skewed. Harvest treatments that do not set the stand age back to zero do not address this age class skew. However, treatments that provide for areas of younger age class as a within stand component do provide for this age class/habitat feature on the ground.

There are more acres of Long Rotation Conifer and in all age classes than the Forest Plan predicts forest-wide. Long Rotation Conifer in the 21-40 age class are over represented forest wide and in the watershed. However they are under represented in the next age class (41- 60). This skew takes care of itself by allowing the 21– 40 age class to age into the next class. There may be harvest opportunities in the oldest three age classes though these age classes are not greatly different than what would have been predicted in the Forest Plan.

Lowland Conifer in the 81 – 100 year age class are over represented forest wide and somewhat over represented in the watershed. There may be opportunities within the watershed in the oldest three age classes to address this skew.

Short Rotation Conifer in the 61 – 80 year age class are under represented forest wide. There seems little opportunity to correct this by management within the watershed.

An additional way to look at age class distributions it examine the age class distributions within a given Vegetative Group (ie Hardwoods, lowland conifers, ect.). Timber harvest opportunities predicted by data base queries are always greater than those realized on the ground. This is due to a variety of factors, including inaccurate or old forest stand data, presence of unique or sensitive resources (such as cultural resources or threatened/endangered/ sensitive species), stand location (stands adjacent to lands recently harvested, or stands offering very poor harvest access) and other resource management concerns. On-the-ground timber harvest opportunities are often 40-60% less than those suggested by data base queries. Minimum rotation age for a given vegetation group vary by management are and by visual quality objective.

Sixty-six percent of the aspen type is under minimum rotation age (40 years). There is little aspen (7%) in the age classes between 41 and 60 years where we would typically look for the highest yield aspen harvest opportunities. Twenty-eight percent of the aspen type is greater than 60 years, with a great percentage greater than 70 years old. We would expect reduced timber yields from these stands. The following statements pertain to age class distributions within a given type and within the watershed.

Age class distributions in the Northern Hardwoods types are skewed toward the middle age classes between 61 and 120 years. Minimum rotation age for hardwoods outside of modification areas is 150 years. Less than 5% of the hardwood acres are greater than 120 years old.

Eighty-two percent of the long rotation conifer are less than 100 years old. Less than 1% of long rotation conifer acres are >140 years.

Lowland Conifer distributions are skewed to the older age classes.

Forty-eight percent of the short rotation conifer are over minimum rotation age, but acres in the youngest age class are currently over represented.

Steps 5 and 6: Synthesis and Recommendations

The following tables are a synthesis of information presented in Steps 3 and 4. By synthesizing historic and current information, findings and recommendations were developed. These findings are grouped by core topic and recommendations include measures that are important for improving watershed health in areas of biodiversity, hydrology, water quality, fisheries, recreation and societal needs. Specific items address TES and sensitive species, current Forest Plan direction, National Fire Plan implementation, improving the efficiency and environmental nature of our road system and the restoration of terrestrial and aquatic ecosystem processes and functions that have been altered as a result of current management practices. The findings and recommendations have been assigned either a high medium or low rank within each core topic. This section of the assessment should provide a basis for developing purpose and need for a variety of projects from fuels to habitat restoration in order to improve ecosystem health. The decision maker would use this analysis to identify projects that are ripe for decision. This would allow for "same time/same place" environmental analysis of a varied mix of projects that provide multiple benefits. The recommendations are ranked either High or Medium.

Findings	Recommendation
Core Topic: Biodiversity	
1) a. Patch sizes within the Dry Pine Community are much smaller than they were historically. b. A comparison of FIA data to GLO bearing tree data shows that currently there are 1/10 the number of jack pine than there was in the mid 1800's	**Manage for larger patch sizes within the Dry Pine Community to increase economy of scale for fire restoration -High** **Increase the jack pine component in this community with native seed source-High**
2) The Mesic Boreal Hardwood Conifer Community is more fragmented than the historic condition of a continuous forest canopy with openings created by wind events	**Manage for gap-phase dynamics at the Landscape level within the Mesic Boreal Hardwood Conifer Community allowing for a continuous canopy condition - Medium**
3) Much of the Mesic Boreal Hardwood Conifer Community is currently maintained as early successional aspen. The late successional stage consisting of a mixture of balsam fir, white pine, white spruce, white cedar, elm, maple, basswood, black ash, and bur oak are under represented.	**Allow succession from aspen to later successional stages to occur in this Native Plant Community. Plant missing components when seed sources are missing. -High**

Findings	Recommendation
Biodiversity Continued	
4) a. In all community types, within stand tree species diversity is generally less than historic levels. Species composition is dependent upon community type. **b. In all community types there has been a loss in conifers and gain in hardwoods except for Balsam Fir**	**Manage for more within stand diversity:** **Dry Pine-increase upland tamarack, jackpine, aspen within pine stands - High** **Dry Mesic Pine/Oak-increase upland tamarack, white pine and jack pine component** **Dry Mesic Pine-increase upland tamarack in pine aspen stands - High** **Mesic Northern Hardwood and Mesic Boreal Hardwood/Conifer -increase upland tamarack white pine, spruce fir, white birch and red pine components -High**
5) Age Class distribution is skewed to younger age classes than historically in all community types except Tamarack.	**Management needs to consider shifting age class distribution to older classes particularly in the DryPine and the Dry Mesic Pine Oak Community -High**
6) Coexistence of fire ecosystems and human development, combined with fire protection and present land management practices, have altered natural fire regimes and increased the risk of catastrophic damaging developments and resources.	**Actively participate with all interested parties and land owners to reduce fuels near infrastructures. Use existing educational tools that target landowner's responsibility to reduce hazard. In high hazard areas conduct fuels inventories to select management activities that reduce hazard to developments and resources and help to restore fire regimes to ecosystems-High**
7) Fire suppression has allowed northern hardwoods and balsam fir to increase in the Dry Mesic Pine Oak Community.	**Return low intensity frequent fires to this community to reduce wildfire severity and restore ecosystem function-High**
8) Fire dependent landscapes are currently composed of small blocks of vegetation with varied fuel characteristics making it difficult to plan larger more economical prescribed burning projects. The current configuration of species and fuels also eliminates the Wild-fire Use Program as a tool to replicate historic fire regimes.	**Future planning of silvicultural activities including timber harvest need to consider the spatial arrangement and fuels condition in fire dependent landscapes in order to work toward a goal of larger blocks of vegetation with similar fuel conditions-High** **Timber sale units could be selected to increase patch size in fire dependent systems, and utilize silvicultural prescriptions that mimic some attributes associated with historic fire - High** **Basal Area reduction may be necessary to allow reintroduction of low intensity fire-High**

Findings	Recommendation
Biodiversity Continued	
9)The black throated blue warbler prefers continuous canopy of mixed hardwood and conifer in larger patch sizes. Patch size is smaller due to current forest management. Dense understory vegetation however is more prevalent due to fire suppression activities.	**The Mesic Boreal Hardwood Conifer Community may hold promise for this species if management for hardwoods and gap-phase processes can be undertaken-High**
10) Caspian tern and the common tern are both colony nesters that prefer sandy shorelines and islands within large lakes. Lake Winnibigoshish and Cass likely had habitat for these species prior to the construction of the dams.	**Look for opportunities to restore sandy shoreline habitat that would not be subject to flooding during the Corps of Engineers reservoir optimization study-High**
11) Goshawks prefer habitat conditions that include structural and compositional diversity. This diversity is commonly lacking in managed stands.	**Increase species diversity as specified in #4 above and manage For live and dead snags during timber harvest activities-High**
12) Cass Winnie have one of the highest populations of breeding bald eagles which need protection.	**Manage for super-canopy red and white pine trees within one quarter mile of Cass and Lake Winnie -High**
13) Spruce grouse favor short-needled species such as spruce, balsam, jack pine and tamarack. Current management has favored hardwood communities and longer needled pines at the expense of short needled species.	**Increase species diversity as specified in #4 above and manage for a mixed hardwood/conifer forest within the Mesic Hardwood Conifer Community -High**
14) Vegetation communities were historically driven by natural forces such as insect and disease, fire and wind events. These forces created characteristics preferred by black-backed woodpeckers such as dead and dying trees, downed wood on the forest floor and generally older age.	**Retain defective and dying and create conifer snags particularly jack pine. Within the Dry Pine, Dry Mesic Pine and Mesic Boreal Hardwood/Conifer Communities develop management activities with respect to black-backed woodpecker habitat - High**
15) The largest acreages of suitable habitat for canada lynx are the Tamarack and Mesic Boreal Hardwood Conifer Communities.	**Manage Mesic Boreal Hardwood Conifer Community as in 2, 4 and 9 above to enhance suitable habitat. Pursue opportunities to decrease over-snow trails and open road densities within this community and the Tamarack Community -High**

Findings	Recommendation
Biodiversity Continued	
16) There is a lack of data concerning fish passage, extent of leaching creosote at timber bridges, and extent of erosion at 70 of 92 stream crossings within the watershed. At least 37 of these crossings consist of a corrugated metal pipe, which has been found to impede fish passage more often than other types of crossings.	**Systematically inventory all stream crossings within the watersheds to identify problem areas - High** **Further evaluate 37 corrugated pipe crossings for aquatic passage concerns -High**
17) Twelve stream crossings have extreme to moderate erosion.	**Plan to correct erosion during project planning – High**
18) Eleven road and trail stream crossings were found to obstruct fish passage.	**Plan to correct passage problems during project planning -High**
19) Eleven timber bridge crossings have been treated with creosote. These may be contributing creosote into streams.	**Further evaluate timber bridge structures and correct problem areas -Medium**
20) Of the 10 waterfowl impoundments, three have been inspected recently. None of those were functioning properly or were being actively managed. These impound ments are serving as barriers to more than 13 miles of stream important for spawning fish and mussels.	**Systematically inventory all impoundments and further evaluate the risks and benefit of retaining Amik, Pigeon River and Pigeon Dam –High** **Assess opportunities for stream restoration -High**
21) Forage for beaver within 300 feet of streams is more abundant than it was in the past. Beaver dams are impounding at least 18 miles of stream within the watersheds, which modifies stream and wetland habitat and may be serving as barriers to movement of aquatic organisms.	**Discourage aspen management within 300 feet of streams that are important spawning areas for fish within the Cass Winnie watershed and tributaries immediately upstream -High** **Conduct a systematic inventory of beaver dams and their effect on fish passage within the Third River and Turtle River watersheds – Medium**
22) Alterations from a natural flow regime caused by Winnie, Knutson, and Ottertail dams may have negative consequences for a variety of aquatic species. Dams also act as barriers to movement for most species.	**Look for opportunities to mimic natural flow regimes from dams during the Corps of Engineers reservoir optimization study -High** **Investigate alternative dam configurations at Knutson that would allow for passage of aquatic organisms -Medium**

Findings	Recommendation
Biodiversity Continued	
23) Rusty crayfish and purple loosestrife are currently the only invasive aquatic species within the watersheds. However, several other species, including the zebra mussel, Eurasian water milfoil, spiny water flea, round gobe and Eurasian ruffe, are found in the Great Lakes and may have the potential to become established and thrive in some lakes within the watershed.	**Work with Minnesota DNR, Sea Grant and universities to increase public awareness of these aquatic and social threats -Medium** **Document presence of rusty crayfish and purple loosestrife when conducting aquatic and integrated inventories - High** **Provide signage at heavily used accesses, especially on Lake Winnibigoshish, Cass, and Cutfoot - High**
24) Pugnose shiners and greater redhorse have been documented in lakes connected by the Mississippi River, but there is little information on their status. Shoreline development, lack of natural flow regimes and low habitat diversity are threats to viable populations.	**Conduct viability analyses and systematic inventories -High** **Maintain littoral vegetation and manage riparian areas to promote multi-age, long-lived species composition. Pursue management recommendations outlined in #'s 16,17,18, 20,21 and 22 above -High**
25) Two sensitive mussel species (black sandshell and creek heelsplitter) are present within the watershed. These species are impacted by altered stream flows, excessive turbidity, and sedimentation.	**Pursue management recommendations outlined in #'s 16, 17, 18, 20, 21, and 22 above – High**
26)Vernal Pools are key ecosystem components imbedded within major community types. In many cases their locations are not identified prior to conducting management activities therefore spatial and temporal changes may be occurring that are well outside the range of what would occur naturally. This is particularly evident in the Mesic Boreal Hardwood Conifer Community where the density of pools is greatest and the landscape has served as a major source of hardwood pulp.	**Identify pools during integrated inventory. Manage pools within community type disturbance regime. Manage for adequate live and dead snags and large woody debris on the forest floor near pool edges.** **Minimize rutting or ground disturbing activities near pools. Leave at least 50% crown closure at pool edge and reserve trees within the pool - Medium**

Findings	Recommendation
Core Topic: Hydrology	
27) Natural flow regimes have been altered by the presence of Ottertail, Knutson and Lake Winnie Dams. Mean monthly flows from Lake Winnie are seasonally reversed, Ottertail's mean monthly flows closely mimic natural seasonal variations, and no continuous flow data is available from Knutson Dam. **Day to day variations on all of the dams have not been assessed but qualitative information suggests day to day operations may be outside the range of natural variability.**	**Install a continuous recording gage to record lake stage, and discharge from Knuston Dam – High** **Pursue management recommendation #22 – High** **Work with local agencies, and dam managers to pursue a long term data collection strategy that would provide dam managers with a larger window for regulation of flows,such as placement of gages near the headwaters at Itasca State Park - High** **Work with the Nature Conservancy and others to perform a more detailed analysis of current dam operation and how a variety of hydrologic parameters relate to the range of natural variability -High**
28) There has been a reduction in channel complexity below Knutson Dam, immediately above Lake Andrusia and above Ottertail Dam.	**Identify opportunities within these stretches to Restore channel complexity that could include large wood, vegetation treatment in riparian areas or rock riffles -High**
29) Lake levels in Cass and Lake Winnie are higher but more stable than historic levels. Higher and more stable levels have an effect on shoreline erosion, recreational use of the lakes, riparian vegetation, heritage sites and aquatic and riparian dependent species.	**Pursue recommendation #22 -High** **Validate active shoreline erosion on Cass Lake, Pike Bay, and Lake Winnie and develop proposed actions and environmental analysis to determine and disclose effects and decide the course of action for these shorelines – High**
30) Satellite imagery analysis of forestland in an open or young condition revealed that four sub-watersheds were above the 60% threshold and five had at least 30% of the upland area in young forest or in an open condition. In these sub-watersheds, increased stream flow rates and subsequent in channel erosion and sedimentation may result. **The amount of impervious surfaces in and immediately surrounding Bemidji has increased from historic levels, thus decreasing the amount of water infiltration within upstream watersheds.**	**Perform a more detailed analysis within these watersheds to confirm satellite imagery results -High** **Modify prescriptions for timber harvest in watersheds at or approaching the threshold – High** **Work with local agencies including the Cass Winnie Clean Water Partnership to determine if there are strategies that might ameliorate the proliferation of impervious surfaces within the watersheds -Medium**

Findings	Recommendation
Hydrology Continued	
31) Shoreline characteristics surrounding Lake Winnibigoshish and immediately upstream of the lake have changed markedly from the early 1800's. Shorelines were once dominated by forested wetland communities including white cedar and tamarack. Third River and the Mississippi most likely had greater amounts of large wood in their channels than now.	**Pursue recommendation #22 –High** **Look for opportunities to increase channel complexity as describe in recommendation #28 -High**
32) Inventory of heritage sites revealed that 19 were at risk from shoreline erosion and recreation use. The actual number of sites at risk has not been fully evaluated especially on Cass Lake and Pike Bay.	**Complete inventory for sites on eroding shorelines-High** **Evaluate significance of sites experiencing Erosion-High** **Stabilize shoreline to reduce erosion at site Areas-High** **Pursue recommendation #29 –High**
33) Groundwater levels play an important role in water level and flow regulation.	**Work with other local agencies to continue to collect groundwater information -Medium** **Pursue recommendation #22 and encourage The use of groundwater information in Modeling -High**
34) Historic flowage easements are currently in place for 82,464 acres of land within the watersheds. There are shoreline improvements and infrastructure located within these easements. Landowners may not be aware of these easements.	**Work with the Army Corps of Engineers and other local agencies to remind landowners of the possible ramifications of building within flood easements -Medium**

Findings	Recommendation
Core Topic: Water Quality and Fisheries	
35) Water quality and clarity on a watershed basis appear to stable although many lakes have only been monitored for a short period of time and therefore trends cannot be established. Three lakes showed a decrease in water clarity that may be related to shore land use and or runoff from impervious surfaces.	**Work with other agencies and the Cass Winnie Cleanwater Partnership to continue Monitoring lakes within the watersheds that are showing downward trends -Medium Pursue recommendation #30 -Medium Become involved in County water planning Efforts -Medium**
36) Although the fishery within the watersheds is above average, continued efforts need to be made to maintain and restore habitat in order to sustain this resource.	**Pursue recommendations #16 through #31. Maintain and enhance riparian and littoral zone vegetation -High Become involved in County water planning Efforts- Medium**
37) Shore land development along lake shores tend to result in a lack of diverse riparian habitat and a decrease in littoral zone vegetation	**Maintain and enhance littoral zone vegetation along undeveloped shorelines and work with other agencies to promote education about riparian values and restoration techniques. Become involved in County water planning Efforts -High**
38) Illegal dumping at various locations within the watershed are common along roads and trails that receive little use.	**Share the experiences of the Scenic Byway consortium from Grand Rapids that has actively marketed their connection with the Chippewa and designated scenic routes with communities on Highways 10/39 and 46- Medium**
	Work with community partners during the Development of corridor plans to identify scenic pullout proposals and ecological enhancement proposals such as wetland restoration or vegetative restoration -Medium

Findings	Recommendation
Core Topic: Recreation	
39) Use at recreation sites is not being monitored quantitatively especially for dispersed activities including trail use, dispersed camping use use of water accesses and river use; making it difficult to assess need for change in management.	**Develop a monitoring plan for tracking dispersed use at facilities -High**
40) Dispersed sites within the watershed have been evaluated and vary greatly in services provided and resource damage present.	**Establish Limits of Acceptable Change for dispersed campsites -High Summarize evaluations comparing them the limits of acceptable change and develop a plan of action to correct problems and upgrade campsite facilities where needed – High**
41) Star Island as well as Lake Windigo is an attractive destination for recreational boaters during mid summer. Many designated and user developed trails exist and it appears that not all are necessary. Sanitation is an issue with septic systems that have not been pumped regularly and inadequate toilet facilities exist at Windigo portage. Two wells need to be abandoned, one on the south shore and one on the north shore of Lake Windigo.	**Develop a recreation management plan for the island. Work with Beltrami and Cass Counties to develop a system for pumping septics on a regular basis and developing toilet facilities that meets environmental guidelines -High Abandon wells as soon as possible -High**
42) Trails in the Cass Winnie Watershed have been developed or designated recently but do not have an O&M Plan and no use is not monitored quantitatively.	**Monitor use and develop an O&M plan for Trails -High**
43) Scenic byways for 10/39 and 46 do not have vegetative or other enhancement corridor management plans.	**Develop plans -Medium**
44) The historic Cutfoot Sioux Ranger station is undergoing restoration and there is potential for additional interpre tation at the site.	**Work with community partners to develop a plan for future interpretation -Medium**

Findings	Recommendation
Recreation Continued	
45) The communities of Alvwood, Deer River, S Lake, Northome, Pennington, Cass Lake, and Blackduck all have an opportunity to capitalize on the common themes of the two Scenic Byways.	**Share the experiences of the Scenic Byway consortium from Grand Rapids that has actively marketed their connection with the Chippewa and designated scenic routes with communities on Highways 10/39 and 46- Medium**
46) There is an opportunity on both of the new scenic byways to construct scenic pullouts and conduct ecological restoration.	**Work with community partners during the Development of corridor plans to identify scenic pullout proposals and ecological enhancement proposals such as wetland restoration or vegetative restoration -Medium**
47) There is interest in revitalization of the downtown area in Cass Lake, to construct a new visitor information center in Cass Lake and also to provide a staging area for bicyclists who utilize Megezi and the Paul Bunyan Trails.	**Actively participate with agencies, local community groups and the City of Cass Lake to create partnerships, leverage funding opportunities and cooperate on construction, design or interpretation and information services -High**
48) The Mississippi River is a recreation historic, scenic, cultural, biologic treasure that the Forest has not fully recognized as a recreation opportunity that we can provide.	**Work with the Mississippi Headwaters Board, local communities of Cass Lake, Deer River, Pennington, and Bena and non-profits to explore the recreation, biologic, historic and cultural opportunities associated with the river -High** **Manage the river corridor in order to protect the unique values that earned its recognition as an eligible wild and scenic river -High** **Consider establishing management area direction for the Mississippi River corridor in Forest Plan Revision -High**
49) Heavy to moderate vegetation management or modification of riparian areas has occurred on 66% of the permitted summer home lots. These riparian areas have less diverse habitat, may result in a higher risk of shoreline erosion and may not meet visual standards within retention and partial retention corridors.	**Enforce existing permit requirements and County standards regarding vegetation removal in riparian areas -High** **Develop a vegetative management plan for recreation residence groups –High** **See Recommendation #37**

Findings	Recommendation
Core Topic:Social	
50) Partnerships are vital in maintaining a wide variety of governmental, non-profit and private contacts and avenues of accomplishing project goals through by utilizing unique talents, leveraging funding and personnel resources.	**Hire a partnership coordinator to work With the other government agencies, non-profits and private individuals -High**
51) Beltrami, Cass and Itasca Counties project slow, steady growth. Increasing development of lake and river shoreline is anticipated.	**Be an active partner with local chamber of commerce groups as well as local natural resource planning entities to keep informed of emerging issues. This will help determine where management of the Chippewa affects the vitality of local and regional social and environmental communities and where there are opportunities to cooperate – High** **Evaluate concepts such as no net loss of NF shoreline ownership in the Forest Plan Revision -High** **Discuss the niche of recreation special uses in the long term role of the National Forests and the Chippewa –High** **Recognize the trend in increased shoreline development when developing project plans and strive for less developed project options -High**
52)The average age of the population of Beltrami, Cass and Itasca Counties continues to become older.	**Create a long-term outlook for Capital Investment Projects, trails, non-market demand to analyze and possibly reflect changes in demand -High**
53)Poverty continues to affect many of the county's residents.	**Analyze developed recreation fees and fee Demo knowing local use and demand- Medium**
54)Continuing interest by the LLBO and the CNF to explore managing lands within the LLIR to reflect Tribal and people of the United States interests.	**Continue to work collaboratively with the CNF and Leech Lake Band to reflect needs and desires within the Forest Plan Revision alternatives- High**

Findings	Recommendation
Social Continued	
56) The Forest Plan management area direction specifies scenic management guidelines for species composition in retention, partial retention and modification areas. Within retention corridors in all management areas aspen is over-represented. Paper birch and white spruce are under represented within management area 1.1 1.5. White spruce is under represented in management area 4.1 and Jack pine and balsam fir are over represented in partial retention and modification areas. In management areas 4.2 and 4.5 paper birch is under represented in partial retention and modification. White spruce is under represented in all corridors and northern hardwoods under represented in partial retention and modification.	**Prepare corridor management plans for Scenic Byways and work to increase under represented species in other corridors with special focus on retention and partial retention corridors -Medium**
57) Sixty six percent of the stands typed as aspen are under 40 year of age. Seven percent is between 41-60 years and twenty-eight percent is greater than 60 years with much of this group over 70 years old. Younger age classes dominate short rotation conifer types although fourty-eight percent is over the minimum rotation age. Middle age (61-120 years) northern hardwoods dominate the watershed, less than 5% is over 120 years old. Eighty two percent of the long rotation conifers are less than 100 years and less than 1% are over 140 years old.	**Look for opportunities to manage aspen by alternative silvicultural techniques as a way to move age class distributions away from younger age classes but also realize a product – High** **Use community types to determine appropriate age class distribution and species composition within project areas -High** **It appears that there may be opportunities for intermediate entries into long rotation conifer stands. Use community types to determine species composition -High** **Look for hardwood management opportunities and use community type to manage at a landscape level -High**

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4. Muskie by Gage 2001 Staff Photo Chippewa National Forest

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