MISSISSIPPI RIVER HEADWATERS RESERVOIRS
MASTER PLAN
AITKIN, CASS, CROW WING, AND ITASCA COUNTIES, MINNESOTA

MAIN REPORT

October 2016

PREFACE

The Mississippi River Headwaters' Master Plan is a strategic land-use document that will serve as a vital tool for the responsible stewardship of resources to benefit present and future generations. This plan provides guidance and facilitates appropriate management, use, development, enhancement, protection, and conservation of the natural, cultural and man-made resources located at the Mississippi Headwaters Reservoirs projects. This document will guide and articulate the U.S. Army Corps of Engineers' responsibilities pursuant to applicable federal laws, policies and regulations. The Master Plan is a dynamic, operational document projecting what could and should happen over the life of the project and is flexible based upon changing conditions. The Plan deals with concepts, rather than details of design or administration. Detailed management and administrative functions are addressed in each section's operational management plan, which implements the concepts of the Master Plan into operational actions. The Master Plan will include all land (fee, easements, or other interests) acquired for the project to support operations and authorized missions. Due to budget limitations, the Corps was unable to update either the mapping or the inventory of existing natural resources for the Sandy Lake Reservoir as part of the current project. These excluded components will be added to the Master Plan as a future supplement.

The primary goals of the Master Plan are to prescribe an overall land-use management plan and identify resource objectives and associated design and management concepts. The Master Plan was developed by an interdisciplinary Corps' team and included coordination with local, state, federal agencies and tribal representatives, along with input from special interest groups and members of the public. The plan provides guidance for appropriate use, development, enhancement, protection, and conservation of the natural, cultural, and man-made resources at the Headwaters. By definition, Master Plans for Corps reservoirs are land and recreational use management plans that do not address the technical aspects of water level management, regional water quality, shoreline management, or operation and maintenance of project operations facilities. To ensure consideration of natural and cultural resources, the Corps also prepared an environmental assessment (EA) to identify and evaluate potential impacts. The previous Mississippi Headwaters Reservoir Master Plan was approved in 1977. A supplement to the 1977 plan was completed in 1990.

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CHAPTER 1 - INTRODUCTION

1.1 Project Authorization

The River and Harbor Acts of June 14, 1880 (21 Stat. 180), and August 2, 1882 (22 Stat. 191), authorized the construction of the U.S. Army Corps of Engineers (Corps) dams at each of the six Mississippi River Headwaters' project sites for the purpose of augmenting the flow of the Mississippi River for navigation. The lakes affected by these acts include: Winnibigoshish, Leech, Pokegama, Sandy, Cross, and Gull. Following authorization of the reservoirs, Congress directed the Secretary of War to establish regulations governing their operation through the River and Harbor Act of August 11, 1888 (25 Stat. 400).

1.2 Project Purposes

Originally the Headwaters were authorized for navigational purposes, but subsequent legislation authorized additional objectives, including: flood control, recreation, fish and wildlife management/natural resource management, hydropower, water supply, and water quality.

1.2.1 Navigation. The Rivers and Harbors Act of 1880 (21 Stat. 180) passed June 14, 1880, authorized the Corps to construct the dams for navigation. The need for flow augmentation from the reservoirs was greatly reduced after the Mississippi River 9-foot Channel Project was completed in the 1930s. The 9-foot Channel Project is a system of 29 locks and dams from Minneapolis, Minnesota, to St. Louis, Missouri, with the primary purpose of maintaining a water depth of nine feet for navigation. The Headwaters has rarely been operated for navigational purposes since completion of this project.

1.2.2 Flood Control. Flood Control, also referred to as Flood Risk Management (FRM), is an authorized purpose as designated by the Flood Control Act of 1936, Public Law 74-738 (50 Stat. 844). The purpose of the Corps' FRM mission is to reduce the threat to life and reduce property damages from riverine and coastal flooding. The Corps' execution of the FRM program serves to integrate and synchronize programs and activities with counterpart activities within the Department of Homeland Security, Federal Emergency Management Agency (FEMA), and other federal, state, regional, and local entities. The Corps operates and manages the reservoirs in accordance with each site's approved water control manual. The Corps attempts to maintain reservoir levels at each site within a specified elevation band during the summer (typically May through September). Flood control objectives are met by a fall/winter drawdown schedule and designated flood control storage pool, which provides storage capacity for spring and summer runoff or high water events.

1.2.3 Recreation. The Flood Act of 1944, Public Law 78-534, and the Federal Water Project Recreation Act of 1965 (16 U.S.C. § 460*l*-12; Public Law 89-72, §1; 79 Stat. 213), authorized the purpose of recreation at Corps sites. The Corps' recreation-related activities contribute economic and social benefits to the communities they serve, providing a natural setting for visitors to engage in outdoor activities that promote physical, mental, and spiritual health. The Corps is the steward of the lands and waters at Corps' water resources projects. The Corps' natural resource management mission is to manage and conserve those natural resources, consistent with ecosystem management principles, while providing quality outdoor public recreation experiences to serve the needs of present and future generations. The Corps manages the long-term public access to, and use of, natural resources in cooperation with other federal, state, and local agencies, as well as the private sector. The Corps

integrates the management of diverse natural resources components, such as: fish, wildlife, forests, wetlands, grasslands, soil, air, and water with the provision of public recreation opportunities.

The Headwaters Reservoirs provide dependable and stable summer lake levels for people to recreate. In turn, these reservoirs benefit visitors, resort owners, lakeshore residents and area commerce.

1.2.4 Fish and Wildlife Management/Natural Resource Management. All Corps reservoirs must comply with the Fish and Wildlife Coordination Act (16 U.S.C. §§ 661-667e), as amended, and the Endangered Species Act of 1973 (16 U.S.C. § 1531 *et seq*.), Pub. L. 93–205, 87 Stat. 884 (1973), requiring federal facilities be managed, operated, and maintained to enhance and protect fish and wildlife. Numerous federal laws and executive orders establish national policy for and federal interest in the protection, restoration, conservation, and management of environmental resources. These provisions include compliance requirements and emphasize protecting environmental quality. They also endorse federal efforts to advance environmental goals. In addition to the Fish and Wildlife Coordination Act (FWCA) and the Endangered Species Act (ESA), recent water resources authorizations have enhanced opportunities for Corps involvement in studies and projects to specifically address objectives related to the restoration of ecological resources and ecosystem management. Examples of legislation that broadly supports federal involvement in the restoration and protection of ecological resources include:

- Federal Water Project Recreation Act of 1965, (16 U.S.C. § 460*l*-12), as amended.
- The National Environmental Policy Act of 1969, (42 U.S.C. § 4321 *et seq*.), as amended.
- Water Resource Development Acts of 1986, 1988, 1990, 1992, 1996, 1999, 2000, 2007 and 2014.
- Coastal Wetlands Planning, Protection and Restoration Act of 1990 (16 U.S.C. §§ 3951-3956).

1.2.5 Water Supply. The Water Supply Act of 1958, (43 U.S.C. § 390b *et seq*.) Public Law 85-500, designates water supply for municipal or industrial use as an authorized purpose; however, there is no provision in the Headwaters' water control manuals for the use or purpose of water supply. Various studies have been conducted analyzing the feasibility of using water from the Headwaters to supplement downstream needs. As a result of these studies, the Corps determined the Headwaters would have limited potential to supply the Minneapolis - Saint Paul metropolitan area with a source of water.

1.2.6 Water Quality. All Corps reservoirs must comply with the Federal Water Pollution Control Act, (33 U.S.C. § 1251 *et seq*.) Public Law 92-500, which requires that all federal facilities be managed, operated, and maintained to protect and enhance the quality of water through conformance with applicable federal, state, and local standards. Water quality objectives are met by maintaining minimum flows, maintaining reservoir levels within specified elevation bands during the summer, and performing annual drawdowns to create volume to store spring runoff.

Some of the main water quality concerns in the Headwaters relate to the threat of eutrophication and the spread of aquatic invasive species. At the Headwaters, the Corps does not own the shoreline around the entire reservoir. Each site works with the Minnesota Department of Natural Resources (MN DNR), Minnesota Pollution Control Agency, lake associations, and other concerned organizations to test and monitor the water quality of the lakes. Public policy and the activities of property owners and users of the watershed directly affect water quality. Lakeshore development in combination with other land-use activities and surface-water recreation increase sediment, nutrient, and other pollutant inputs. These inputs lead to unnatural eutrophication and reduce water quality. Other undesirable effects of lakeshore development and recreational use include the loss of native plants and animals, loss of littoral

habitat, and increases in invasive species including exotics. Protecting water quality through prudent policy and precautionary treatment of lakeshore property is more effective and less expensive than restoration of a degraded ecosystem.

All of the Headwaters' dams affect water levels in numerous adjoining lakes whose water surface elevations are within the operating range of reservoir operations. As such, dam operations may affect the water quality both upstream and downstream. The mechanisms by which water quality changes could be influenced by reservoir operation include:

- Higher or lower summer pool levels affect the size and placement of littoral and riparian communities. Changes in lake nutrition (inflow and cycling of nutrients) and localized dissolved oxygen conditions could happen, but would likely be minor.
- Changing the vertical operating range or changing the mode of the annual operating cycle could affect the size and placement of littoral and riparian communities and could modify the volume and seasonal timing of water movement into and out of riparian wetlands. Such water exchange could be a significant factor in assessing potential methyl-mercury loading and bioaccumulation in fish.
- Shoreline erosion due to elevated lake levels can influence water quality by creating a source for sediment, mercury, and phosphorus.

1.2.7 Hydropower. There are no existing or planned federal hydropower developments in the Headwaters. Releases from the Headwaters, particularly in the fall and winter, do improve the flow duration characteristics for downstream hydropower plants.

Currently, there are nine hydropower dams affected by the operation of the six Corps' Headwaters' dams. Two additional hydropower facilities are in various stages of completion downstream of the Corps' dams – Coon Rapids, currently under construction, and Upper St. Anthony, currently in the planning stage. Two dams (Stump Lake and Prairie) are not affected by the operation of the Corps' dams; however, their operation impacts the system's water control plan. Water is regulated from the six Corps' reservoirs in the fall and winter to draw down the water levels to create volume to store spring runoff. The total combined drawdown flow from all six dams varies each year dependent upon the hydrologic conditions (inflows, snowpack, etc.).

1.3 Purpose and Scope of Master Plan

The Mississippi Headwaters Reservoir Master Plan (The Master Plan) provides guidance for appropriate use, development, enhancement, protection, and conservation of the natural, cultural, and man-made resources at the Headwaters. It serves as a vital tool for the responsible stewardship of project resources for the benefit of present and future generations. A Master Plan is programmatic and identifies conceptual types and levels of activities, not designs, project sites, or estimated costs. All actions by the Corps and individuals who are granted leases to Corps lands must be consistent with the Master Plan. Therefore, it must be kept current to provide effective guidance in the Corps' decision-making. The previous Mississippi Headwaters Reservoir Master Plan was approved in 1977. A supplement to the 1977 plan was completed in 1990.

The Master Plan is based on regional and local needs, resource capabilities, and expressed public interests that are consistent with authorized project purposes. It provides a district-level policy consistent with national objectives, as well as state and regional goals and programs. This Master Plan supersedes the previous Mississippi Headwaters Reservoir Master Plan (1977).

The Master Plan presents an inventory of land resources, land classification, an analysis of resource use, anticipated influences on resources, and an evaluation of future needs (required to provide a balanced management plan for cultivating the value of the land and water resources). Also included in the Master Plan is an evaluation of expressed public opinion, resource objectives, and a land classification system that will guide the future development of the Headwaters' project. Public input was important in identifying significant resources; problems and opportunities; and resource objectives. These factors were taken into consideration in forming the Master Planning process and final recommendations.

Both the Master Plan and Environmental Assessment (EA) were prepared in accordance with the following guidance:

- Engineer Regulation (ER) 1130-2-550, *Project Operations – Recreation Operations and Maintenance Guidance and Procedures,* 15 November 1996 (with changes 1 October 1999, 1 March 2002, 15 August 2002, 30 August 2008, 30 March 2009, 30 January 2013, and 30 September 2013).
- Engineer Manual 1110-1-400, *Engineering and Design – Recreation Facility and Customer Service Standards*, 1 November 2004.
- ER 200-1-5, *Environmental Quality – Policy for Implementation and Integrated Application of the USACE Environmental Operating Principles and Doctrine*, 30 October 2003.
- ER 200-2-2, *Environmental Quality – Procedures for Implementing the National Environmental Policy Act*, 4 March 1988.
- ER 1105-2-100, *Planning Guidance Notebook, 22 April 2000 (with App D and G revised June 2004, App F revised January 2006, App H revised November 2007)*.

The Master Plan will not discuss or propose changes to the operation of the Headwaters' dams.

1.4 Mississippi Headwaters Lakes Project

The Corps began construction on the Headwaters' Dams in 1881, completing them in 1912. The Headwaters are a set of impounded natural lakes that were formed approximately 10,000 years ago by receding glaciers in north-central Minnesota. This project consists of six dams that regulate reservoirs on Lake Winnibigoshish, Leech Lake, Pokegama Lake, Sandy Lake, Cross Lake, and Gull Lake. Lake Winnibigoshish and Pokegama dams are located on the main stem of the Mississippi River. The others are all situated on tributary streams. Although these dams were constructed to aid in commercial navigation, they are currently operated for the general public good and with consideration of the tribal trust relationship for purposes of flood risk management, recreation, and fish and wildlife habitat. The total drainage area upstream of these dams is 4,535 square miles. The vegetation throughout the Headwaters includes a number of plant communities, including pine-mixed hardwood, birch-aspen, and bog and marsh. The habitats of the Headwaters are diverse and support an abundance of fish and wildlife.

Figure 1 shows all six Headwaters' project sites. Additional maps for each project site can be found in Appendix C – Plates.

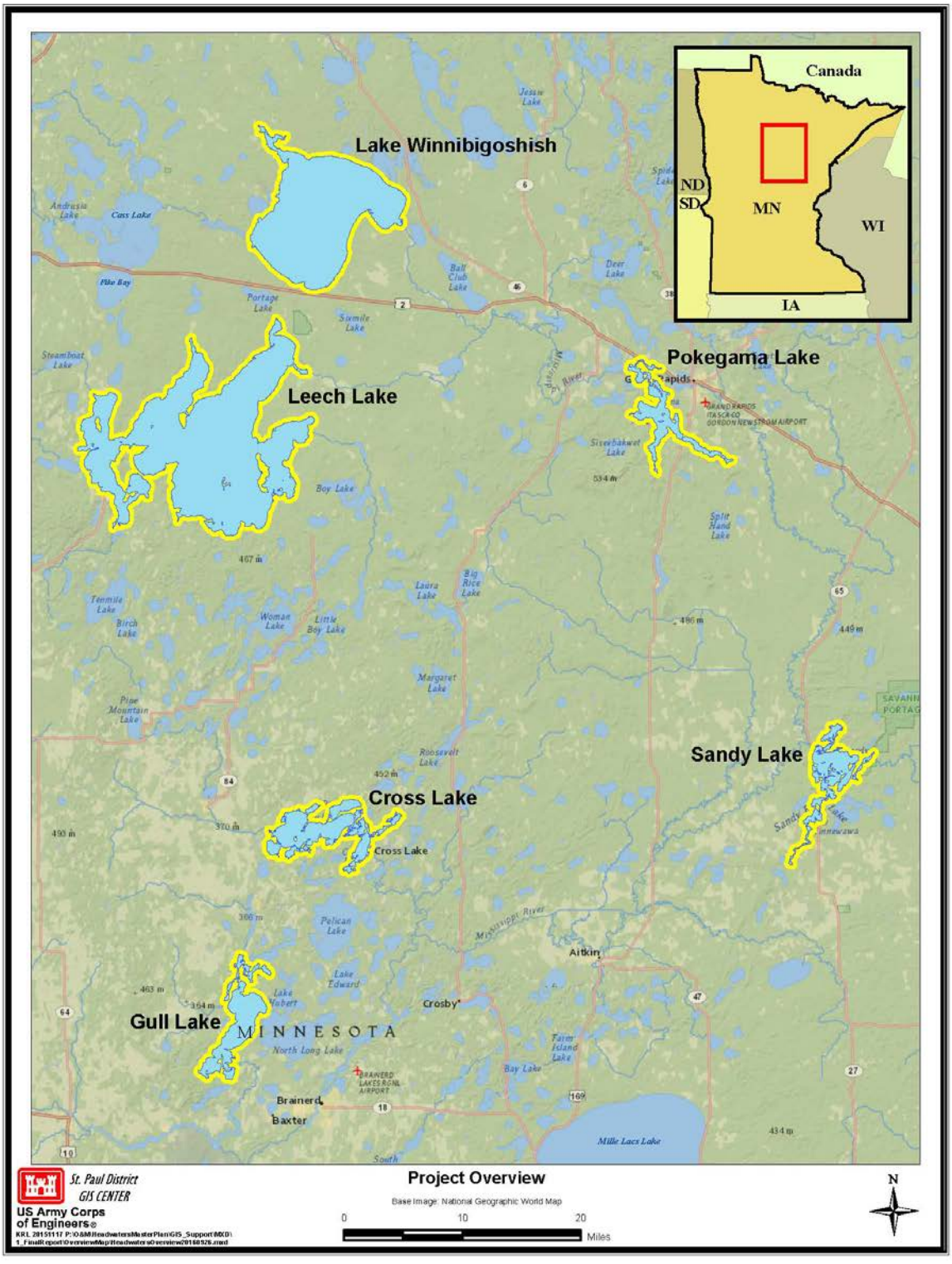

Figure 1. Headwaters' Project Overview.

1.4.1 Lake Winnibigoshish. The Winnibigoshish or "Winnie" Dam was the first dam built on the Mississippi River. The Corps began construction of the original timber dam in 1881. The timber dam was put into operation in 1884 and was renovated with concrete in 1901. The Winnie Dam is situated on the Mississippi River at the outlet of Lake Winnibigoshish, approximately 14 miles northwest of Deer River, Minnesota. The dam is approximately 170 river miles downstream from the source of the Mississippi River at Lake Itasca and 408 river miles above St. Paul, Minnesota. Lake Winnibigoshish is 67,000 acres in size with about 140 miles of shoreline. The reservoir receives runoff from 1,442 square miles, and the operation of Winnibigoshish reservoir affects 29 lakes in addition to Lake Winnibigoshish.

In May 1905, the Corps was granted permanent use of 134 acres at the dam site by the U.S. Department of the Interior (DOI). The DOI subsequently transferred 31 acres of the original grant to the State of Minnesota in 1949. The Corps holds 82,400 acres of flowage easements on federal and private lands around the reservoir. Although no land is held in fee title, the Corps administers the land granted by the permanent use permit as if it were held in fee title.

Nearly 2 million board-feet of white and Norway pine cut from the lakeshore of Lake Winnibigoshish were used in the original construction of the pilings, dam, and other structures. Unlike other Headwaters' lakes, Winnie remains mostly undeveloped and is surrounded primarily by public land, particularly the Chippewa National Forest. The lake is a popular fishing destination and is highly regarded as one of the premier walleye and perch lakes in the upper Midwest.

1.4.2 Leech Lake. The Corps began construction of the Leech Lake Dam in 1883 and put the dam into operation in 1885. The Leech Lake Dam is located at the northwest edge of the town of Federal Dam, Minnesota, at the outlet of the reservoir on the Leech Lake River. The dam is located 27 miles above the junction of the Leech Lake River with the Mississippi River, 410 river miles above St. Paul, Minnesota, and is geographically located approximately 100 miles west-northwest of Duluth, Minnesota. Leech Lake is the third largest lake in Minnesota, covering 111,527 acres. The reservoir controls the runoff from 1,163 square miles, and operations affect 13 natural lakes in addition to Leech Lake.

The project is adjacent to the Leech Lake Reservation and also located within the Chippewa National Forest. The Corps manages 314 acres at Leech Lake, of which 119 acres are held in fee title. The remaining 195 acres are held under a permanent-use permit from the DOI, which the Corps administers as if it were held in fee title. The Corps also holds an additional 100,541 acres in flowage easements.

Anglers are drawn to the lake for its vast fishing opportunities, including walleye, perch, musky, and bass. The Leech Lake Recreation Area provides water access to Portage Bay, the largest bay on Leech Lake, via the Leech Lake River, in which the Corps operates and maintains a buoyed navigation channel. A private concessionaire operates a marina upstream from the dam.

1.4.3 Pokegama Lake. Construction of the Pokegama Dam started in June 1883 with the dam going into operation in 1884. The Corps completed reconstruction of the dam from timber to concrete in 1904, with periodic maintenance and upgrades completed since that time. Pokegama Dam lies on the Mississippi River approximately 3 miles upstream of the city of Grand Rapids, Minnesota and 345 river miles above St. Paul, Minnesota. Pokegama Lake measures 16,800 acres, and the reservoir receives runoff from 3,265 square miles. The basin is located 150 miles north of Minneapolis, Minnesota. The operation of Pokegama Reservoir affects 17 natural lakes in addition to Pokegama Lake. The Corps

holds fee title to 10 acres at the dam site. The Corps also has flowage easements on an additional 54,235 acres and flowage rights reserved on 12,288 acres of public domain lands around the reservoir.

Prior to impoundment, Pokegama Lake was mostly wetland and was described by locals as a vast region of wild rice. Below the lake was a series of falls. The Pokegama Dam was built in the narrows just above a smaller set of falls. A larger 10-foot drop was covered with water when a paper mill dam opened just downstream. This reach of rough water was historically known as the Grand Rapids of the Mississippi River, now the namesake of the town.

The Pokegama Recreation Area is easily accessed by visitors as it is adjacent to heavily traveled U.S. Highway 2, just west of the town of Grand Rapids. The campsites adjacent to the Mississippi River give campers a spectacular view.

1.4.4 Sandy Lake. The Sandy Lake Dam was completed in 1895. The Dam is located on the Sandy River, approximately 1 mile upstream of the junction of the Sandy and Mississippi Rivers, 264 river miles above St. Paul, Minnesota. The Sandy Lake reservoir is 9,400 acres at normal pool and receives runoff from 421 square miles. The basin is located roughly 60 miles west of Duluth, Minnesota and 120 miles north of Minneapolis, Minnesota. It is the most eastern watershed of the six Headwaters' basins and is the only Corps' Headwaters reservoir that does not share a common boundary with another Headwaters reservoir watershed. The backwater effect from the dam affects eight lakes that are connected to the reservoir. The Corps holds fee title to 1,164 acres of land and flowage easements on another 7,978 acres at Sandy Lake.

A navigation lock, the only one in the Headwaters reservoir system, was completed a few years after the dam was built, but is no longer in use. Its purpose was to allow steamboat travel within the developing Sandy Lake area. The dam site is near the terminus of the Historic Savanna Portage, which connected Sandy Lake and the Upper Mississippi River with the St. Louis River and Lake Superior. The 6-mile canoe portage was used first by Native Americans and later by explorers, fur traders, and missionaries in the 18th and 19th centuries.

1.4.5 Cross Lake – Pine River Dam. Construction began on the Pine River Dam in 1884, and it was put into operation in 1886. It was reconstructed from timber to concrete between 1905 and 1907 and was last remodeled in 2002. The dam and recreation area are located in Crosslake, Minnesota, 22 miles north of Brainerd, Minnesota. The dam is situated on the Pine River at the outlet of Cross Lake, 15 river miles above the junction of the Pine and Mississippi Rivers, and 199 river miles above St. Paul, Minnesota. The lakes that form Cross Lake Reservoir, which measures 13,660 acres, are commonly referred to as the Whitefish Chain of Lakes and are located completely within the boundary of Crow Wing County.

The Pine River Dam controls the runoff from a 562 square mile basin. The basin is located 90 miles west of Duluth and 120 miles north-northwest of Minneapolis. The backwater effect from the dam affects 15 lakes that are connected to the reservoir.

The Corps administers 432 acres of land held in fee title at the Cross Lake Recreation Area (formerly known as the Ronald Louis Cloutier Recreation Area) and a number of additional parcels scattered around the reservoir system. These parcels include lands on South Cross Lake Bay, Clamshell Lake, Upper Whitefish, Arrowhead, Rush, Big Trout, Little Pine, Upper Hay, and Lower Hay Lake. The Corps also holds an additional 21,718 acres in flowage easements.

The Cross Lake Recreation Area is best known for its highly-visited campground and two swimming areas. The Corps owns and/or operates six of the seven public boat accesses on the Whitefish Chain of Lakes.

1.4.6 Gull Lake. The Gull Lake Dam was the last of the Headwaters reservoir dams to be constructed, but was the first structure initially built of concrete instead of timber. The dam was put into service in 1911, and the concrete structure was completed in 1912. The dam is on the Gull River about half a river mile below the outlet of Gull Lake, 11 river miles upstream of the junction of the Crow Wing and Mississippi Rivers, and approximately 167 river miles upstream of St. Paul.

The Gull Lake Reservoir measures 13,000 acres at normal pool level. It is located 8 miles northwest of Brainerd, Minnesota and receives runoff from 287 square miles. The basin is located approximately 100 miles northwest of Minneapolis, Minnesota and the same distance west of Duluth, Minnesota. The backwater effect from the dam affects ten natural lakes that are connected to the reservoir.

The Corps presently administers two parcels of land: 21 and 82 acres, totaling 103 acres. The 21-acre parcel is situated on the north shore of Nisswa Lake and is predominately marshland considered unacceptable for any intensive recreational development, and is categorized as fee title land. The 82-acre parcel was acquired by the DOI in 1895 under a special-use permit and is located adjacent to the dam site on the Gull River. The land has been developed into the Gull Lake Recreation Area, providing camping and day use opportunities. The Corps holds an additional 15,058 acres in flowage easements at the reservoir.

The Gull Lake Recreation Area (formerly known as the Terry R. Johnson Recreation Area) has land on both the Gull River and Gull Lake. Archeological evidence suggests that the area around Gull Lake Dam has been inhabited several times since 800 B.C. and is the site of several Aboriginal burial mounds. Gull Lake is well known as a fishing and water recreation destination. The campground and day use area are highly utilized by the public.

1.5 Prior Design Memorandums

The original Master Plans for the six reservoir projects were completed by the St. Paul District Corps of Engineers between 1964 and 1967 for each individual reservoir project. In 1977, the Corps revised the Master Plan by modifying the format to a watershed-based approach, wherein each reservoir project was incorporated to one Master Plan document. The creation of the 1977 Master Plan was contracted to a design firm with input from the Corps. In 1990, the Master Plan was reviewed by an interdisciplinary team from the Corps, and a minor supplement and EA were created as a result to update sections that pertained to project developments.

1.6 Project Information

Tables 1 -7 describe pertinent information regarding each of the reservoir projects.

Table 1. Headwaters Project Summary.

DAM CONSTRUCTION	
Began	1881 – Winnibigoshish
Completed	1912 – Gull Lake
DAMS	

HEADWATERS' SUMMARY		
	Number of Dams	6
	Number of Perimeter Dikes	30
	RESERVOIRS	
	Total Acreage of Drainage Basins Controlled	4,535 square miles
	Number of Natural Lakes Affected	99
	Total Capacities at Normal Summer Pool	
	Total Reservoir Area	235,800 acres
	Total Reservoir Storage	1,600,000 acre-feet
	Total Capacities at Max Operating Limits	
	Total Reservoir Area	340,700 acres
	Total Reservoir Storage	2,899,000 acre-feet
	REAL ESTATE	
	Fee Title Lands	1,745.9 acres
	Use Permit Lands	385.3 acres
	Flowage Easement Lands	294,218.2 acres
	RECREATION*	
	Recreation Areas	13 – Corps Managed; 5 – Out grant Managed
	Campsites	321
	Beaches	5
	Boat Ramps (on Corps Fee-owned/Administered Lands)	13 – Corps Managed; 2 – Out grant Managed
	Marinas	1 – Out grant Managed
	Group Picnic Shelters	7
	VISITATION	
	2014 Visitation	Data Not Available**
	2013 Visitation	Data Not Available**
	2012 Visitation	2,556,658
	2011 Visitation	2,291,305
	2010 Visitation	1,998,605
	2009 Visitation	2,361,717
	STAFFING (Measured in Full Time Equivalent – FTE's)	
	2014 FTEs	16.1
	2013 FTEs	16.9
	2012 FTEs	17.3
	2011 FTEs	16.8
	2010 FTEs	16.3

** Facilities are Corps managed unless otherwise noted.*

***Due to ongoing Corps-wide efforts to update, verify, and standardize how visitation is estimated at project sites, visitation data is not available past 2012, at the time of Master Plan revision.*

Table 2. Winnibigoshish Pertinent Project Information.

	DAM CONSTRUCTION	
	Began	1881
	Completed	1884

WINNIBIGOSHISH

Rehabilitation to Concrete Began	1899			
Rehabilitation to Concrete Ended	1901			
Estimated Cost (**historical cost - 1901**)	$387,470			
DAM				
Type	Embankment: Earthfill with timber diaphragm Outlet Structure: Gated multi-bay concrete sluiceways, concrete on timber piling			
Embankment Length	1,000 feet			
Embankment Top Width	20 feet			
Embankment Height	26 feet			
Outlet Structure Length	162 feet			
Number of Gates	5 (14 ft. wide bays divided into 3 sections), 1 (12 ft. wide) log sluice			
Number of Perimeter Dikes	4			
Maximum Operating Limit	1303.14' NVGD29			
RESERVOIR				
Drainage Basin	1,442 square miles			
Natural Lakes Affected in Drainage Basin	*1. Lake Winnibigoshish* *2. Cutfoot Sioux Lake* *3. Little Cutfoot Sioux* *4. Sunken Lake* *5. Little Lake* *6. Brauswah Lake* *7. Upper Pidgeon Lake*	*8. Middle Pidgeon Lake* *9. Lower Pidgeon Lake* *10. Dixon Lake* *11. Little Dixon Lake* *12. Little Wolf Lake* *13. Kenogama Lake* *14. Raven Lake*	*15. Rabbits Lake* *16. Sugar Lake* *17. Cass Lake* *18. Rice Lake* *20. Popple Lake* *12. Sioux Lake* *23. Buck Lake*	*24. Kitchi Lake* *25. Long Lake* *26. Big Lake* *27. Burns Lake* *28. Moose Lake* *29. Andrusia* *30. Pike Bay*
Summer Pool Target Elevation	1298.19' NVGD29			
Area	66,000 acres			
Storage	700,000 acre-feet			
Flood Elevation at Max Operating Limit	1303.14' NVGD29			
Area	115,000 acres			
Storage	1,114,000 acre-feet			
Flowage Easement Acquired Elevation (Approximate)	1306.86' NVGD29			
Minimum Outflow During Normal Conditions	100 cfs			
Average Annual Inflow	720 cfs			

RECORD HIGH POOL & LAKE ELEVATIONS SINCE 1936*		
DATE	***POOL ELEVATION (NVGD29)***	***LAKE ELEVATION (NVGD29)***
June 15, 2001	1300.20'	Not Available
July 08, 1975	1300.58'	Not Available
July 4, 1957	1300.84'	Not Available
June 26, 1950	1303.17'	Not Available
August 20, 1944	1301.74'	Not Available
August 15, 1943	1301.79'	Not Available

REAL ESTATE	
Fee Title Lands	0
Dept. of Interior Special Use Permit Lands	103.2 acres
Flowage Easement Lands	82,400 acres
RECREATION**	
Recreation Areas	2
Campsites	22
Beaches	0
Boat Ramps (on Corps Fee-owned/Administered Lands)	1
Marinas	0
Group Picnic Shelters	1
VISITATION	
2014 Visitation	Data Not Available***
2013 Visitation	Data Not Available***
2012 Visitation	450,600
2011 Visitation	392,718
2010 Visitation	412,306
2009 Visitation	380,429

** The current reservoir operating plan began in 1936. Caution should be exercised when comparing pre-1936 events to later events. For the sake of operational consistency, only high water events post-1936 are presented in this table.*

*** Facilities are Corps managed unless otherwise noted.*

****Due to ongoing Corps-wide efforts to update, verify, and standardize how visitation is estimated at project sites, visitation data is not available past 2012, at the time of Master Plan revision.*

Table 3. Leech Lake Pertinent Project Information.

LEECH LAKE

DAM CONSTRUCTION				
Began	1883			
Completed	1885			
Rehabilitation to Concrete Began	1899			
Rehabilitation to Concrete Ended	1903			
Estimated Cost (**historical cost - 1904**)	$246,688.40			
DAM				
Type	Embankment: Earth fill with timber diaphragm & puddle clay-filled core Outlet Structure: Multi-bay concrete control structure with concrete apron			
Embankment Length	3,314 ft.			
Embankment Top Width	28 ft.			
Embankment Height	15 ft.			
Outlet Structure Length	294 ft.			
Number of Gates	1 (12 ft. wide) log-sluiceway w/ stop logs, 20 (6 ft. wide) sluiceways w/ stop logs, 5 (4 ft. wide) slide gates			
Number of Perimeter Dikes	0			
Maximum Operating Limit	1297.90' NVGD			
RESERVOIR				
Drainage Basin	1,163 square miles			
Natural Lakes Affected in Drainage Basin	*1. Leech Lake* *2. Steamboat Lake* *3. Little Steamboat Lake* *4. Boy Lake*	*5. Portage Lake* *6. Lamish Lake* *7. Lomish Lake* *8. Swift Lake*	*9. Sucker Lake* *10. Swamp Lake* *11. Kabekona Lake* *12. Benedict Lake*	*13. Horseshoe Lake* *14. Garfield Lake*
Summer Pool Target Elevation	1294.70' NVGD29			
Area	117,000 acres			
Storage	580,000 acre-feet			
Flood Elevation at Max Operating Limit	1297.90' NVGD29			
Area	161,000 acres			
Storage	1,250,000 acre-feet			
Flowage Easement Acquired Elevation (Approximate)	1301.70' NVGD29			
Minimum Outflow During Normal Conditions	120 cfs			
Average Annual Inflow	720 cfs			

RECORD HIGH POOL & LAKE ELEVATIONS SINCE 1936*		
DATE	***POOL ELEVATION (NVGD29)***	***LAKE ELEVATION (NVGD29)***
June 30, 2014	1295.65'	1295.71'
June 16, 2001	1295.77'	1296.09'
July 07, 1975	1295.98'	1296.05'
July 10, 1962	1295.99'	1296.18'
June 26, 1950	1296.94'	Not Available
August 19, 1944	1296.58'	1296.60'

REAL ESTATE		
Fee Title Lands	118.5 acres	
Dept. of Interior Special Use Permit Lands	195.3 acres	
Flowage Easement Lands	100,541.2 acres	

	RECREATION**	
	Recreation Areas	1 - Corps Managed; 1 – Out grant Managed****
	Campsites	78
	Beaches	0
	Boat Ramps (on Corps Fee-owned/Administered Lands)	3
	Marinas	1 – Out grant Managed****
	Group Picnic Shelters	1
	VISITATION	
	2014 Visitation	Data Not Available***
	2013 Visitation	Data Not Available***
	2012 Visitation	456,987
	2011 Visitation	407,972
	2010 Visitation	421,062
	2009 Visitation	391,089

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***** Out grant refers to agencies other than the Corps that are managing facilities on Corps fee-owned lands. Such agencies include: other federal agencies, military organizations, state agencies, local government agencies, businesses, non-profit, quasi-public, or community organizations, and educational institutions (such as schools and universities).*

Table 4. Pokegama Lake Pertinent Project Information.

	DAM CONSTRUCTION				
	Began	June 1883			
	Completed	1884			
	Rehabilitation to Concrete Began	1889			
	Rehabilitation to Concrete Ended	1904			
	Estimated Cost (**historical cost - 1904**)	$211,030			
	DAM				
	Type	Embankment: Earth fill with timber diaphragm Outlet Structure: Gated multi-bay concrete sluiceways on quartzite outcropping.			
	Embankment Length	160 feet			
	Embankment Top Width	20 feet			
	Embankment Height	14 feet			
	Outlet Structure Length	225 ft.			
POKEGAMA	Number of Gates	13 (8 ft. wide) sluiceways, 1 (12 ft. wide) log sluice			
	Number of Perimeter Dikes	5			
	Maximum Operating Limit	1278.42’ NVGD29			
	RESERVOIR				
	Drainage Basin	660 square miles			
	Natural Lakes Affected in Drainage Basin	*1. Pokegama* *2. Ball Club Lake* *3. White Oak Lake* *4. Little White Oak* *5. Rice Lake*	*6. Little Rice Lake* *8. Vermillion Lake* *9. Little Vermillion Lake* *11. Siseebakwet Lake* *12. Little Siseebakwet*	*11. Gould Lake* *12 Loon Lake* *13. Long Lake* *14. Snells Lake* *15. Leighton Lake*	*16. Blackwater Lake* *17. Cutoff Lake* *18. Little Drum Lake*
	Summer Pool Target Elevation	1273.42’ NVGD29			
	Area	16,800 acres			
	Storage	98,000 acre-feet			
	Flood Elevation at Max Operating Limit	1278.42’ NVGD29			
	Area	23,200 acres			
	Storage	158,000 acre-feet			

	Flowage Easement Acquired Elevation (Approximate)	1280.42' NVGD29	
	Minimum Outflow During Normal Conditions	200 cfs	
	Average Annual Inflow	1,200 cfs	
	RECORD HIGH POOL & LAKE ELEVATIONS SINCE 1936*		
	DATE	***POOL ELEVATION (NVGD29)***	***LAKE ELEVATION (NVGD29)***
	May 01, 2001	1276.62'	1276.75'
	May 06, 1975	1276.77'	1277.00'
	May 10, 1954	1277.11'	1276.91'
	May 14, 1950	1277.03'	1277.39
	April 29, 1948	1277.89'	1277.90'
	March 30, 1945	1277.03'	1277.33'
	REAL ESTATE		
	Fee Title Lands	9.8 acres	
	Dept. of Interior Special Use Permit Lands	0	
	Flowage Easement Lands	66,523.0 acres	
	RECREATION**		
	Recreation Areas	1	
	Campsites	21	
	Beaches	0	
	Boat Ramps (on Corps Fee-owned/Administered Lands)	1	
	Marinas	0	
	Group Picnic Shelters	1	
	VISITATION		
	2014 Visitation	Data Not Available***	
	2013 Visitation	Data Not Available***	
	2012 Visitation	404,319	
	2011 Visitation	349,440	
	2010 Visitation	380,784	
	2009 Visitation	345,713	

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Table 5. Sandy Lake Pertinent Project Information.

	DAM CONSTRUCTION	
	Began	May 1891
	Completed	October 1895
	Rehabilitation to Concrete Began	1907
	Rehabilitation to Concrete Ended	1912
	Estimated Cost (**historical cost - 1931**)	$480,141.61
SANDY LAKE	**DAM**	
	Type	Embankment: Earth fill with timber diaphragm Outlet Structure: Gated multi-bay mass concrete sluiceways and apron supported by original timber pilings.
	Embankment Length	1,586 feet total
	Embankment Top Width	22 feet
	Embankment Height	20.5 feet
	Outlet Structure Length	109 feet

Number of Gates	6 (5 ft. wide x 4 ft. tall) bays, 1 log sluice (11 ft. wide), 1 lock chamber (30 ft. wide x 160 ft. long)			
Number of Perimeter Dikes	4			
Maximum Operating Limit	1221.31' NVGD29			
RESERVOIR				
Drainage Basin	421 square miles			
Natural Lakes Affected in Drainage Basin	*1. Sandy Lake* *2. Aitkin Lake*	*3. Sandy River Flowage (Flowage Lake)* *4. Round*	*5. Tiesen* *6. Sandy River*	*7. Davis* *8. Rat*
Summer Pool Target Elevation	1216.31' NVGD29			
Area	9,400 acres			
Storage	62,000 acre-feet			
Flood Elevation at Max Operating Limit	1221.31' NVGD29			
Area	12,900 acres			
Storage	118,000 acre-feet			
Flowage Easement Acquired Elevation (Approximate)	1222.31' NVGD29			
Minimum Outflow During Normal Conditions	20 cfs			
Average Annual Inflow	249 cfs			
RECORD HIGH POOL & LAKE ELEVATIONS SINCE 1936*				
DATE	***POOL ELEVATION (NVGD29)***	***LAKE ELEVATION (NVGD29)***		
June 29, 2012	1222.93'	Lake gage discontinued		
April 30, 2001	1221.76'	Lake gage discontinued		
May 6, 1975	1222.10'	Lake gage discontinued		
April 25, 1969	1221.75'	Lake gage discontinued		
May 19, 1950	1224.80'	1224.82'		
REAL ESTATE				
Fee Title Lands	1,164.3 acres			
Dept. of Interior Special Use Permit Lands	0			
Flowage Easement Lands	7,998.0 acres			
RECREATION**				
Recreation Areas	1			
Campsites	60			
Beaches	1			
Boat Ramps (on Corps Fee-owned/Administered Lands)	3			
Marinas	0			
Group Picnic Shelters	1			
VISITATION				
2014 Visitation	Data Not Available***			
2013 Visitation	Data Not Available***			
2012 Visitation	186,066			
2011 Visitation	177,917			
2010 Visitation	182,631			
2009 Visitation	293,434			

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Table 6. Cross Lake Pertinent Project Information.

CROSS LAKE

DAM CONSTRUCTION				
Began	1884			
Completed	March 1886			
Rehabilitation to Concrete Began	1905			
Rehabilitation to Concrete Ended	1908			
Estimated Cost (**historical cost – 2003 rehab**)	$11,278,761.93			
DAM				
Type	Embankment: Earth fill with timber diaphragm & puddled clay & sheet pile, concrete capped wall Outlet Structure: Gated multi-bay reinforced concrete control structure with concrete apron			
Embankment Length	1769 feet			
Embankment Top Width	N/A			
Embankment Height	23.9 feet			
Outlet Structure Length	150 feet			
Number of Gates	13 (6 ft. wide x 17 ft. tall)			
Number of Perimeter Dikes	17			
Maximum Operating Limit	1235.30			
RESERVOIR				
Drainage Basin	562 square mile			
Natural Lakes Affected in Drainage Basin	*1. Cross Lake* *2. Dagget Lake* *3. Little Pine Lake* *4. Rush Lake*	*5. Island Lake* *6. Ox Lake* *7. Upper White Fish* *8. Lower White Fish*	*9. Big Trout Lake* *10. Arrowhead Lake* *11. Pig Lake* *12. Clamshell Lake*	*13. Bertha Lake* *14. Upper Hay Lake* *15. Lower Hay Lake*
Summer Pool Target Elevation	1229.32’ NVGD29			
Area	13,600 acres			
Storage	101,000 acre-feet			
Flood Elevation at Max Operating Limit	1235.30’ NVGD29			
Area	15,500 acres			
Storage	188,000 acre-feet			
Flowage Easement Acquired Elevation (Approximate)	1238.82’ NVGD29			
Minimum Outflow	30 cfs			
Average Annual Inflow	270 cfs			
RECORD HIGH POOL & LAKE ELEVATIONS SINCE 1936*				
DATE	***POOL ELEVATION (NVGD29)***	***LAKE ELEVATION (NVGD29)***		
June 23, 2012	1230.09’	Not Available		
May 17, 1999	1230.17’	Not Available		
June 12, 1965	1230.57’	Not Available		
May 25, 1950	1231.41’	Not Available		
June 17, 1944	1231.98’	Not Available		
June 17, 1943	1231.50’	Not Available		
REAL ESTATE				
Fee Title Lands	432.1 acres			
Crow Wing County Special Permit Lands	5.0			
Flowage Easement Lands	21,717.7 acres			
RECREATION**				
Recreation Areas	5 – Corps Managed; 4 Out grant Managed****			
Campsites	122			
Beaches	3			
Boat Ramps (on Corps Fee-owned/Administered Lands)	4 - Corps Managed; 2 - Out grant Managed*****			
Marinas	0			

	Group Picnic Shelters	2
	VISITATION	
	2014 Visitation	Data Not Available***
	2013 Visitation	Data Not Available***
	2012 Visitation	498,156
	2011 Visitation	484,400
	2010 Visitation	478,850
	2009 Visitation	458,937

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***** Out grant refers to agencies other than the Corps that are managing facilities on Corps fee-owned lands. Such agencies include: other federal agencies, military organizations, state agencies, local government agencies, businesses, non-profit, quasi-public, or community organizations, and educational institutions (such as schools and universities).*

Table 7. Gull Lake Pertinent Project Information.

GULL LAKE						
	DAM CONSTRUCTION					
	Began	1911				
	Completed	1912				
	Rehabilitation to Concrete Began	N/A – Original structure				
	Rehabilitation to Concrete Ended	N/A – Original structure				
	Estimated Cost (**historical cost - 1912**)	71,430.00				
	DAM					
	Type	Embankment: Earth fill with concrete curtain wall Outlet Structure: Gated multi-bay concrete control structure with concrete apron				
	Embankment Length	201 feet				
	Embankment Top Width	26 feet				
	Embankment Height	9.4 feet				
	Outlet Structure Length	68.9 feet				
	Number of Gates	5 (5ft. wide x 4 ft. high) slide gates, 1 (11 ft. wide) stop log bay				
	Number of Perimeter Dikes	0				
	Maximum Operating Limit	1194.75				
	RESERVOIR					
	Drainage Basin	287 square miles				
	Natural Lakes Affected in Drainage Basin	*1. Gull Lake*	*3. Roy Lake*	*5. Round Lake*	*7. Bass Lake*	*9. Hole-in-the-Day*
		2. Upper Gull Lake	*4. Nisswa Lake*	*6. Spider Lake*	*8. Love Lake*	*10. Margaret Lake*
	Summer Pool Target Elevation	1194.00' NVGD29				
	Area	13,000 acres				
	Storage	62,015 acre-feet.				
	Flood Elevation at Max Operating Limit	1194.75' NVGD29				
	Area	13,100 acres				
	Storage	71,000 acre-feet				
	Flowage Easement Acquired Elevation (Approximate)	1194.75' NVGD29				
	Minimum Outflow	20 cfs				
	Average Annual Inflow	152 cfs				
	RECORD HIGH POOL & LAKE ELEVATIONS SINCE 1936*					
	DATE	***POOL ELEVATION (NVGD29)***		***LAKE ELEVATION (NVGD29)***		
	May 30, 2012	1,194.54'		1195.09'		

	May 17, 1999	1194.31’	1194.79’
	July 22, 1952	1194.51’	1195.09’
	May 10, 1950	1194.46’	1195.01’
	May 11, 1938	1194.78’	1195.01’
	July 16, 1937	1194.64’	1195.04’
	REAL ESTATE		
	Fee Title Lands	21.1 acres	
	Dept. of Interior Special Use Permit Lands	81.9 acres	
	Flowage Easement Lands	15,058.3 acres	
	RECREATION**		
	Recreation Areas	3	
	Campsites	39	
	Beaches	1	
	Boat Ramps (on Corps Fee-owned/Administered Lands)	1	
	Marinas	0	
	Group Picnic Shelters	1	
	VISITATION		
	2014 Visitation	Data Not Available***	
	2013 Visitation	Data Not Available***	
	2012 Visitation	560,530	
	2011 Visitation	478,858	
	2010 Visitation	544,034	
	2009 Visitation	492,115	

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CHAPTER 2 - PROJECT SETTING AND FACTORS INFLUENCING MANAGEMENT AND DEVELOPMENT

2.1 Description of Headwaters Reservoirs

The Headwaters consists of six natural lake reservoirs impounded by dam control structures along with outlet works, embankments and dikes, public use lands and facilities, and flowage easement rights at each reservoir. The Headwaters' dams were built in varying stages from 1881 to 1912, starting with the Winnibigoshish Dam and ending with the Gull Lake Dam. The Headwaters include 1,745.9 acres held in fee title, 380.3 acres on which the DOI has granted the Corps permanent use permits, and 294,218.2 acres of flowage easement lands at the dam sites and around the reservoirs. The principle features of the Corps owned and operated components of the Headwaters are listed below. Additional information can be obtained within the site-specific Water Control Manuals. See section 1.6 Project Information for a detailing of natural lakes that are affected by each reservoir's operations.

2.2 Reservoirs, Main Control Structures & Outlet Works, Embankments and Dikes

2.2.1 Winnibigoshish

Reservoir. Winnibigoshish Reservoir contains runoff from 1,442 square miles of the Mississippi River drainage basin. Storage in the reservoir affects 16 lakes, including Lake Winnibigoshish, which covers 66,000 acres at target summer pool elevation. When the maximum operating elevation (1303.14' NVGD 29) is exceeded, a total of 30 lakes are affected by reservoir storage, which reaches 115,000 acres in size.

Control Structures & Outlet Works. The original 1884 control structure was made of timber. It was converted to concrete in 1899 and today consists of reinforced concrete abutments and piers supported on timber pilings. The total length of the dam between abutments is 162 feet, and the structure stands approximately 21.7 feet tall (from the apron to top of control structure). Outflow is through five, 14-foot-wide bays and one, 12-foot-wide stop log bay (old log sluice). Each of the five main spillway bays has two concrete bulkheads and one leaf gate. A leaf gate also controls the log sluice bay. The fishway in the structure has been sealed. The control structure supports a 20-foot-wide county highway bridge. The concrete spillway apron below Winnibigoshish Dam is also supported by the original timber substructure and is 148.5 feet long by 138.5 feet wide. A minimum outflow of 100 cubic feet per second (cfs) is required from the structure during normal operating conditions.

Embankments and Dikes. Winnibigoshish Reservoir is contained by one main embankment and four perimeter dikes. The main embankment, 800 feet long with an elevation of 1310.5 feet, is an earthen dike with a timber diaphragm core filled with puddled clay. The slopes of the embankment are protected by sod and rip-rap surfacing. The lakeside surface of the embankment, from the control structure to the right bank, is protected by a concrete slab.

The first perimeter dike (part of the State Highway No. 2 embankment) is short and low, with a maximum height of two to three feet. The second dike consists of six segments separated by sand knolls. The third dike is in two sections with the east section at an 8-foot maximum height. The second, third, and fourth dikes prevent the overflow of water south from Lake Winnibigoshish to the Leech Lake River via Six Mile Lake and are critical during flooding.

2.2.2 Leech Lake

Reservoir. The Leech Lake Reservoir contains runoff from 1,163 square miles of the Leech Lake River drainage basin. At normal pool, the backwater effect from the dam affects 8 lakes, which are connected to the reservoir. Target summer pool puts the reservoir at 117,000 acres in size. When the maximum operating limit (1297.90' NVGD29) is exceeded, a total of 14 lakes (including Leech) are affected by backwater, and the reservoir reaches 161,000 acres in size.

Control Structures & Outlet Works. The original 1885 control structure was constructed of timber. It was converted to concrete in 1903 and today consists of reinforced concrete abutments and piers supported by a timber bearing-pile and sheet-pile substructure. The total length of the dam between abutments is 294 feet, and the structure stands approximately 11.8 feet tall (from the apron to top of control structure). Bays in the structure include twenty-five, 6-foot sluiceways and one, 12-foot log sluice. The old log-sluice and twenty of the 6-foot sluiceways are controlled with stop logs. The remaining 6-foot sluiceways are controlled by cast iron slide gates. The control structure supports an 8-foot, 10-inch wide bridge that has a separate walkway for pedestrians. The bridge is used only for foot traffic and maintenance vehicles. The reinforced concrete apron at Leech Lake Dam is supported by the timber substructure and is 39 feet long, 294 feet wide, and 12 inches thick. Water regulations require a minimum outflow of 120 cfs during normal operating conditions.

Embankments and Dikes. Leech Lake Reservoir is contained by one main embankment. It has no perimeter dikes. The main embankment is an earthen dike which extends 3,314 feet north from the control structure. It has a minimum height of 15 feet and consists of a timber diaphragm core filled with puddled clay. The top elevation, at 1303.24 feet, is nearly 4 feet above the top of the control structure piers and nearly 5.5 feet above the maximum operating elevation. The top of the embankment is 28 feet wide and carries a 20-foot roadway.

2.2.3 Pokegama

Reservoir. In conjunction with the Winnibigoshish and Leech Lake Reservoirs, Pokegama Reservoir controls the runoff from 3,265 square miles of the Mississippi River drainage basin. Pokegama Dam directly controls runoff from 660 square miles of the basin. Operation of Pokegama Reservoir affects 17 lakes, in addition to Pokegama Lake. At target summer pool elevations the reservoir is approximately 16,800 acres in size. When the maximum operating limit of 1278.42' NVGD29 is exceeded the reservoir reaches 23,200 acres in size.

Control Structures & Outlet Works. The control structure was originally installed in 1884 and was constructed out of timber. It was rehabilitated to concrete in 1904 and today consists of reinforced concrete abutments and piers, which have been constructed on a natural quartzite outcropping. The total length of the structure between abutments is 225 feet, and it stands approximately 14 feet tall (sill elevation to top of control structure). There are thirteen, 8-foot wide sluiceways and one, 12-foot wide log sluice. After the 2012 rehabilitation all of the sluiceways are controlled by sluice gates. A 6-foot wide walkway over the top of the structure provides access to the sluiceways along with a 6-foot wide pedestrian bridge. The concrete spillway apron is 52 feet long and 225 feet wide. A minimum outflow of 200 cfs is required during normal operating conditions.

Embankments and Dikes. Pokegama Lake Reservoir is contained by one main embankment and five perimeter dikes. The main embankment at Pokegama Dam has a rock-filled timber crib core covered with compacted soil. The embankment surface is rip-rapped and sodded to prevent erosion. The top

elevation of the main embankment, east and west, is 1278.4 feet with a height of 14 feet. The west embankment is 60 feet long, and the east embankment is 100 feet long.

Of the five perimeter dikes around Pokegama reservoir, three lie on the tip of the southeastern arm (Wendigo arm) of the lake. The other two dikes are on the northeast end of Pokegama Lake between Poole Bay and the Blandin Dam reservoir (Lake Sylvan). Some of the dikes are used as road embankments.

2.2.4 Sandy Lake

Reservoir. The Sandy Lake Dam and Reservoir controls runoff from 421 square miles of the Sandy Lake drainage basin. The backwater effect from the dam affects 8 lakes which are connected to the reservoir. The reservoir is approximately 9,400 acres in size at target summer pool elevation. The reservoir increases to approximately 12,900 acres at flood elevation 1221.31' NVGD29.

Control Structures & Outlet Works. The control structure was originally constructed in 1895 out of timber. It was rehabilitated to concrete in 1912 and today consists of reinforced concrete abutments and piers supported by the original timber pilings. The total length of the dam between abutments is 109 feet, and it stands approximately 16.9 feet tall (from the apron to top of control structure). There are a total of 12 bays, which consist of 1 log sluice that is 11-feet wide; 6 gated bays that are 5-feet wide; and the previous lock chamber (no longer operable), now divided into 5 bays, each with an approximate width of 5.2 feet and sill elevation of 1216.81 feet. The log sluice bay can be opened for additional discharge by removing stop-logs with a chain-hoist and jib crane system. The 6 gated bays are controlled manually. An 8-foot wide maintenance roadway/pedestrian bridge is supported by the structure, and there is a concrete spillway apron below the dam. A minimum outflow of 20 cfs from the structure is required during normal operating conditions.

Embankments and Dikes. Sandy Lake Reservoir is contained by one main embankment in two sections and four perimeter dikes. The main embankments consist of earth fill with a timber diaphragm. The right and left sections are 75 feet and 30 feet long, respectively, with top elevations of 1225.31 feet and 1227.81 feet, respectively.

There are 4 perimeter dikes, which are located in low areas and have a minimum top elevation of 1225.1 feet. They are designed to prevent an uncontrolled overflow of stored water during extreme flood events.

2.2.5 Cross Lake

Reservoir. The Pine River Dam controls runoff from 562 square miles of the Pine River drainage basin. The backwater effect from the dam affects 15 lakes which are connected to the reservoir and create the Whitefish Chain of Lakes. Cross Lake is approximately 13,600 acres at target summer pool elevation 1229.32' NVGD29. The reservoir expands to approximately 15,500 acres when the maximum operating limit of the control structure is reached at 1235.30' NVGD29.

Control Structures & Outlet Works. Installation of a timber control structure was completed in 1886 at Cross Lake. The control structure underwent rehabilitation to concrete in 1908 and is now composed of reinforced concrete abutments and piers supported on timber pilings. The total length of the dam between abutments is 150 feet, and it is approximately 23.7 feet tall (top of the control structure to the downstream apron). The dam has 13 sluiceways that are controlled by leaf gates which are 6.0 feet

wide. The gates are adjusted mechanically with stem openers. When the lower leaf rises to its top elevation (approx. 7.6 ft.), it engages the bottom half of the upper leaf, and both gate leafs then rise in tandem. The control structure supports a walkway. The top of the control structure corresponds to the top of the concrete parapet wall at elevation 1240.3 feet. A minimum outflow of 30 cfs is required during normal operating conditions.

Embankments and Dikes. Cross Lake Reservoir is contained by one main embankment and 17 perimeter dikes. The main embankment extends 158 feet from the right side of the control structure and 1,611 feet from the left of the control structure. Prior to rehabilitation, the main embankments at Pine River Dam consisted of earth fill with a timber diaphragm and a core filled with puddled clay. The embankment was rehabilitated and strengthened with sheet piling driven through the embankment and was raised via a concrete parapet I-wall that was cantilevered on the steel sheet pile. The total length of the main embankment, excluding the control structure, is 1,769 feet with a top elevation of 1240.3 feet.

The perimeter dikes at Cross Lake reservoir have a combined total length of 9,805 feet and are designed to prevent uncontrolled overflow of stored water during extreme flood events. Eleven of the seventeen dikes are part of a road system in the area. The remaining dikes (Nos. 2, 3, 10b, 12, 15 & 16) are without road surfacing and can easily be accessed.

2.2.6 Gull Lake

Reservoir. The Gull Lake Dam and Reservoir controls runoff from 287 square miles of the Gull Lake drainage basin. The backwater effect from the dam created the Gull Lake Chain of Lakes. The target summer range of the reservoir is 1194.00' NVGD29, which equates to 13,000 acres in reservoir size. The maximum operating limit of the control structure is 1194.75' NVGD29, which expands the reservoir to 13,100 acres in size. The dam operations affect 10 lakes total, including 8 natural lakes.

Control Structures & Outlet Works. The Gull Lake dam is the only Headwaters' dam originally constructed of concrete. The control structure consists of reinforced concrete abutments and piers supported on timber pilings. The total length of the structure between abutments is 68.9 feet, and it stands 11 feet tall (from the apron to top of the control structure). There are 5 slide gate bays with 5-foot wide by 4-foot high steel slide gates and one 11-foot wide log sluiceway. The 5 gated bays are controlled manually. The log sluice bay can be opened for additional discharge by removing stop-logs. A five-foot wide fishway on the right side of the dam has been blocked off due to concerns about carp migration. An 8-foot wide public roadway is supported by the structure, and there is a concrete spillway apron below Gull Lake Dam. Water regulations require a minimum outflow of 20 cfs from the structure during normal operating conditions.

Embankments and Dikes. Gull Lake Reservoir is contained by one main embankment. There are no perimeter dikes. The main embankment of the control structure consists of two earth-filled embankments with concrete curtain walls. The right bank embankment is 129 feet in length with 90 feet of curtain wall. The left embankment is 72 feet in length with 33 feet of curtain wall. The total length of the embankment is 201 feet with a minimum top elevation of 1198.1 feet.

2.2.7 Public Use Lands and Facilities

The Headwaters provides public use and recreation opportunities at all six reservoir project site locations - Winnibigoshish, Leech, Pokegama, Sandy, Cross, and Gull. The Corps developed and manage most Headwaters' facilities, but a few facilities are managed by other federal, state, county, quasi-

public, non-profit, or private organizations. Public use areas associated with the project sites include developed campgrounds; boat launches and water access points; day use areas featuring picnic shelters, playgrounds, and beaches; visitor's centers; project/visitor offices; and several small trail systems.

2.3 Hydrology

The Headwaters is located in north central Minnesota in the Upper Mississippi River Basin watershed and the Minnesota Sand and Gravel Aquifers (glaciated regions). The Headwaters' area has experienced several glacial advances with the last retreating approximately 10,000 years ago (Wisconsin Glaciation). The glaciers caused the landscape of the area to be gently sloped with an abundance of wetlands, natural lakes, rivers, streams, and sand and gravel deposits. The Headwaters directly control a total drainage area of 4,535 square miles.

Figure 2 shows a generalized annual overview of reservoir operations at Headwaters' Project sites. Maximum monthly inflow to the Headwaters generally occurs from April to June due to snowmelt and spring rain runoff. Most of this inflow, however, is retained in the reservoir for summer recreation pool and flood protection purposes. As a result of this retention, monthly inflows generally exceed outflows during the spring as the reservoirs are filling. Rain that falls directly into the reservoirs during the spring and summer can constitute a significant portion of the total volume of "inflows" from a given event due to the large area the reservoirs encompass. Outflows are reduced in the summer when the highest evaporation losses occur and are increased during the fall and winter as the reservoir level is drawn down to create storage for spring flood management. Water levels on Headwaters lakes are relatively stable and are operated within a 2-10 foot operating band, although flood and drought events can cause higher and lower elevations. Due to the relatively flat topography and high presence of lakes and wetlands, runoff effects in project watersheds are slow and attenuated. Flood events are characteristically of long duration, rising gradually to a crest point and receding slowly.

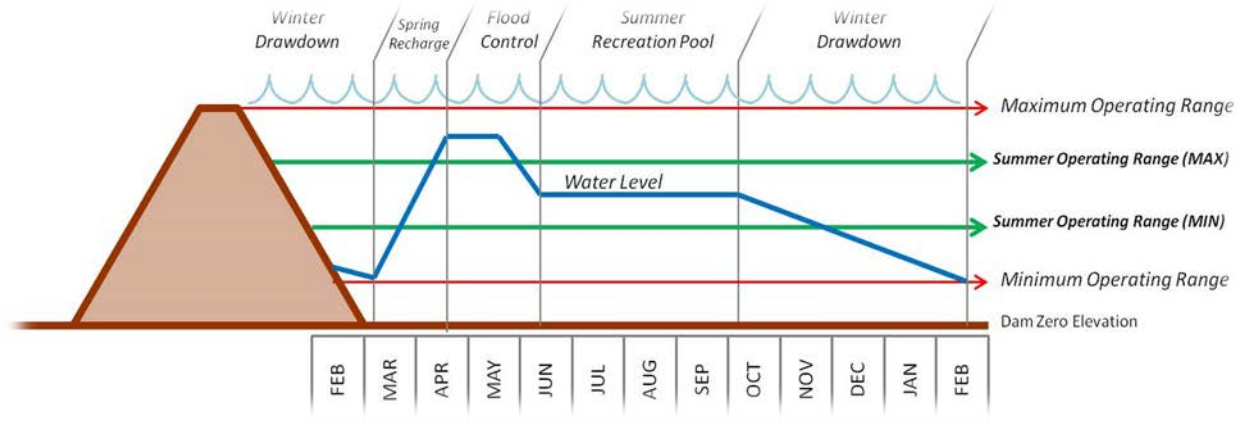


Figure 2. Generalized Headwaters' Project – Annual Reservoir Operation Overview.

The following breakdown will detail select specific hydrologic aspects of each reservoir project. Maps of each watershed can be found in Appendix C – Plates.

2.3.1 Winnibigoshsish. Lake Winnibigoshish is the fifth largest lake in Minnesota at 66,000 acres in size. The dam and reservoir outlet are located on the main stem of the Mississippi River. Other main tributaries of the reservoir include the First, Third and Pigeon Rivers. The watershed spans 1,442 square

miles, with the lake comprising 89 square miles alone, and is bound by the Leech Lake Reservoir basin to the south, Rainy River basin to the north, and Pokegama Lake Reservoir basin to the east.

2.3.2 Leech. Leech Lake reservoir discharges to the east through Leech Lake Dam into the Leech Lake River on the northeast side of the lake. Three main rivers contribute to the reservoir including Boy River, Necktie River, and Kabekona River. The Boy River enters Leech Lake reservoir from the east and drains much of the watershed area south and southeast. The Necktie and Kabekona Rivers flow into the reservoir from the west. The watershed is bound by Lake Winnibigoshish reservoir basin to the north, Pine River reservoir basin to the south, and Pokegama Lake reservoir basin to the east. The watershed encompasses 1,163 square miles, with the lake comprising roughly 165 square miles of that area.

The Leech Lake River downstream of the reservoir consists of a 27-mile stretch of channel, flowing primarily through swamp and marshland, to the Mississippi River. Tributaries to the Leech Lake River include Drumbeater Creek and Six Mile Brook.

2.3.3 Pokegama. The Pokegama Dam is located on the main stem of the Mississippi River, which flows through the center of the 660 square mile Pokegama drainage basin in a southeasterly direction. The Pokegama reservoir watershed is bound by Lake Winnibigoshish reservoir basin to the northwest and Leech Lake reservoir basin to the west. At 26 square miles, the area of Pokegama Lake is relatively small compared to the area's drainage basin. Leech and Winnibigoshish dams are upstream of Pokegama, and it generally takes 30 to 36 hours for their discharges to reach Pokegama reservoir. The town of Grand Rapids, Minnesota, and the Blandin Dam are located approximately 2 miles downstream from the Pokegama dam.

2.3.4 Sandy. The Sandy Lake Dam and reservoir outlet are located on the Sandy River approximately 1.25 miles above its confluence with the Mississippi River. Four main tributaries contribute to the Sandy Lake reservoir and include the following: the West Savanna River from the north; the Prairie and Tamarack rivers from the east; and the Sandy River from the south. The Mississippi River has a significant backflow effect on the Sandy River channel downstream of the dam and can greatly diminish outflow from the dam. In extreme water conditions the backflow can cause head flow reversal when the water level in the river channel exceeds the water level of Sandy Lake. The dam structure was designed to withstand this flow reversal. The town of Aitkin, Minnesota is approximately 43 river miles downstream of the Sandy Lake Dam.

2.3.5 Cross. The Pine River Dam forms the Cross Lake Reservoir and Whitefish Chain of Lakes. The water within the reservoir includes 15 natural lakes and originates from three main rivers. The Pine River flows into the western end of the reservoir with the South Fork of the Pine River contributing to the Pine River above its entry into the reservoir. Daggett Creek drains the northeastern portion of the watershed and flows into the east end of the reservoir. The watershed shares a common boundary with the Leech Lake reservoir basin to the north and the Gull Lake reservoir basin to the south. The Pine River Dam is located 14.5 miles upstream of the Pine River and Mississippi River confluence.

2.3.6 Gull. Gull Lake Dam and Reservoir is located on the Gull River outlet of Gull Lake. The four main tributaries to the reservoir (Mayo Creek, Stony Brook, Corey Brook, Home Brook) drain in from the north and west. The dam is on the Gull River about a half river mile below the outlet of Gull Lake, 11 river miles upstream of the junction of the Crow Wing and Mississippi Rivers and 11.5 river miles downstream of the town of Brainerd, Minnesota. Gull Lake Reservoir is actually a chain of ten lakes.

2.4 Sedimentation and Shoreline Erosion

Erosion and sediment production from rivers within the watershed is a relatively minor problem due to the forest cover, soil types, and land topography in the area. Sediment production from shoreline erosion within the reservoir boundaries is of concern for the loss of real estate and water quality reasons but has only a minor impact on the elevation-storage characteristics of the reservoir. Shoreline erosion within the Headwaters' lakes is caused primarily by high lake levels combined with wind and wave action that accelerates erosion. Erosion of the shorelines around the six Headwaters' lakes is most serious on Winnibigoshish, Leech, and Sandy Lakes. Extensive riprap has been placed at Lake Winnibigoshish to combat the erosion. In an effort to reduce shoreline erosion, the Corps has partnered with local agencies and stakeholders to transform shorelines from manicured lawns to native vegetation. Sediment production and siltation tend to occur in the shallow harbors and lake-access channels. More detailed information concerning erosion and sedimentation can be found in each site's Water Control Manual.

2.5 Water Quality

The Headwaters are located in the Northern Lakes and Forests Ecoregion of Minnesota. Many of the lakes found here are deep and clear with abundant gamefish populations. This ecoregion is heavily forested and made up of rolling hills interspersed with pockets of wetlands, bogs, lakes, and ponds. Lakes are very sensitive to damage from atmospheric deposition of pollutants, storm water runoff from logging operations, land development, mining, inadequate wastewater treatment, and failing septic systems. Agriculture is somewhat limited by the terrain and lack of nutrients in the soil, though there are some beef and dairy cattle farms in the area. All Headwaters' lakes, except Sandy Lake, have mean summer (June thru September) values of total phosphorus, chlorophyll a, and Secchi transparency that are comparable to "typical" Northern Lakes and Forest ecoregion lakes.

According to the Minnesota Pollution Control Agency (MPCA), all Headwaters' lakes may be vulnerable to cultural-induced eutrophication from both point and non-point source pollution. Small increases in the reservoirs' phosphorus content could result in a perceptible loss in Secchi transparency and increased frequency of nuisance algal blooms. Per the MPCA, concentrations of mercury in fish tissue exceed the water quality standard in all six reservoirs as of 2014, and Minnesota Department of Health fish consumption advice should be followed. All reservoirs, with the exception of Sandy Lake, currently fully support swimming and esthetics-use criteria.

2.5.1 Winnibigoshish. Lake Winnibigoshish, a large, relatively shallow lake, is classified as mesotrophic by the MPCA; however, limited phosphorus data indicate that the reservoir may be eutrophic. The lake is often windswept and tends to be well-mixed. Weak stratification occurs at some locations when conditions permit.

A study by the Minnesota Chippewa Tribe Water Research Lab estimates 80 percent of the annual phosphorus load to Lake Winnibigoshish is from tributaries and 19 percent is from precipitation. The estimated phosphorus load from septic systems is 0.7 percent.

2.5.2 Leech. Leech Lake is the third largest lake in the state and reaches depths of approximately 150 feet. Leech Lake is classified as a mesotrophic lake based on Carlson's Trophic State Index. Dissolved oxygen and water temperature profiles in Walker Bay exhibit the characteristics of a classically stratified dimictic lake with stratification typically occurring prior to the end of May and continuing until late

September or October. The remainder of Leech Lake is relatively shallow and windswept. The windswept areas are well-mixed and only stratify temporarily during hot, calm periods.

2.5.3 Pokegama. Based on Secchi transparency and data for 1990 thru 1995, Pokegama Reservoir is borderline oligotrophic/mesotrophic. Dissolved oxygen and water temperature profiles exhibit the characteristics of a classically stratified dimictic lake. Stratification usually occurs prior to the end of May and continues throughout the summer until late September or October.

2.5.4 Sandy. Sandy Lake Reservoir is considered a highly-colored eutrophic lake and is composed of several bays with a relatively large, shallow main bay. Bill Horn and Webster bays exhibit characteristics of a classically stratified dimictic lake. The main bay is windswept and rarely stratifies except for short periods on hot calm summer days. During these times of stratification anoxia can occur and release phosphorous into the waters.

Point and non-point pollution are attributable to the eutrophication of Big Sandy Lake. Lower than expected Secchi transparent readings are a result of coloration to the water due to bog staining from surrounding wetlands. Phosphorous and chlorophyll a values in the lake are more typical of North Central Hardwood ecoregion lakes than of Northern Lakes and Forest lakes. In 2006, the MPCA placed Big Sandy on Minnesota's 303(d) List of Impaired Waters for aquatic recreation due to excessive nutrients. The data indicated that the lake had total phosphorus concentrations in excess of the MPCA's state water quality narrative standard. An estimated 95 percent of phosphorous loading to Big Sandy Lake is derived from the major tributaries in the watershed – the Sandy, Prairie, and Savanna Rivers.

2.5.5 Cross. The Cross Lake Reservoir is a part of the Whitefish Chain of Lakes and considered mesotrophic based on the Carlson's Trophic State Index, using 1990 thru 1995 data. Dissolved oxygen and water temperature profiles exhibit the characteristics of a classically stratified dimictic lake. Stratification usually occurs prior to the end of May and continues throughout the summer until late September or October. Specific pollution concerns in the watershed result from extensive land development, urban and agricultural runoff, malfunctioning or outdated septic systems, and a publicly owned treatment works facility, which discharges directly above the reservoir into the Pine River.

2.5.6 Gull. Gull Lake is considered a mesotrophic lake that exhibits the characteristics of a classically stratified dimictic lake. Stratification usually occurs prior to the end of May and continues throughout the summer until late September or October. Gull Lake has a highly developed shoreline, which can negatively affect water quality.

2.6 Climate

2.6.1 Annual Conditions. Minnesota experiences fairly dramatic changes in climate throughout the year. The Headwaters characteristically have comfortable, warm summers and cold winters. January temperatures at the northernmost extent of the Headwaters' region average 5 degrees Fahrenheit, with temperatures having been recorded as low as -50 degrees. Temperatures in the summer months average 65 degrees; the area south of Brainerd typically reports an average 5 degrees warmer. Summer temperatures greater than 100 degrees have occurred. Precipitation averages 28 inches annually with a variation from 17 to 38 inches per year at the most easterly portion of Big Sandy Lake. At the opposite end of the Headwaters' region, the annual precipitation falls between 15 and 34 inches and averages 22 inches. The evaporation rate for the entire reservoir system averages about 20-22 inches per year.

Annual snowfall is generally between 43-50 inches. Figure 3 provides information on annual precipitation and snowfall in Minnesota.

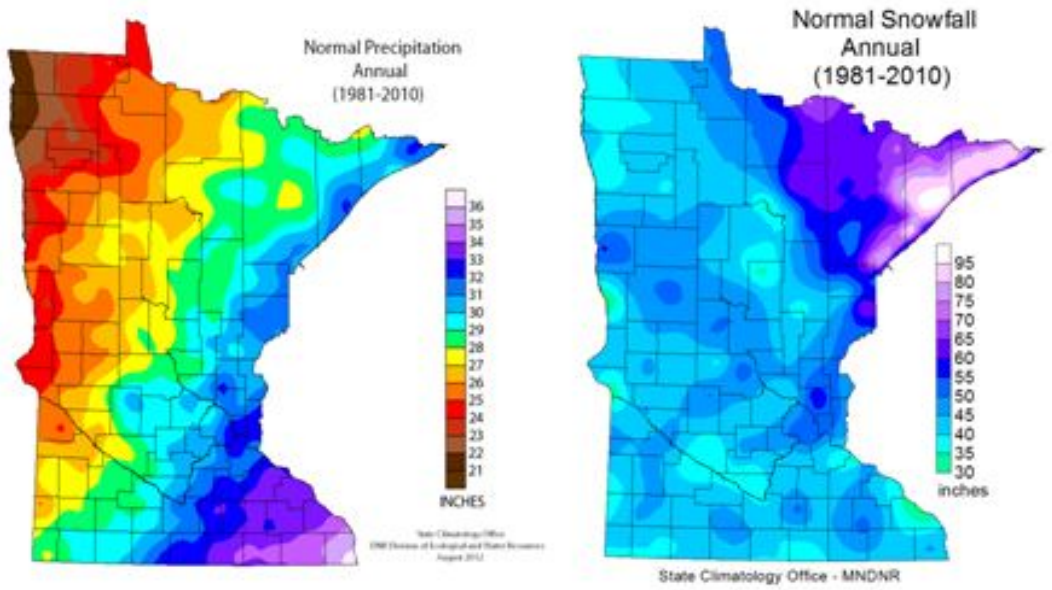


Figure 3. Minnesota Annual Precipitation and Snowfall.

2.6.2 Climate Change. The Intergovernmental Panel on Climate Change's 4th Assessment Report (IPCC 2007) found that global climate warming is "unequivocal" and largely attributable to human activities. Despite the certainty that climate change is currently underway and having an impact on natural resources, there are still many unanswered questions about how these climate effects will play out at the local, state, and regional level and how ecosystems will respond to those changes. According to the IPCC, global average temperatures have risen by 1.5 degrees and can be expected to raise another 2-11 degrees by 2100, depending on future emission levels.

For the Upper Mississippi Region, there is general consensus among scientists that, during the last century, there has been a moderate to large upward trending in average temperature, minimum temperatures, average precipitation, extreme precipitation, and streamflow. A recent review of studies by the Corps of Engineers (USACE 2015) summarized these findings:

> *The general consensus in the recent literature points toward moderate increases in temperature and precipitation, and streamflow in the Upper Mississippi Region over the past century. In some studies, and some locations, statistically significant trends have been quantified. In other studies and locales within the Upper Mississippi Region, apparent trends are merely observed graphically but not statistically quantified. There has also been some evidence presented of increased frequency in the occurrence of extreme storm events (Villarini et al., 2013[1]). Lastly, a transition point in climate data trends, where rates of increase changed significantly, was identified by multiple authors at approximately 1970.).*

[1] In USACE 2015.

This same study goes on to project future climate conditions:

> *There is strong consensus in the literature that air temperatures will increase in the study region, and throughout the country, over the next century. The studies reviewed here generally agree on an increase in mean annual air temperature of approximately 3.6 to 10.8 degrees by the latter half of the 21st century in the Upper Mississippi Region. Reasonable consensus is also seen in the literature with respect to projected increases in extreme temperature events, including more frequent, longer, and more intense summer heat waves in the long term future compared to the recent past.*

A summary of the findings of observed and projected trends based on this review are shown graphically below (Figure 4). Implications for climate change effects to socioeconomic and natural resources are discussed in the EA.

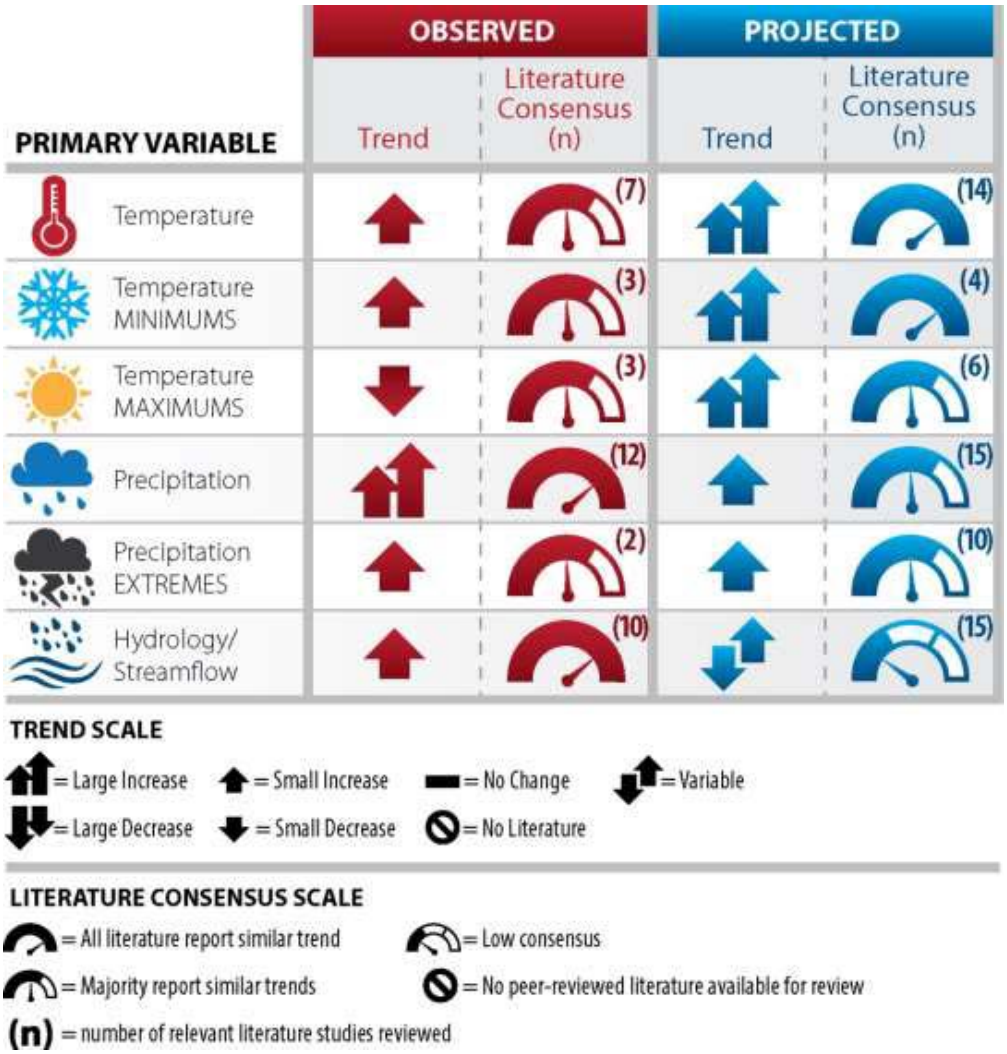


Figure 4. Observed and Projected Climate Trends (USACE 2015).

2.7 Geology, Topography and Soils

Geological formations that were altered by such factors as deposition, erosion, and vegetation are the parent material for the soils of the Headwaters of the Mississippi River. There are several types of glacial drift in the Headwaters. The area from northern Gull Lake to Leech Lake is part of the St. Croix moraine system. In the northern Headwaters', along the southern edge of Lake Winnibigoshish there is a sandy outwash plain. Extending south of this outwash to Leech Lake is a major area of till plain.

The area around Big Sandy Lake in Aitkin County is primarily till plain with a large outwash area characterized by surface deposits of sand and gravel to the northeast.

Cass County in which Gull Lake, Leech Lake, and Lake Winnibigoshish are located is composed of undulating upland surface dotted with many lakes.

Crow Wing County in which Cross Lake is located consists primarily of glacial outwash with a dominant moraine in the eastern portion and areas of till plain to the south.

Itasca County in which Pokegama Lake is located is characterized by gray glacial drift and surface features identified with the Wisconsin glacial period.

The development of the soils around the lakes is partially a result of the vegetation that became established on the various glacial deposits. The north and east areas of the Headwaters consist of poor, infertile gravels, sands and stones, upon which pine-spruce and birch-aspen vegetation became established. The needle and leaf litter from these forests did not mix with the glacial deposits, thus forming a mat. As a result, the soils in this area are bleached and light colored. In contrast, soils to the west and southwestern portions of the region established prairie grasses. These were more easily incorporated with the sands, silts and clays of the lake beds and outwash plains to create darker surface soils with a high degree of organic matter.

Three hundred different soils within the state of Minnesota have been consolidated into fifteen groups. Nine of these groups occur in the Headwaters' region. Of these nine groups, five are found in or adjacent to one or more of the Headwaters' areas, and are defined as follows:

Group 2 (Pokegama Lake): These medium-textured forest soils consist of calcarious loam and sandy loam till. Drainage is good in hilly portions with many depressions occupied by lakes or peat. The major problem associated with this group is erosion and/or maintenance of organic matter on the mineral sub-surface soils. Most of these soils are forested.

Group 3 (Gull Lake): These course- to medium-textured forest soils are light colored, non-calcareous glacial material consisting of gravel, sands, loam, or a mixture of these. Stones are abundant. The numerous depressions are lakes, marshes, peat, or mineral soils often underlain with a hard pan condition. Major problems include stoniness, erosion control, and poor drainage in level areas. Such areas are generally forested.

Group 4 (Pokegama Lake, Sandy Lake): These fine-textured soils are light colored and weakly calcareous. They contain reddish clay till or reddish lacustrine (lake) clay. These soils are moderately well drained except for level areas where drainage is a problem. These soils are generally forested.

Group 6 (Leech Lake, Pokegama Lake, Sandy Lake): These course to fine-textured forest soils and organic soils of glacial lake plain are calcareous light colored soils of waterlain sands, loams, and silts. Poorly drained peat is found in depressions and old lake bottoms. Drainage ranges from excessive to poor depending on soil texture and elevation. Forests cover most of these soils. The major problem is excessive water.

Group 9 (Lake Winnibigoshish, Cross Lake, Gull Lake): These course- to medium-textured forest soils formed from glacial outwash and are composed mostly of gravel or sandy gravel near the surface. Often these sands and gravels are overlain with fine sandy loams that become peat in depressions. They may be excessively drained soils and are subject to drought and wind erosion.

The majority of the area contains a gently rolling topography with numerous floodplain wetlands. The central region of Minnesota is abundant in lakes of various sizes, with Leech Lake and Lake Winnibigoshish being two of the largest in the state.

2.8 Fish and Wildlife Resources

Minnesota has a tremendous resource of lakes, streams, forests, and open spaces that support many complex and varied forms of wildlife. The habitats of the Headwaters are diverse and support an abundance of fish and wildlife. The forests, marshes, and wetlands bordering and connecting many water bodies provide ideal habitat conditions for many species of migratory waterfowl and game fish. These habitats have been divided into four basic types, each composed of various vegetative communities. The four categories are as follows: wetland, lowland forest, upland forest, and open upland. The evolution of these habitats or ecosystems at each of the projects has been modified and, in part, reflects development and recreational activities.

Many of the animals around the lakes range over a wide area; others are more confined in their distribution. In all cases, a species is limited by environmental tolerances. Although the general land character of the lakes area was once primarily coniferous, numerous factors such as lumbering and forestry have reduced the area to second growth forests of mixed deciduous and coniferous vegetation. This has impacted the ecosystem and resulted in the sharing of habitats by some forms of wildlife that have adapted to survival under a variety of conditions.

Approximately 57 species of mammals - 31 of which are relatively abundant - are found in the Headwaters. The white-tailed deer is the only common large herbivore. Common carnivores are the black bear, red fox, raccoon, long-tailed weasel, mink, and striped skunk. Common rodents are the woodchuck, ground squirrel, tree squirrel, chipmunk, beaver, muskrat, porcupine, mouse, and vole.

Over 240 species of avifauna are found in the region, either as residents or transient migrants. The richness of the birdlife is due partially to the fact that the area is the western limit for many eastern or forest species and the eastern limit for many western or grassland species. The region is also one of the funneling areas of the Mississippi flyway.

Ten reptile and 14 amphibian species are found in the Headwaters' region. The cool climate limits the number of these cold blooded species.

The lakes and rivers of the Headwaters generally have healthy fish populations that support a famous and popular sport fishery. Walleye tend to be the most important game fish for most anglers. Some lakes are stocked with game fish species by the MDNR, but many are supported strictly by natural

reproduction. The Leech Lake Band raises and stocks fingerling lake whitefish and walleye. In general, game fish populations are stable; however, increased fishing pressure has led to decreased individual fishing success. In some cases, this has led to the perception that the fishery is in decline. While in general fish populations are stable, the potential for future problems is increasing due to increasing human impacts.

Fish species that can be found in some or all areas of the Headwaters include the following: Banded Killifish, Bigmouth Shiner, Black Bullhead, Black Crappie, Blacknose Shiner, Bluegill, Bluntnose Minnow, Bowfin (dogfish), Brassy Minnow, Brook Stickleback, Brown Bullhead, Burbot (eelpout), Central Mudminnow, Common Shiner, Creek Chub, Emerald Shiner, Fathead Minnow, Golden Shiner, Green Sunfish, Hornyhead Chub, Hybrid Sunfish, Iowa Darter, Johnny Darter, Lake Trout, Lake Whitefish, Largemouth Bass, Least Darter, Logperch, Longnose Dace, Mimic Shiner, Mottled Sculpin, Muskellunge, Northern Pike, Pumpkinseed, Rainbow Smelt, Rock Bass, Sand Shiner, Shorthead Redhorse, Silver Redhorse, Smallmouth Bass, Spotfin Shiner, Spottail Shiner, Tadpole Madtom, Trout-Perch, Tullibee (Cisco), Walleye, White Sucker, Yellow Bullhead, and Yellow Perch.

As part of the authorized mission of conserving and managing natural resources, the Headwaters attempt to maintain stable operating levels for the purpose of wild rice. Wild rice is an annual semi-aquatic grass that reproduces each year from seed stock deposited the previous fall seasons and benefits from periodic disturbance. Minnesota has more acres of natural wild rice than any other state in the country. The plant typically grows in shallow to moderate water depths (1-3 feet) and is affected by water flow, turbidity, water quality and water level fluctuations. Wild rice is sensitive to varying water levels and production in individual stands from year-to-year is subjective, depending on local water conditions. Wild rice has special cultural and environmental significance to the Native Americans. From an environmental perspective, it is an important habitat component and is often viewed as an ecological indicator species due to its sensitivity to growing conditions.

2.8.1 Climate Change and Wildlife Impacts. This Master Plan emphasizes the need to have adequate resource protection to maintain species diversity, habitat quality, and outdoor recreational opportunities. Environmental challenges beyond our control could significantly impact natural resources. Climate change may alter the landscape of the Headwaters in multiple ways, the most visible being changes in river flows and/or lake levels. More erratic high flows and droughts can influence rates of siltation, rim erosion, lake access for recreational boating, and flood protection. Wildlife can move or migrate as conditions change, but plants have difficulty surviving significant climatic change. Some species can be generalists across a wide range of growing conditions, but more conservative species with very specific growth niches will likely be impacted. The exact impacts are difficult to predict, but climate is singularly the most influencing determinant of landscapes.

Due to different responses to climate change by individual species and habitats, wildlife management plans will likely need to be updated on a more frequent basis. For example, special actions may be needed to ensure the survival of species and habitats that are negatively affected by climate change. Other species may benefit from a changing climate by expanding their range or increasing in abundance, which would require a separate set of wildlife management actions. In addition, the movement of species could create new communities of species that will require wholly new management regimes. Climate change is a large and growing threat to wildlife and natural systems, but it will also exacerbate other existing threats. Efforts to address climate change should not diminish the immediate need to combat threats that are independent of climate change, such as habitat loss, invasive species spread,

pollution, and wildlife diseases. Goals include sustain ecosystems and viable wildlife populations regardless of the threat.

2.9 Vegetative Resources

Forest communities are the dominant type of vegetation in the Headwaters' area. Scattered bog and marsh communities that are found in shallow bays and poorly drained areas are also present, but not as dominant. The forest and bog and marsh communities in the Headwaters are composed of elm-ash, maple-basswood, birch-aspen, pine-mixed hardwood, cedar-balsam-spruce, and tamarack bog and marsh. A number of plant species are associated with each of these communities. There is an assortment of vegetative overstory, understory, and groundcover that enhances diversity and recreational potential of an area.

2.9.1 Lake Winnibigoshish. This lake has a shoreline of lowland forest that is characteristically elm-ash. Slightly upland from the shoreline are birch-aspen and pine-mixed hardwoods, which seem to do well in sandier soils. Maple-basswood communities are situated away from the lake on high ground behind the elm-ash communities. Marsh communities are numerous.

2.9.2 Leech Lake. Leech Lake is different from the five other lakes in that approximately one-quarter of the shoreline is bog. The rest of the shoreline is either forested or developed land. The prevailing communities are elm-ash and maple-basswood intermixed on gentle slopes.

2.9.3 Pokegama Lake. The shoreline is composed primarily of maple-basswood and birch-aspen communities. The climax forest consists of maple-basswood with the birch-aspen community approaching this climax through succession. The upland sites of low relief in the northern extremities of the lake are elm-ash forest. Although there are occasional pure stands of Norway pine and white pine, the concentration of heavy soils in the area has resulted in a noticeable absence of pine-mixed hardwoods vegetation. Several small groupings of cedar, balsam, spruce, and tamarack have established themselves. Marsh communities are established in numerous bogs throughout the watershed.

2.9.4 Sandy Lake. The forest vegetation surrounding Sandy Lake is predominantly deciduous. Elm and ash with some aspen and oak is found at lower elevations associated with marsh habitats. Maple and basswood intermixed with aspen and oak are predominant. There are almost no pure pine stands, although there are some pine-mixed communities on the east and southeast shore of Sandy Lake.

2.9.5 Cross Lake. Heavy development has disturbed most of the shoreline vegetation on this lake. The land along the water generally rises dramatically from the shoreline. Pine and hardwoods such as oak and birch are common with much of the shoreline comprised of Norway, white, and Jack pine.

2.9.6 Gull Lake. This was the first Headwaters lake to become heavily developed. Much of the shoreline vegetation has been disturbed. Elm-ash and maple-basswood communities form the primary vegetative cover with scattered stands of birch-aspen, pine, and mixed hardwood communities also found. Marsh communities are located primarily in the north and south parts of the lake in bays.

2.10 Threatened and Endangered Species

The Endangered Species Act (ESA) states that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of

the purposes of the Act. The purposes of the ESA are to provide a means to conserve the ecosystems upon which endangered species and threatened species depend and to provide a program for the conservation of such federally-listed species. The Corps manages and implements the threatened and endangered species program in accordance with ER 1130-2-540.

Three species found in the Headwaters' region are on the federal threatened and endangered species list. The Canada lynx (*Lynx canadensis*) is currently listed as a threatened species and may be found throughout the region. They prefer dense forests and prey on snowshoe hares. Their preferred habitat includes a mix of evergreens and hardwoods, such as maple and birch, with interspersed mature and young forest. The lynx population increases and decreases in relation to the snowshoe hare population. When snowshoe hare numbers are low it is likely that there are no lynx in Minnesota. Historically, the decline of lynx in the lower 48 states was due to trapping and timber harvests that changed and fragmented lynx habitat. Today, timber harvest, recreation, and related activities continue to threaten lynx habitat.

The gray wolf (*Canis lupus*), previously listed as a threatened species, can be found throughout the region. The gray wolf was delisted in Minnesota on August 8, 2007, but was relisted on December 19, 2014. A 2012-2013 MNDNR study documented about 2,200 gray wolves in Minnesota. Gray wolves prefer forested areas and prey on deer, moose, beavers, and small mammals. The gray wolf is found in almost all habitat types: prairie, forest, mountains, and wetlands. In the conterminous 48 states today, they are found in mostly forested lands in Minnesota, Wisconsin, Michigan, Montana, Idaho, Oregon, Washington, and Wyoming. Although wolves in the western Great Lakes area primarily use northern woodlands, they have expanded their range into areas that are a mix of forest and agriculture in Minnesota and Wisconsin.

The Northern long-eared bat (*Myotis septentrionalis)* is currently listed as a threatened species. It was listed on April 2, 2015. This species hibernates in caves and mines with constant temperatures, high humidity, and no air currents. They swarm in the surrounding wooded areas in autumn. Northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. They roost and forage in upland forests during spring and summer months and are impacted by the white-nose syndrome, which has caused a dramatic decline in their numbers.

The bald eagle (*Haliaeetus leucocephalus*) was previously listed as threatened and is found throughout the project area. The bald eagle was delisted on March 12, 2007, but it is still protected under the Bald and Golden Eagle Protection Act. Bald eagles generally nest near coastlines, rivers, and large lakes where there is an adequate food supply. They nest in mature or old-growth trees, snags (dead trees), cliffs, and rock promontories. Nest sites typically include at least one perch with a clear view of the water where they forage. Bald eagles overwinter throughout the country but are most abundant in the West and Midwest. The two primary characteristics of bald eagle winter habitat are an abundant, readily-available food supply with one or more suitable night roost sites. The majority of wintering eagles are found near open water where they feed on fish and waterfowl, often taking dead, crippled, or otherwise vulnerable animals. Mammalian carrion is an important alternate source of food at some locations. Also, many bald eagles spend a substantial portion of the non-nesting period in terrestrial habitats far from open water, relying on prey that they can easily catch, such as small mammals, or scavenge, such as big game or livestock. Eagle numbers have been steadily increasing since a ban on DDT was enacted in 1974.

Minnesota has numerous species identified on their state Endangered, Threatened, and Special Concern Species List. For upland and wetland areas within the Project's watersheds, 105 species have been identified (Appendix D). Some of these species have the potential to live on Corps' land and some have been previously observed. As outlined in Chapter 3, the Corps aims to conduct a more thorough survey of the Corps lands in the Headwaters to identify these species and ensure appropriate monitoring and protective measures are in place. The following species from Minnesota's Endangered, Threatened, and Special Concerns Species List have been observed on Corps lands in the Headwaters (Table 8).

Table 8. Minnesota Endangered, Threatened, and Special Concern Species in the Headwaters.

	SPECIES STATUS	HEADWATERS' SITE
MAMMALS		
	N/A	N/A
BIRDS		
NELSON'S SPARROW	Special Concern	Leech
WILSON'S PHALAROPE	Threatened	Leech
AMPHIBIANS AND REPTILES		
BLANDING'S TURTLE	Threatened	Gull
FISH		
LEAST DARTER	Special Concern	Leech
PUNGOSE SHINER	Threatened	Gull
MOLLUSKS		
CREEK HEELSPLITTER	Special Concern	Winnibigoshish

*Data extracted from National Heritage Information System.

2.11 Ecological Setting

An ecosystem is a dynamic community of biological organisms, including humans, and the physical environment in which they interact. Ecosystem management by the Corps is a proactive, goal-driven approach to sustaining ecosystems and their values. The Corps will manage ecosystem communities on project lands with a view toward sustaining the ecosystems and promoting regional environmental values. Such ecosystems and communities will be identified in resource objectives and/or land-use classifications contained in the Master Plan. Preferential treatment will be given to the management of ecosystems, communities, and habitats identified as having special status species.

The Minnesota Department of Natural Resources and the U.S. Forest Service have developed an Ecological Classification System (ECS) for ecological mapping and landscape classification in Minnesota following the National Hierarchical Framework of Ecological Units PDF (ECOMAP 1993). As defined in the ECS, the Northern Minnesota Drift and Lake Plains Section (MDL) covers the center of Northern Minnesota, including all of the Headwaters' sites. The MDL has complex surface geology, formed over many episodes of glaciation. It is characterized by deep (200-600 ft [60-180 m]) glacial deposits in outwash plains, lake plains, till plains, outwash channels, moraines, and drumlin fields. The patterns of vegetation in the MDL reflect the complex and patchy distribution of these glacial deposits. Mesic forests of sugar maple, basswood, paper birch, aspen, and northern red oak are widespread. They occur mostly on moraines or till plains characterized by rough topography, fine-textured parent material, or soils with sub-horizons that perch snowmelt and rainfall. Historically, forests and woodlands of jack pine and red pine were very common. These fire-dependent communities occur on the sandy outwash plains formed by glacial melt water. Sandy and gravelly deposits that cap many of the major moraines in the western part of the MDL provide habitat for mixed forests of pine and boreal hardwood species such as

quaking aspen and paper birch. The eastern part of the MDL is formed of deposits from glacial lakes Upham and Aitkin. These lake plains have expansive areas of acid peatland communities such as black spruce bogs and poor swamp forests, along with rich swamp forests of white cedar and black ash. Sedge meadows and alder and willow swamps occur along the sluggish streams draining the flat lake plains and along the Mississippi and Leech Lake rivers.

2.12 Wetlands

The Corps is committed to developing and maintaining wetlands at the Headwaters' sites. In Public Law 86-717, codified at 16 U.S.C. § 580m-580n (within the Corps this is known as the "Forest Cover Act"), Congress authorized the Chief of Engineers to protect and develop vegetative cover, such as wetlands, so as to yield maximum benefit and otherwise improve such areas. Wetlands are those areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support—and that under normal circumstances do support—a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Existing wetlands will be protected, conserved, and maintained with one goal being "no net loss" of wetlands at any one project. On hydric soils (indicating previous wetland conditions) consideration and management emphasis should be given to returning, operating, and/or maintaining wetlands for wetland plant communities. Consideration should be given to buffering the wetland within an adequate amount of land to prevent abuse or loss from adjacent land uses. The development and maintenance of wetlands should integrate the needs of fish and wildlife and support national programs and efforts associated with the Endangered Species Act of 1973 (16 U.S.C. § 1531 *et seq*.); 33 U.S.C. § 2317 (Section 307 of the Water Resources Development Act of 1990, PL 101-640); EO 11990, Protection of Wetlands; and the North American Waterfowl Management Plan.

Wetlands are a critical component of the Headwaters' ecosystem. One of the primary functions of wetlands is to store water and slowly release it over time, which reduces flooding. They also act as filters by retaining sediments and nutrients, resulting in healthier streams and lakes. Wetlands provide a unique habitat for a wide variety of wildlife and recreational opportunities including hunting, fishing, and trapping. There are multiple types of wetlands that exist in the Headwaters, ranging from wet meadows to shallow marshes to floodplain forests.

2.13 Utilities

Utility placement requests on Corps' lands are processed through the St. Paul District's Real Estate section. The Real Estate section evaluates requests on a case-by-case basis to ensure utilities are placed in areas most suitable for development. The Real Estate section will consider protection and preservation of the natural environment, cultural resources, and the type of land classification when making its decision.

2.14 Timber Resources

The Forest Cover Act, 16 U.S.C. § 580m-580n, Public Law 86-717, provides a statutory mandate for multiple use forest management, or other vegetative management, on project lands and waters. Forest and woodland management are aimed at developing, maintaining, protecting and/or improving vegetation conditions for timber, fish, soils, recreation, water quality, and other beneficial uses. The Corps possesses the authority to sell forest products in accordance with ER 405-1-12 as part of effective forest management.

2.15 Cultural Resources

Cultural resources are integral, nonrenewable elements of the physical landscape in the Headwaters' region. Cultural resources (a.k.a. historic properties) include pre-contact and historic archaeological sites and artifacts, historic standing structures, shipwrecks, historic and archaeological districts, cultural landscapes, and ethnographic resources. Many of the cultural resources located at Headwaters' recreation areas are either eligible for listing or are already listed on the National Register of Historic Places (NRHP). Cultural resources investigations at Corps recreation areas have provided important information that has contributed to our understanding of past cultures, which enriches our identities and the identities of future generations.

Construction of the Headwaters' dams and associated structures, reservoir operations, and development of the recreation areas have negatively impacted numerous cultural resources. Ongoing operation and maintenance activities have the potential to affect cultural resources today and into the future. Such affects would be limited due to the variety of federal and state laws and Corps guidelines and regulations that mandate protection and preservation of cultural resources.

2.15.1 Pre-Contact and Historic Background. The Headwaters' region was shaped by the effects of retreating ice during the Wisconsin glaciation (approximately 70,000 to 12,000 years ago [ya]) through a complex sequence of climatic and geomorphic changes during the Late Pleistocene. Continued climatic alterations throughout the Holocene influenced geomorphic processes, vegetation changes, and ecotone shifts. Such events affected cultural development because they affected resources available to human populations (e.g., Ojakangas and Match 1982; Wright 1972; Wright et al. 2004).

Humans presumably arrived in the region shortly after the glacial ice retreated, approximately 15,000 to 12,000 ya. The Native American cultural history in the Headwaters' regions is typically divided into three general time periods or traditions: Paleo, Archaic, and Woodland. These divisions are then subdivided into various taxonomic units (e.g., Benchley et al. 1997; Gibbon 2012). The Headwaters' recreation areas contain a variety of significant cultural resources and archaeological manifestation (e.g., Bradford 2014; Harrison 1985; Johnson 1978, 1979; Winchell 1911).

The Paleo Period (early ca. > 13,000-12,500 ya and late ca. 12,500-9,500 ya) stages are defined by fluted and lanceolate shaped projectile points. It is thought that in the Paleo Period, groups of humans were few in number, widely scattered, and highly mobile hunter-gatherers. They specialized in hunting megafauna and large game species (e.g., mammoth, giant bison). Paleo sites are rare and largely represented by individual find spots. To date, no Paleo age sites have been identified at Headwaters' recreation sites.

The Archaic Period is divided into Early (ca. 9,500-7,500 ya), Middle (ca. 7,500-3,000 ya), and Late (ca. 3,000-2,000 ya) stages, marked by diversification of the subsistence base and regional differences in material culture. Population during the Archaic increased, and groups tended to be more sedentary. Material characteristics include notched and stemmed projectile points, ground stone tools, implements made of copper, long-distance exchange, and communal cemeteries. Most of the Headwaters' recreation sites contain archaic components including a significant Old Copper component at Sandy Lake.

The Woodland Period is denoted by increased populations, a trend toward semi-sedentism, extensive construction of burial mounds and widespread use of ceramics and domesticated plants. The Woodland

is divided into Early (ca. 2,000-1,600 ya), Middle (ca. 1,600-1,000 ya), and Late (ca. 1,000-400 ya) stages, each defined by distinctive notched, stemmed, and triangular projectile points and a variety of decorated and undecorated ceramics. By the later stages of the Late Woodland period (Psinomani complex), groups thought to be ancestral Siouan speakers (Dakota) inhabited the Headwaters' region and eventually interacted with the French. Most of the Headwaters' recreation sites have Woodland components, such as the National Register of Historic Places (NRHP) listed Gull Lake Dam Mound Group.

In the late seventeenth century, French voyagers and missionaries were the first Europeans to visit the Headwaters' region (e.g., Folwell 1969). For the most part, the French and later British presence was limited and scattered, although epidemics and the displacement of eastern native groups to the west created major upheavals to aboriginal ways of life. In the Headwaters' region this situation resulted in warfare, and by the late eighteenth century, the Dakota were displaced from the region by the Anishanabe. Subsequent trading was carried out by the British into the early nineteenth century and by Americans thereafter. The fur trade was in decline by the middle of the nineteenth century due to depletion of fur-bearing animal populations. Some of the recreation areas contain Contact Period (ca. 400-200 ya) components.

The historic period (ca. 200-present) in the Headwaters' region is dominated by lumbering, agriculture, transportation (e.g., railroad and river), industrialization (e.g., mining, mills), and the displacement of native populations to reservations (e.g., Leech Lake, Mille Lacs, Red Lake, White Earth). By the mid-nineteenth century, the Corps was researching construction of a series of reservoirs in the Headwaters to provide water to downstream milling interests and reliable navigation (e.g., Anfinson 2003). The Lake Winnibigoshish dam is listed on the NRHP while the remaining five dam structures have all been determined eligible for listing on the NRHP. All of the recreation sites have cultural resource components from the historic period.

2.16 Economics

Agriculture, lumber, mining, and recreation/tourism are the primary industries making up the economy in the Headwaters' area.

The Headwaters' area has been forced to adapt to economic changes to stay viable. When the lumber industry was at its peak, the timber companies housed their workers in small quarters. As the timber industry declined, there was no longer a need for timber companies to house employees. Resorts began to buy the employee housing from the timber companies. Resorts were at their peak in the 1950s-1960s. Eventually, resorts started to sell their property by portions, selling cabins off one by one. People were then able to privately develop around the lakes.

Recreation and tourism play a critical role in Minnesota by providing jobs and income in many communities. People who visit the Headwaters spend money in the nearby communities on lodging, attractions, food and other services, which has a direct effect on the economy in the form of income that pays wages and tax revenue. Businesses serving tourists are buyers of goods and services required to meet the needs of the visitors. Therefore, tourist spending creates indirect effects by contributing to wages and employment in other local businesses that supply goods and services to the tourism industry.

Headwaters' project sites also generate revenue from recreation. The money collected from the sites is turned over to the U.S. Department of Treasury. Table 9 provides revenues from the Headwaters' project sites for fiscal years 2010 - 2014.

Table 9. Headwaters' Recreation Revenues for Fiscal Years 2010 – 2014.

RECREATION REVENUES FY 2010 – FY 2014					
	2010	2011	2012	2013	2014
USACE	$50,910,603	$49,323,977	$51,774,560	$57,768,486	$50,779,959
ST. PAUL DISTRICT	$862,881	$881,721	$924,804	$847,500	$850,558
HEADWATERS' PROJECT	$587,522	$601,472	$600,451	$573,766	$585,906

2.17 Recreation Facilities, Activities and Needs

See Chapter One for a description of the recreation facilities at the Headwaters' project sites.

2.17.1 Zones of Influence

The primary area of influence encompasses portions of Aitkin, Cass, Crow Wing, and Itasca counties and the towns/cities of Crosslake, Brainerd, Deer River, Federal Dam, Grand Rapids, and McGregor. Because the Headwaters' project sites are located in six cities and four counties, the town or city in which the dam is located has been utilized as the basis for summarizing the population characteristics of each Headwaters' site. The combined population of the six cities in 2010 was 28,031. This represents a gain of 14.7% (or 3,584 persons) over the 2000 population of 24,447. The largest growth occurred in Grand Rapids, which gained 3,105 people and represents 87% of the total increase. McGregor's population declined by 13 people. Table 10 provides information for each of the Headwaters' sites related to zones of influence and population.

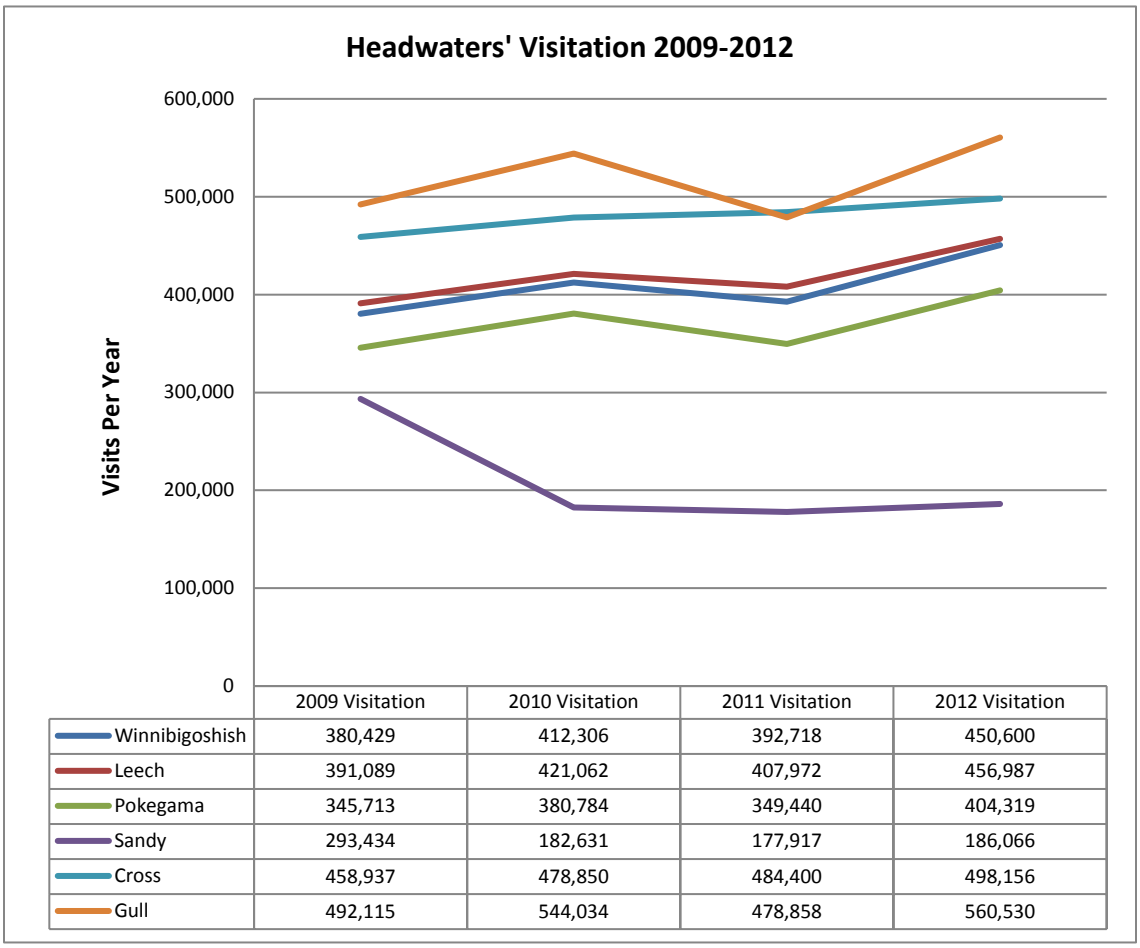
Table 10. Headwaters' Zones of Influence and Population.

	HEADWATERS' SITES					
	Winnibigoshish	Pokegama	Leech	Sandy	Cross	Gull
TOWN	Deer River	Grand Rapids	Federal Dam	McGregor	Crosslake	Brainerd
NEAREST LARGE CITY	Grand Rapids	Grand Rapids	Grand Rapids	Grand Rapids	Brainerd	Brainerd
COUNTY	Itasca	Itasca	Cass	Aitkin	Crow Wing	Cass
2000*	903	7,764	101	404	1,893	13,382
2010*	930	10,869	110	391	2,141	13,590
2000 – 2010 (+/-)	+3%	+40%	+9%	-3%	+13%	+2%

* Census City population

2.17.2 Visitation Profile

The Headwaters is a popular recreation location in Minnesota, primarily due to the relatively short distance from the Twin Cities of Minneapolis and St. Paul, the abundant lakes, north woods scenery, and many opportunities for recreation. The Headwaters averages 2,407,337 visits per year, with peak visitation occurring between May and September. Figure 5 provides visitation numbers by site for years 2009 – 2012.



	2009 Visitation	2010 Visitation	2011 Visitation	2012 Visitation
Winnibigoshish	380,429	412,306	392,718	450,600
Leech	391,089	421,062	407,972	456,987
Pokegama	345,713	380,784	349,440	404,319
Sandy	293,434	182,631	177,917	186,066
Cross	458,937	478,850	484,400	498,156
Gull	492,115	544,034	478,858	560,530

Figure 5. Headwaters' Visitation 2009 – 2012.

The visitor population at Headwaters' sites consists of visitors who utilize campgrounds and day use areas, both permanent and seasonal residents in the surrounding areas, and visitors who stay at other lodging, such as hotels and other resorts[2]. The Headwaters' project sites provide the public with access to recreational boating, sailing, kayaking, paddle boarding, fishing, and swimming. The Headwaters also provide access to snowmobile trails, snowshoeing, walking, biking, picnicking, marinas, and restaurants.

[2] Information related to how Corps conducts visitation numbers: http://corpslakes.usace.army.mil/employees/usurveys/modern-over.cfm

Table 11 shows 86% of camping reservations during the peak season at Headwaters' sites were made by Minnesota residents and, of these, 25% were from the Twin Cities metropolitan area. This area (denoted "Metro Area" on the table) consists of seven counties: Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington. The local area outlined in Table 11 is considered everything within a 30-mile driving distance to the site. The "other" category listed in Table 11 consists of locations in Minnesota that are neither local nor metropolitan areas.

Table 11. Geographic Locations of Reservations for Headwaters' Sites.

	HEADWATERS' SITES					
	Winnibigoshish	Pokegama	Leech	Sandy	Cross	Gull
LOCAL AREA	19%	31%	3%	3%	15%	21%
METRO AREA	20%	17%	16%	24%	31%	24%
OTHER	61%	52%	81%	73%	54%	55%

Source: www.recreation.gov, 2014.

The top three cities with residents who camp in the Headwaters (based on total visits per site) are: Grand Rapids (5%), Brainerd (5%), and Duluth (3%). Table 12 provides a breakdown of the cities with the most residents who camp at each of the Headwaters' sites.

Table 12. Top Three Cities with Residents Who Camp at Each Headwaters' Site.

	HEADWATERS' SITES					
	Winnibigoshish	Pokegama	Leech	Sandy	Cross	Gull
1	Grand Rapids (12%)	Grand Rapids (20%)	Grand Rapids (14%)	Cloquet (8%)	Brainerd (6%)	Brainerd (10%)
2	Duluth (5%)	Deer River & Minneapolis (4%)	Cohasset (4%)	Duluth (5%)	Minneapolis (4%)	Baxter (4%)
3	Deer River & Minneapolis (3%)	Bemidji (3%)	Brainerd (4%)	Brainerd (3%)	Duluth (3%)	Sauk Rapids (2%)

Source: www.recreation.gov, 2014.

At this time, demographics of day users are unknown—a study is recommended to determine these demographics.

2.17.3 Recreation Analysis

The recreational use and development of the Headwaters area expanded greatly after World War II, while other industries, such as farming and timber harvesting, were in decline. As a result, the economy began shifting toward more dependence on summer residents and tourism. In the mid-20th century, most of the resorts in the Headwaters' area were small, family-owned operations. They were very lake-dependent, advertising fishing, boating, and swimming, activities. With most of the activity occurring during the summer, many of the recreation-related businesses closed during the winter months.

Many of the smaller resorts from the mid-20th century are no longer operating and many of the resort properties have been sold for private development. A number of the larger resorts have changed their focus from water-based recreation to multiple recreational and seasonal opportunities combined with conference centers. Although the resort industry has been declining, it still plays a role in recreation and lake access in Northern Minnesota. Figure 6 provides information on the number of private resorts by county in the Headwaters' area.

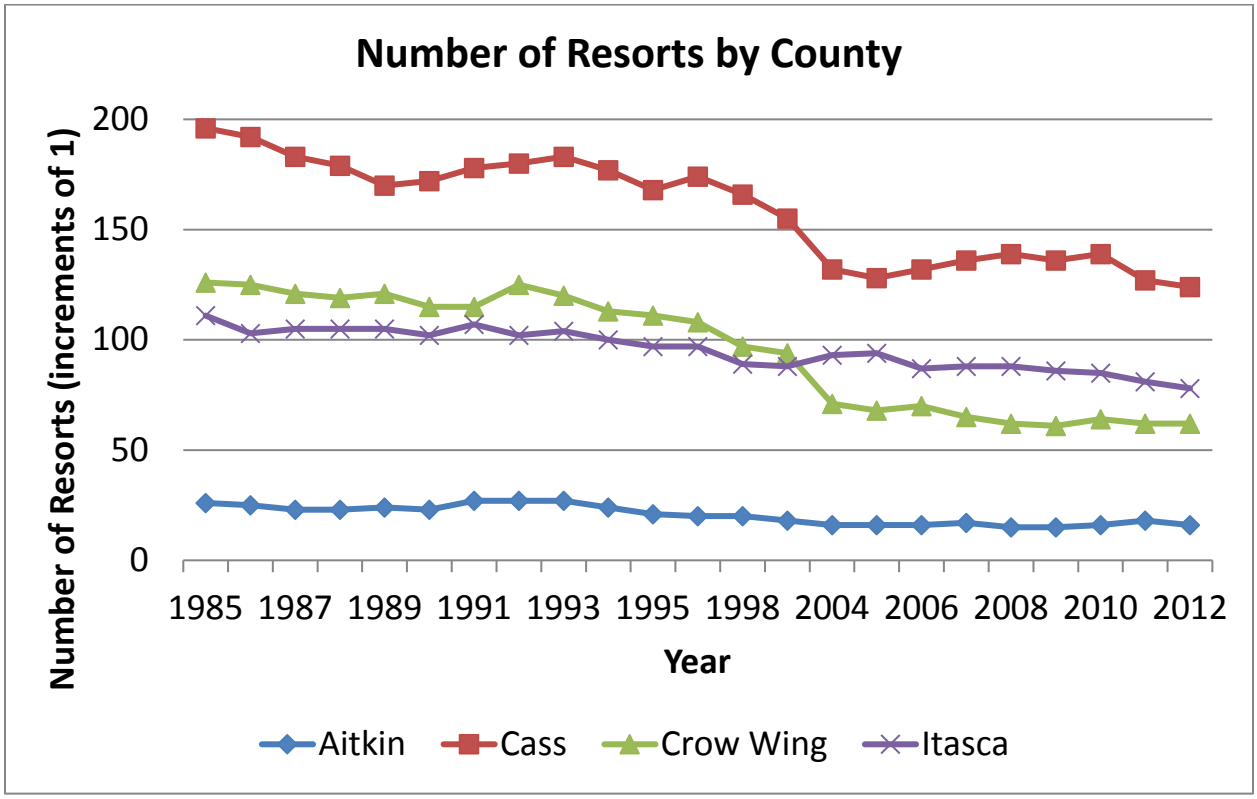


Figure 6. Number of Private Resorts by County.

In addition to the resorts in the area, a large number of golf courses have been developed in the region. Summer use of the trail systems by mountain bikers and all-terrain vehicle (ATV) riders also is increasing. Hunting and fishing activities within the region has remained relatively stable and still accounts for sizeable portion of the overall recreational use of the area. Other federal, state, and local government agencies also provide recreational opportunities in the area through parks, forests, recreation areas, and refuges.

Several reports done by other federal and state agencies provide additional information related to recreation projections for the nation and within Minnesota. The reports show a general decline in several outdoor recreation activities and decline in participation from certain segments of the population.

According to the Federal Outdoor Recreation Trends conducted by the U.S. Department of Agriculture in 2014, participation in most recreation activities is projected to grow through 2030. The activities projected to have the highest percentage of growth in days of participation by 2030 are downhill skiing, visiting interpretive sites, hiking, and birding. Projected percentage growth is lowest for hunting, snowmobiling, motorized off-road vehicles, and fishing.

The Federal government is striving to meet the needs of present and future users through the America the Beautiful Pass[3]. This program provides affordable and convenient access to Federal recreation lands. Up to 100% of the pass program's proceeds are used to improve and enhance visitor recreation

[3] http://www.recreation.gov/showPage.do?name=landing&landing=/htm/interagency/index.jsp

services. The program is available to a wide range of demographics including, 4th graders, seniors, military, volunteers, and individuals with disabilities.

The Minnesota's State Comprehensive Outdoor Recreation Plan, completed in 2014, also provides recreation projections and trends for the state. This report shows that there is a decline in hunting, fishing, boating, wildlife watching, and wilderness use. The decline in these activities is most commonly seen among young adults and their children. These changes can be attributed to changes in demographics, including age and ethnicity. The population is aging and there are fewer younger people as compared to the baby boomer generation. The population is also becoming more diverse and these demographic changes are producing new users who enjoy outdoor recreation in a different way than traditional users.

While visitation at Corps'-owned recreation areas remains strong, there are indications of demand for upgraded facilities and non-traditional recreation opportunities. Some recreational activities have evolved and modernized and the user base has changed. One way the Corps tracks visitor satisfaction is through visitor comment cards. Comment cards collected from visitors at Cross, Gull, and Sandy sites in 2010 indicated that, overall, visitors were pleased with the facilities, employees, and environmental setting. Comments from campers and day users revealed users enjoy the connection with nature and park safety. Users would also like more modern amenities similar to their home (i.e. Wi-Fi, clean restrooms), larger campsites for hosting family events and larger vehicles. The challenge for the future will be to maintain the existing recreation infrastructure and environmental quality while meeting the changing demands and needs of the public.

2.17.4 Recreational Carrying Capacity

At this time, the carrying capacity is unknown for the recreation facilities in the Headwaters. Minnesota's total population is projected to exceed 6 million by 2031 and swell to 6.45 million by 2065. With the population increasing, there may be more demand for public access to the lakes. In the future, carrying capacity may be considered as part of determining how to manage natural resources on Corps-owned land.

2.18 Real Estate

Prior to construction of the Headwaters' projects, the Corps acquired fee-title interests and flowage easements by direct purchase or by exercising the government's right of eminent domain (Condemnation). Various Executive Orders and Proclamations had retained perpetual flowage rights over public domain lands and Indian lands in the project areas. In addition, the State of Minnesota ceded flowage rights to the federal government over many acres in support of the Headwaters' projects. The government has conducted numerous land disposal transactions subsequent to the acquisition process. Land disposals are initiated when the government identifies it no longer needs the real estate interest. However, a flowage easement is typically reserved upon disposal of fee title lands.

Acquisition of any additional real estate interests deemed necessary for Headwaters' project operation or maintenance purposes will be completed pursuant to Public Law 91-646, Uniform Relocation Assistance and Real Property Acquisition Act of 1970, as amended.

Table 13 summarizes the multiple types of real estate interests that are held by the federal government for the Headwaters' projects. The types of real estate interests are defined below. Appendix C- Plates provides maps on the various land types described in the Master Plan.

Table 13. 2016 Headwaters' Project Real Estate Summary Table (in acres).

PROJECT	FEE TITLE	PERMANENT USE PERMIT	FLOWAGE EASEMENT	JOINT USE PERMIT
WINNIBIGOSHISH	0	10	82,400	0
LEECH	119	195	100,541	0
POKEGAMA	10	0	66,523	0
SANDY	1,164	0	7,978	0
CROSS	432	0	21,718	5
GULL	21	82	15,058	0

Acreages presented in the Master Plan are for planning purposes only. Official acreages are maintained by the District Real Estate Office. The 2016 Master Plan Acreages are based on present day GIS measurements of management areas and may reflect deviations from previous planning document(s).

Fee-Title: Land where the federal government holds the fee-simple title to a specific legal description, subject to existing easements for public roads and highways, public utilities, railroads, and pipelines. Fee-title is a permanent and absolute tenure of an estate in land with freedom to dispose of it at will.

Within the Headwaters' area, fee title lands include sections of land that were inundated when the dams were constructed along with multiple areas that were acquired for project purposes.

Permanent Use Permit: The U.S. Department of the Interior granted the Corps permanent use of these lands for special use. The Corps manages permanent use permit lands similar to fee title lands.

Flowage Easement: The federal government acquired perpetual flowage easement rights on certain private lands that adjoin public land in the Headwaters. In addition, the federal government reserved flowage rights on public lands when they were made available for patent. The right may not appear on the patent but only in the authorizing legislation. For example, the law that allowed public domain lands to be made available for homesteading purposes provided that the patents were subject to the right of the United States to overflow. Acts of Congress granted flowage easements on certain Indian Reservation lands. Flowage easements give the government a perpetual right to occasionally flood lands in connection with the operation and maintenance of the lake. With few exceptions, these flowage easements grant the federal government the right to prevent human habitation on the flowage easement and to prevent any activity that would limit the government's ability to periodically store flood water on the land. In some instances, the reference to a flowage easement restriction is omitted during the preparation of new deeds during changes in property ownership. This omission does not diminish the legality or validity of flowage easement restrictions over the property involved.

Joint Use Permit: The joint use lands were acquired by a formal agreement between the U.S. Army Corps of Engineers and Crow Wing County, Minnesota, which sets forth the terms and conditions for shared use of public property or facilities.

2.18.1 Acquisition Policy. Real estate interests were acquired for the Headwaters under authority of the Rivers and Harbor Acts of 1880 and 1882. The authorized project required real estate interests for the operation and maintenance of six (6) dams, 28 perimeter dikes, and permanent and occasional flowage areas.

2.19 Tribal Trust

As part of the Corps' tribal trust responsibility, the Corps considers the relationship between local Native American tribes and the Federal Government on various operational elements of the Headwaters'

projects. Portions of the Headwaters' project sites are located within the boundaries of Native American Reservations. The lakes and streams of the Mississippi Headwaters' area, as well as the plants and animals associated with them, hold spiritual, economic, and subsistence value to the various bands and tribes in the area. Natural resources are a fundamental aspect of their cultural identity.

The greatest density of culturally important archeological sites in the Headwaters' area is typically found along the shorelines of lakes, rivers, and streams. These sites are located both above and below the current water levels. The primary tribal goal, with regard to cultural resources, is to ensure that the heritage of Native Americans is preserved as an integral part of community life, providing orientation to its people, their language, music, stories, and traditions. The preservation of these cultural sites is considered a vital legacy to be maintained for future generations. Any deviation from the authorized water control manuals should be coordinated with the Headwaters' tribal interests to ensure appropriate consideration of the natural and cultural resources that may be impacted.

CHAPTER 3 - MANAGEMENT GOALS AND RESOURCE OBJECTIVES

The Corps' vision for the future management of land, water, and recreational resources of the Headwaters' project sites is to provide quality outdoor recreation opportunities while protecting, conserving, and sustaining project resources for the benefit of present and future generations.

The vision for the Headwaters' project sites is to recognize the past while planning for and shaping the future. This vision is supported by the following broad management goals:

- Identify and protect environmentally sensitive species, habitats, and landscapes.
- Identify and protect cultural resources.
- Improve and support water quality.
- Identify outdoor recreation demands and provide those that complement natural resources in the area.
- Manage public use areas to provide safe and enjoyable opportunities.
- Collaborate with community stakeholders.
- Maintain open communication with the public at large.
- Create partnerships to leverage fiscal resources.
- Strive to maintain a highly-qualified staff.
- Incorporate sustainability in all activities to the greatest extent possible.

3.1 Resource Objectives

The following resource objectives set forth specific objectives for recreation, environmental stewardship, and general resources. The resource objectives are intended to guide the future management of the Headwaters.

3.1.1 Recreation Resource Objectives

- Evaluate, improve, and modernize day use and campground facilities based on user needs and industry standards including, but not limited to, the following: sewer hook ups, increased electrical service, concrete RV pads, group campsites, wireless internet access, amphitheaters, fish cleaning stations, restrooms, trails, interpretive signage, playgrounds, boat ramps, parking areas, and camper cabins.
- Improve and expand opportunities for passive recreation such as hiking, birding, and nature study by providing and maintaining high quality trails and wildlife viewing stations.
- Improve interpretive services through collaboration with partners, construction of facilities conducive to group gatherings, and community outreach programs.
- Work toward universal accessibility in all aspects of the recreation mission. Provide access opportunities that contribute to the quality of life for all ages, ethnic backgrounds, and people with physical limitations.
- Conduct a carrying capacity study on existing recreation facilities. Once the study is complete, continually monitor and review for changing conditions.
- Evaluate and maintain high-quality public water access points.
- Evaluate recreational experiences using comment cards and other methods.
- Increase visitor base through equipment and facility loans and rentals.
- Evaluate current land use and ensure proper balance between impacts of visitors and the resources.

3.1.2 Environmental Stewardship Resource Objectives

- Identify and proactively manage habitats to protect threatened, endangered, and species of special concern.
- Monitor lands and waters for invasive and exotic species and take action to prevent and/or reduce their spread.
- Identify, protect, and/or restore important native vegetation ecosystems where they occur or historically occurred on project lands.
- Evaluate opportunities to enhance wildlife connectivity including, but not limited to, improving fish passages and connecting fragmented terrestrial habitat.
- Inventory, protect, and interpret cultural resources.
- Carefully evaluate land-use requests, such as road and utility easements to avoid unnecessary resource damage or negative effects on public use. Ensure that all alternatives are considered.
- Improve water quality by participating in watershed management efforts primarily through the use of partnerships.

3.1.3 General Resource Objectives

- Identify legal authorities of lands and waters in all aspects of operations (shoreline permits, buoy placement, enforcement, etc.)
- Comply with all applicable laws, regulations, and policies.
- Protect and enhance the unique qualities and visual identity of the Headwaters.
- Foster public and employee safety through education and training, research, and proactive visitor assistance activities, such as: personal visitor contact, water safety patrols, and timely maintenance of signs and public use facilities. Establish carrying capacities for all activities through a process of public involvement and scientific analysis as needed.
- Maintain regular contact with community members and agency stakeholders and partners. Host and attend periodic information exchange meetings and public workshops to ensure open communication on all activities.
- Identify and re-establish all boundaries including fee, permanent use, and easement lands. Eliminate encroachments and trespassing by maintaining an easily-recognized federal property boundary line and performing periodic inspections of these boundaries. Maintain contact with adjoining landowners, real estate agents, and developers to ensure that they understand Corps' policy and regulation. Take prompt action to resolve encroachments and trespassing occurrences.

Implementation of these objectives requires time, manpower, and budget. The objectives provided in this chapter are established to provide high levels of stewardship to Corps'-managed lands and resources, while still providing an appropriate level of public service. These objectives will be pursued through assistance from volunteer efforts, partnership agreements, hired labor, contract labor, permits, and special lease conditions. In all management actions, the Corps will strive for a reasonable and pragmatic approach to the management of resources.

Engineering Regulation (ER) 1130-2-550 establishes the policy for the administration and management of Corps' recreation programs and facilities. ER 1130-2-540 establishes the policy for the administration and management of natural resource activities. The rules and regulations governing public use at Corps' water resources development projects are published as Title 36 of the Code of Federal Regulations, Chapter III, Section 327.0-327.30 and enforced by Corps personnel with Title 36 citation authority.

CHAPTER 4 - LAND ALLOCATION, LAND CLASSIFICATION, AND EASEMENT LANDS

This Master Plan is essentially a land-use plan; specific parcels of land are classified into land-use categories based on resource capability. This plan provides a conceptual guide for use, management, and development of all Corps' lands, which are divided into management areas in the Headwaters. The boundaries of the management areas are based on physical, administrative, and operational characteristics.

This chapter briefly describes the types of land classifications that are used within the Corps, not all occur within the Headwaters' project sites. Chapter 5 contains both descriptions of each of the six categories of classification and details on the management activities undertaken for each.

4.1 Land Allocation

In accordance with Engineer Pamphlet (EP) 1130-2-550, land allocations identify the authorized purposes for which Corps lands were acquired. There are four categories of allocation:

- Operations
- Recreation
- Fish and Wildlife
- Mitigation

All of the Corps' lands in the Headwaters were allocated for Operations. Operation lands were acquired to provide safe, efficient operation of the project for its authorized purpose of navigation.

4.2 Land Classification

All lands acquired for the Headwaters are further classified to guide development and resource management consistent with authorized purposes and other Federal laws. There are six categories of classification:

- Project Operations
- High Density Recreation
- Mitigation
- Environmentally Sensitive Areas
- Multiple Resource Managed Lands
- Water Surface

The classification process refines the land allocations to fully utilize project lands and considers public desires, legislative authority, regional and project-specific resource requirements, and suitability. Land classification indicates the primary use for which project lands are managed.

4.2.1. Project Operations. This classification includes lands required for the dam and associated structures, administrative offices, maintenance facilities, and other areas that are used to operate and maintain the Headwaters. When compatible with operational requirements, project operations lands may be used for wildlife habitat management or recreational use. Licenses, permits, easements, or other outgrants are issued only for uses that do not conflict with operational requirements.

4.2.2. High Density Recreation. These lands are designated for intensive levels of recreational use to accommodate and support the recreational needs and desires of visitors. They include lands on which existing major recreational facilities are located and allow for developed public recreation facilities, commercial

concession development, quasi-public development, and high-density or high-impact recreational use. In general, any uses of these lands that interfere with public enjoyment of recreation opportunities are prohibited. Low-density recreation and wildlife management activities compatible with intensive recreation use are acceptable, especially on an interim basis. No agricultural uses are permitted on those lands except on an interim basis for maintenance of scenic or open space values. Permits, licenses, and easements are not issued for non-compatible manmade intrusions, such as: pipelines, overhead transmission lines, and non-project roads, except where warranted by the public interest and where no viable alternative area or route is available.

4.2.3. Mitigation. This classification is for lands that were acquired to specifically for the congressionally authorized purpose of offsetting losses associated with development of the project. The Headwaters do not have any lands under this classification; therefore, there is no management plan related to a mitigation.

4.2.4. Environmentally Sensitive Areas. This classification describes areas where scientific, ecological, cultural, or esthetic features have been identified. These areas must be considered by management to ensure they are not adversely impacted. Typically there is limited-to-zero public use development on lands within this classification to ensure these sensitive areas are not adversely impacted. Agricultural or grazing uses are also not permitted on lands with this classification. These areas are typically distinct parcels located within another, and perhaps larger, land classification area.

4.2.5. Multiple Resource Management Lands. This classification allows for the designation of a predominate use as described below, with the understanding that other compatible uses described below may also occur on these lands:

• **Low Density Recreation.** These lands are designated for dispersed and/or low-impact recreation use. Development of facilities on these lands is limited. Emphasis is on providing passive recreational opportunities such as walking, fishing, hunting, or nature study. Site-specific, low-impact activities like primitive camping and picnicking are allowed. Facilities may include boat ramps, boat docks, trails, parking areas and vehicle controls, vault toilets, picnic tables, and fire rings. Manmade intrusions, including power lines, non-project roads, and water and sewer pipelines, may be permitted under conditions that minimize adverse effects on the natural environment. Vegetation management, including agricultural activities that do not greatly alter the natural character of the environment, are permitted for a variety of purposes, including erosion control, retention and improvement of scenic qualities, and wildlife management. Hunting and fishing are allowed in some locations pursuant to tribal or state fish and wildlife management regulations where these activities are not in conflict with the safety of visitors and project personnel.

• **Wildlife Management General.** These lands are designated for stewardship of fish and wildlife resources. They contain valuable wildlife habitat components that are maintained to yield habitat suitable for a designated wildlife species or group of species. Private use of wildlife lands is prohibited except for agricultural activities undertaken to improve wildlife habitat. Licenses, permits, and easements are not allowed for manmade intrusions; i.e., pumping plants, pipelines, cables, transmission lines, or non-project roads. Exceptions to this policy are allowable where necessary for the public interest and where no viable alternative location or route exists. Wildlife lands are available for sightseeing, wildlife viewing, nature study, and hiking. Consumptive uses of wildlife, including hunting, fishing, and trapping, are allowed when compatible with the wildlife objectives for a given area and with both Federal and state fish and wildlife management regulations.

• **Vegetation Management.** Management activities in these areas focus on the protection and development of forest resources and native vegetative cover.

• **Future or Inactive Recreation Areas.** This sub-classification consists of lands on which recreation areas are planned for the future or lands that contain existing recreation areas that have been temporarily closed.

4.2.6. Water Surface. There are four possible sub-classifications but none are used in the Headwaters.

• **Restricted.** Water areas restricted for project operations, safety, and security purposes.

• **Designated No-Wake.** To protect environmentally sensitive shoreline areas, recreational water access areas from disturbance, and/or public safety.

• **Fish and Wildlife Sanctuary.** Annual or seasonal restrictions on areas to protect fish and wildlife species during periods of migration, resting, feeding, nesting, and/or spawning.

• **Open Recreation.** Those waters available for year-round or seasonal water-based recreational use.

4.3 Project Easement Lands

Easement Lands are all lands upon which the Corps holds an easement interest, but no fee title. Planned use and management of easement lands will be in strict accordance with the terms and conditions of the easement estate acquired for the project. Easements were acquired for specific purposes and do not convey the same rights or ownership to the Corps as other lands.

Operations Easements. Corps retains rights to these lands necessary for operations.

Flowage Easement. Corps retains the right to inundate these lands for project operations.

Conservation Easement. Corps retains the rights for aesthetic, recreation and environmental benefits.

CHAPTER 5 - RESOURCE PLAN

The management plan is based on resources available and public needs, and will provide for full utilization while protecting project resources. This plan provides guidance on what types of development and activities are permitted.

5.1 Classification and Justification

This chapter will describe in broad terms how project lands will be managed. In accordance with Engineering Pamphlet (EP) 1130-2-550, this can be accomplished by using one of two approaches: 1) Management by Classification, which is the method used below, and 2) Management by Area. The resource objectives outlined in Chapter 3 are broken down into three categories of environmental, recreation, and general objectives. To accomplish the Corps' vision of providing quality outdoor recreation opportunities while protecting, conserving, and sustaining project resources in the Headwaters, some resource objectives will be integrated in multiple land classification types. This will in turn allow the appropriate balance between environmental stewardship and recreational opportunities. The Corps is the managing agency for all land classifications in the Headwaters (designated below) except those areas specifically identified in the high density recreation land classification. A more descriptive plan for managing these lands can be found in the Operational Management Plans (OMP) for each Headwaters' site. The OMPs are updated periodically and management tasks described in the OMPs must support the objectives set forth in this Master Plan. These lands have been classified by definition in EP 1130-2-550.

The land classifications used in the Headwaters' sites are:

- Project Operations
- High Density Recreation
- Environmentally Sensitive Areas
- Multiple Resource Managed Lands

See Appendix C for plates showing the various land classifications found throughout the Headwaters' Project. Table 14 provides a breakdown of land classifications by acres. A description of each type of land classification is described below.

Table 14. Land Classification (in acres).

Classification	Acres
Project Operations	80
High Density Recreation	180
Environmentally Sensitive Areas	264
Multiple Resource Managed Lands - Low Density Recreation	127
Multiple Resource Managed Lands – Wildlife Management/Vegetation Management	392
Future Recreation Area	1.2
Flowage Easements	294,218

*Sandy Lake excluded in current land classifications totals (See section 6.5)

**Acreages presented in the Master Plan are for planning purposes only. Official acreages are maintained by the District Real Estate Office. The 2015 Master Plan Acreages are based on present-day GIS measurements of management areas and may reflect deviations from previous planning documents.

5.1.1 Project Operations (80 acres). This category includes those lands required for the Headwaters' dams, spillways, levees, dikes, offices, maintenance facilities, and other areas that are used for operation of the projects. Where compatible with operational requirements, project operations lands may be used for wildlife habitat management, recreational use, or agricultural activities. Licenses, permits, easements, or other outgrants are issued only for uses that do not conflict with operational requirements. Public access to these areas is restricted in some locations.

The management plan for these areas is to continue to operate the dams and related facilities and to provide physical security. Examples of management activities for these lands include: renovate/update facilities with modern technology, address aging infrastructure concerns, and modernize facilities to be more energy efficient.

Management for wildlife, natural resources, and recreational use will remain a priority as long as there is no conflict with operational requirements. Examples of wildlife, natural resources, and recreational use management include: modernizing visitor centers, trails, or interpretive information; protecting culturally sensitive areas; and constructing fish passageways.

5.1.2 High Density Recreation (180 acres). This category includes land developed for intensive recreational activities for the visiting public. These could include day use areas and/or campgrounds, areas for commercial concessions (e.g., marinas) and quasi-public development. In general, any uses of these lands that interfere with public enjoyment of recreation opportunities are prohibited. Low-density recreation and wildlife management activities compatible with intensive recreation use are acceptable, especially on an interim basis. No agricultural uses are permitted on these lands except on an interim basis for maintenance of scenic or open space values. Permits, licenses, and easements are not issued for non-compatible manmade intrusions, such as pipelines, overhead transmission lines, and non-project roads, except where warranted by the public interest and where no viable alternative area or route is available.

In the Headwaters' area, the majority of high density recreation lands are either managed directly by the Corps or leased to other agencies/entities for management and operation. The Corps' management activities differ depending on whether the land is managed by the Corps or leased to another entity for management.

The majority of the high density recreation lands managed by the Corps were similarly classified in the 1977 Master Plan. The management plan for these areas is to maintain and modernize these lands for public use and enjoyment. Modernization includes, but is not limited to, adding Wi-Fi, additional electric/sewer hook ups, and additional camper cabins. Additional upgrades could include new restrooms, picnic areas, play structures, and improvements to boat ramps, parking areas, and fish cleaning stations.

For recreation areas leased to other entities, the management plan is to work cooperatively with the partners to ensure recreation needs are being met and managed in accordance with the resource objectives identified in Chapter 3. The following recreation areas at Crosslake Reservoir are managed by other entities: South Crosslake Bay Recreation Area is outgranted to the City of Crosslake, the Historical Village is outgranted to the Historical Society, and Upper and Lower Hay Recreation Areas are outgranted to the DNR. At Leech Lake reservoir, Tonga's Marina is outgranted to a private concessionaire.

5.1.3 Environmentally Sensitive Areas (264 acres). Environmentally Sensitive Areas (ESAs) are classified as such to preserve the scenic, historical, archaeological, scientific, water quality, or ecological value of the overall project. Defining sensitive areas as part of the Master Plan process assists in the protection of valuable resources. These sites are mapped and managed by the Corps. To protect the sensitivity of these areas, ESAs were merged together for mapping purposes regardless of the criteria used to determine their level of sensitivity. The majority of ESAs identified in the Headwaters contain significant cultural sites and historic properties. Other ESAs were identified because they contain federal sensitive species habitat or wetlands. Degree of sensitivity varies by location and by contributing factors to sensitivity. An area may be available to construct a properly designed hiking trail, or may be actively managed by forestry practices like timber stand improvement without negatively impacting the site's sensitivity. Other sites can be very sensitive to human disturbance and need adequate protection from development. An example of this degree of sensitivity would be bald eagle nests; eagles are especially sensitive to human activities during active breeding seasons and a protective buffer zone around nests helps avoid this disturbance.

Areas designated as sensitive can change over time and continued monitoring provides valuable information to manage these sensitive areas. Through the use of Geographic Information System (GIS) databases maintained with separated layers, the dynamic nature of sensitivity can be managed in an up-to-date program. Some areas may be highly sensitive to change; other areas need prescribed management to remain viable. The goal of sensitive area management is to protect and preserve known areas that contribute to the diversity and health of the Headwaters' area.

The two broad categories of management plans for ESAs are as follows: 1) cultural sites and historic properties, and 2) sensitive species habitat or wetlands. Examples for the management plan for cultural sites and historic properties may include: inventory of cultural sites, develop and update Historical Management Property Plans, and inventory and interpret cultural resources. Examples of the management plan for sensitive species habitat or wetlands includes, but is not limited to: protect and restore shoreline, development of forestry plans, monitor and prevent the spread of invasive species, invasive species outreach efforts, prescribed burns, and restoration of lands to more natural habitat.

5.1.4 Multiple Resource Management Lands. These lands can be divided into four subcategories for the purposes of this Master Plan. The following is a description of use pertaining to each subcategory and associated acreages.

Low Density Recreation (127 Acres). Low density refers to lands with minimal development or infrastructure that support passive public recreational use (e.g. hiking trails, fishing, hunting, wildlife viewing, etc.). Existing or future limited development of these areas is appropriate for this subcategory. Low density recreation recognizes that limited development has or will occur here, yet is not at a level of a high density recreation area. Accordingly, wildlife management and vegetation management can easily co-exist with the recreational accommodations. Other factors that may determine this classification include access, past use and the level of development on neighboring private lands. Resource objectives for low density recreation include environmental stewardship activities that achieve natural resource management goals while also recognizing the compatibility of limited development for recreational pursuits.

The management plan for the low density recreation areas is to maintain and modernize where appropriate for public use and enjoyment. Examples of actions that could be taken may include: trails,

partnerships to enhance passive recreation areas, and recreational opportunities like geocaching, birding clubs, and mountain biking.

Vegetation Management (392 acres). This subcategory is the largest portion of land in the Headwaters and includes lands designated for stewardship of forest and other native vegetative cover. Management activities in these areas focus on the protection and development of vegetative and wildlife resources. With proper management, these areas also provide valuable habitat for a wide range of species. These lands are available for sightseeing, wildlife viewing, nature study, and hiking. Consumptive uses of wildlife, including hunting, fishing, and trapping, are allowed when compatible with the objectives for a given area and with both federal and state fish and wildlife management regulations. Examples of management activities compatible with both vegetative development and low density recreation may include: developing self-guided interpretive trails, creating wildlife viewing stations, updating scenic viewing areas, planting trees and native vegetation, limited timber harvesting, thinning and other forest management activities.

Future/Inactive Recreation Areas (1.2 acres). These areas either are flagged for future recreational development or are recreation areas that are currently closed. The only area classified as a future recreation area in the Headwaters is located at the Cross Lake Reservoir due to the planned expansion of the parking area adjacent to Big Trout Lake. Environmental and public review will be completed prior to any construction activity.

5.1.5 Flowage Easement (294,218 acres). The Corps retains rights to inundate these lands for project operations. See Chapter 2 for additional information on flowage easements.

CHAPTER 6 - SPECIAL TOPICS

This chapter discusses special topics not specifically addressed in other chapters of the Master Plan. Special topics are defined in this chapter as any problem, concern, and/or needs that could affect or are affecting the stewardship and management potential of the lands and waters under the jurisdiction of the Headwaters project.

6.1 Post Settlement Headwaters' Dams History

At the time of their construction, the Headwaters' dams represented a significant civil engineering undertaking accomplished in a then-remote area of Minnesota. Prior to construction of the Headwaters' reservoirs, and decades prior to construction of the locks and dams on the Mississippi River, water levels in the river between the Headwaters and Lake Pepin had great seasonal variation. Early Mississippi River steamboat navigation was totally dependent upon nature providing a three-foot water level in the river for weeks or months during the normal July and August seasonal dry periods.

The first Headwaters' dams consisted of earthen embankments filled with puddled clay. The control structure, through which water flowed, was timber. Stop logs, wooden bear trap gates, or steel tainter gates regulated the sluiceways. Each dam was equipped with a log sluice. The Corps of Engineers started work on the dam at Winnibigoshish in 1881, followed by Leech Lake (1882), Pokegama (1882), Pine River (1884), Sandy Lake (1892), and Gull Lake (1911). A distinguishing feature of the Sandy Lake Dam was its navigational lock, which permitted the passage of steamboats and other craft. Unlike the other dams, the original Gull Lake Dam was concrete.

Although the area was sparsely populated near the dams at the time of their construction, the logging industry in the Headwaters' region was very active. Lumber companies were beneficiaries of the increased summer flow as it helped drive logs downriver. The leading lobbyists for the system of reservoirs, however, were Minneapolis flour millers, particularly William D. Washburn. In the early years of reservoir operation, flour mills at the Falls of St. Anthony in Minneapolis benefited greatly from the increased flows during what had previously been dry periods.

All of the timber control structures were rebuilt in concrete between 1899 and 1909. By this time, road construction and new settlements had progressed in the vicinity of the dam sites, making concrete construction possible. The reconstructed dams included log sluice and fish ladder bays.

The reservoir system was originally authorized by Congress to regulate water levels for navigation purposes. However, its impact on navigation was short lived. Mississippi River channel modification undertaken after 1907 and the series of locks and dams built in the 1930s more efficiently regulated water levels. During this time, recreational use of the Headwaters' lakes and rivers by fisherman, hunters, campers, and boaters greatly increased. Reservoir resort and lakeshore property owners became as concerned about water levels as Minneapolis flour millers had been 40 years earlier. Farmers, wild rice growers, and the northern Minnesota paper mills and sawmill owners also added their voices to the management of Headwaters' lake water levels.

Each Headwaters' reservoir housed a community of dam tenders responsible for the operation of the dam sites. The dam tender took rain and snow depth readings, monitored the river gauges and adjusted

the gates on the sluiceway. Their job was year round with long winters where the temperature could reach minus 59 degrees.

The dam tenders and their families were witnesses to a great transformation of the Headwaters' wilderness. In the beginning, it was a pioneer experience with gates adjusted to facilitate navigation and augment the flow downstream. By the 1930s boaters, campers, fishermen, and hunters visited the reservoirs regularly. The nation was now beginning to experience an increase in leisure time recreational pursuits and tourism. The dam tender's job thus evolved to that of today's Natural Resource Specialist and Park Ranger responsibilities, which included operating the gates for purposes of flood risk reduction.

Most of the dam sites accommodated tent campers as early as 1909 on an informal basis until the completion of Master Plans for recreational site development between 1964 and 1977. Today, regulation of the reservoirs acknowledges diverse needs, including those of fish and wildlife conservation, shoreline property owners, tribal interests, flood risk reduction, and water supply.

6.2 Interpretive Services and Outreach Program

The Interpretive Services and Outreach Program (ISOP) is an essential part of the Corps' Civil Works program. Through this program, the Corps can communicate missions and accomplishments, achieve management objectives, and foster environmental stewardship. ISOP aids in reaching diverse audiences and partners, which can improve visitor and employee safety, help with team cohesiveness, and enhance visitor experiences. It is one of the most effective tools the Corps has to connect with the general public, user groups, partners, and stakeholders.

The Corps defines interpretation as "Communication and education processes provided to internal and external audiences, which support the accomplishments of the agency's missions, tell the agency's story and reveal the meanings of and the relationships between natural, cultural, and created environments and their features." The Corps' focus is to help people connect with the Headwaters' environment, leading to their involvement and support. This outreach can be done through displays, brochures, visitor center exhibits, and interpersonal contacts, to name a few.

Interpretive services are provided by highly trained Park Rangers, who have the skills to help visitors relate to Corps sites, promote safety, encourage stewardship, and tell the Corps' story. Although Park Rangers traditionally use these skills for ISOP, communication between any Corps employee and members of the public can benefit from interpretive techniques.

Headwaters' ISOP has been working to communicate to the public through various resources, including self-guided signage on trails and interactive displays. Sandy Lake's 2015 Visitor Center remodel updated many of the outdated displays, bringing new interest and public involvement to the program. Reduced personnel and budget constraints have presented many challenges to providing interpretive services to the public. However, the increased popularity of social media and the Internet has opened up many new possibilities to reach more people without direct interaction. Moving forward, the Corps understands that new technologies must be embraced to connect and communicate with the public. Although there are new ways to reach the public, face-to-face interaction remains one of the most effective means of communication.

6.3 Volunteers and Partnerships

In today's financial environment, volunteers and partnerships are essential tools that allow the Corps to effectively manage recreation and environmental resources. It is imperative to work together with volunteers, state governments, private/ public entities, local communities, and other partners on common goals. The Headwaters has multiple partnerships with various organizations and demographics. Partnering pools scarce resources, promotes coordination, and focuses efforts on resolving common problems and missions in a mutually beneficial manner avoiding unnecessary duplication of effort. The Headwaters' partnering efforts in FY14 totaled a value of over $115,000. The Headwaters utilizes volunteers at all of the projects, averaging a collective 290 volunteers annually among the six projects. These volunteers' services totaled approximately $507,355 in FY14 alone. This is made possible by Public Law 98-63 (July 31, 1983), which authorized the U.S. Army Corps of Engineers Volunteer Program. In the Headwaters, volunteers play an important role in operating and maintaining the sites. They serve as campground hosts, maintain Corps facilities, plant trees, aid visitors, keep recreation areas clean, and maintain trails among many other activities. Figure 7 provides total volunteer hours for FY 2010 – FY 2014 for all Headwaters' sites. The Corps plans to continue to work with partners and the public to continue to manage resources, provide high quality recreational opportunities, and reach desired management goals.

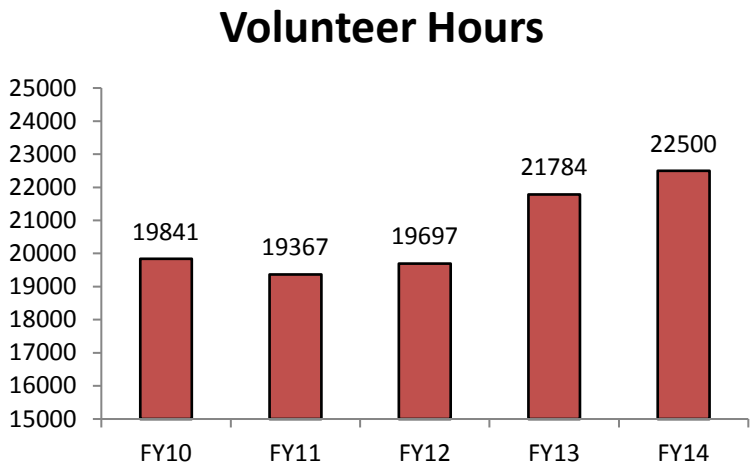


Figure 7. Volunteer Hours FY 2010 – FY 2014.

6.4 Invasive Species

The Headwaters has an immense wealth of natural resources, pristine lakes, rivers and streams, abundant forests, and a wide array of wildlife. It also has a rich outdoor heritage with access to boating, swimming, and fishing. That heritage is now threatened by invasive species that could jeopardize recreation and the delicate ecological order. Invasive species are plants and animals that live in the water and on land that are not native to the region. When these species are accidently or intentionally introduced, they can upset the ecological balance.

At this time, the invasive species of greatest concern found in the Headwaters are as follows:

Lake Winnibigoshish: Zebra Mussels and Faucet Snails (Little Winnie & the Mississippi River: Spiny Water Fleas, Zebra Mussels).

Leech Lake: Eurasian Water Milfoil, Curly Leaf Pondweed, Purple Loosestrife, Rusty Crayfish and Reed Canary Grass.

Pokegama Lake: No known infestations to date.

Sandy Lake: Purple Loosestrife, Flowering Rush and Chinese Mystery Snails.

Cross Lake: Zebra Mussels (Pine River: Zebra Mussels).

Gull Lake: Zebra Mussels, Purple Loosestrife, (Gull Lake Chain: Curly Leaf Pondweed Zebra Mussels, Purple Loosestrife).

For more information on individual species, please visit: http://nas.er.usgs.gov/

These seemingly unrelated species share a common and disturbing trait: in the ecosystem, they lack disease and predator controls so they reproduce and spread at alarming rates. They can dramatically affect the Headwater region's annual $4 billion dollar tourism and $2 billion dollar fishing industry. It takes coordination of efforts from federal, state, and local agencies and non-profits with an economic and a preservation incentive to stop the spread of these invasive species.

The Headwaters have taken the following actions to address invasive species control and facilitate public information on the subject:

- Developed and implemented an Invasive Species Operating Plan, which provides a framework to coordinate and guide efforts to prevent the introduction, reduce the spread, and promote appropriate management of invasive species populations within the Headwaters' Lakes Project.
- Purchased a decontamination unit with federal handshake funds in partnership with Gull Chain of Lakes Association (GCOLA) and the Student Conservation Association (SCA). Trained personnel to pressure wash and decontaminate watercraft and trailers that are entering and leaving the Gull Lake Recreation Areas boat access.
- Partnered with lake associations and tribal resource managers to facilitate work done by their volunteers and employees at Corps boat launch facilities to inspect boats and trailers and provide information and handouts to the public on invasive species.
- Developed and implemented a St. Paul District Emerald Ash Borer (EAB) Management Plan and St. Paul District Firewood Policy which restricts the use of firewood at Corps recreation areas in accordance with MN DNR & USFWS requirements.
- Partnered with United States Department of Agriculture in setting traps for Gypsy Moths and Emerald Ash Borer. The trapping program is designed to find early detections of these invasive species while they are small and are easiest to eliminate.

6.5 Sandy Lake Real Estate

The intent of the Headwaters' Master Plan was to include all of the six headwater site locations. Real Estate interests affect each section of the Master Plan. Prior to the development of this Master Plan, new mapping technology had not been implemented in Headwaters' real estate documents. Therefore, a significant portion of the budget and time spent on the Master Plan went to updating such documents and maps. Since the majority of the lands in the Headwaters were acquired in the late 1800s, this turned out to be a difficult task. Due to limited budget and time for this project, the Corps decided to exclude the mapping portion for the Sandy Lake Reservoir Project for this Master Plan Revision. Since the Sandy Lake Reservoir Project was excluded in the mapping updates, the project was also excluded in the natural resource inventory and land classification portions of the Master Plan. The Corps plans to update the Master Plan in the future to include this supplemental Sandy Lake information. Sandy Lake was still considered and included when developing the goals and objectives for the Headwaters. The St. Paul District Real Estate section holds the records for all federally-managed tracts of lands in the Headwaters, so specific real estate concerns can still be resolved.

CHAPTER 7 - AGENCY AND PUBLIC COORDINATION

The Master Planning process recognizes the needs and desires of those persons or agencies associated with or affected by Corps' facilities. Coordination and communication with these parties is an integral part of all Master Plans.

7.1 Scoping Meetings

The St. Paul District invited federal, state, and local agencies, Native American Indian Tribes/Bands, and the public to engage in and comment on the update to the Mississippi River Headwaters' Master Plan. A stakeholder meeting and public open house were held in July 2015 at the Cross Lake Campground Office in Crosslake, Minnesota, to inform the public on the update to the Master Plan, as well as gather input on the Master Planning process. Information gathered during these meetings was used to prepare the Master Plan and a draft version will be made available for agency and public comment. Following the review and comment period, the Master Plan will be completed.

The stakeholder meeting was a formal meeting where specific Federal, state, and local agencies and Native American Tribes/Bands were invited to attend in person or via phone. A formal presentation was used to provide background on the need for the Master Plan, goals of the plan, and the planning process. Stakeholders were invited to provide verbal and written feedback on concerns related to the Master Plan.

The public open house was an informal meeting where interested citizens could ask questions and provide their ideas related to the Master Plan. A presentation was used to orient the public to the Master Plan and planning process. Attendees were invited to fill out comment cards to provide feedback.

The St. Paul District also created a website to share the previous Master Plan and other relevant information with the public. An electronic mailbox was also set up for the public to provide comments throughout the planning process.

A summary of comments received during the scoping phase can be found in Appendix B, Public and Agency Coordination. All comments received were considered, and some proposals were integrated in the Draft Master Plan. For a summary of issues or concerns identified during the scoping process, see section 6 of Appendix A, the Environmental Assessment. Additional material, including copies of press releases and news articles can be found in Appendix B.

7.2 Tribal Coordination

The Tribal Historic Preservation Officers for the Leech Lake and Mille Lacs bands were contacted and the plan to update the Headwaters' Master Plan was outlined. The bands were invited to engage in the planning process and to attend the agency and public meetings in July 2015. In addition, the bands were invited to meet separately with the Corps to address any concerns. During the scoping process, the White Earth Nation requested to be included in the planning process.

CHAPTER 8 - SUMMARY OF RECOMMENDATIONS

This Master Plan conceptually establishes and guides the orderly administration, maintenance, preservation, enhancement, and management of all natural, cultural, and recreational resources at the Headwaters. This plan is stewardship-driven, seeking to balance recreational development and use with protection and conservation of natural and cultural resources. Population growth, changes in demographics, advancement of recreation trends, and invasive species are just some of the influences affecting the resources, management decisions, and land use around the Headwaters. The following sections describe focal points to assist the Corps when facing challenges well into the future. The goals outlined in Chapter 3 define how the Corps plans to manage its lands and resources for the future. Most of these goals are more conceptual in nature, whereas the details of implementation will be spelled out in the Headwaters' Operation Management Plans. Implementation of these recommendations requires time, manpower, and budget.

8.1 Land Classification Changes

Update land classifications: This Master Plan includes minor changes to land classifications. The majority of the acreage changes occurred due to changes in classification categories required by the current Engineering Regulations. Through updated mapping technology, the Corps was able to better evaluate their managed lands to determine the proper land classifications. A comparison of the land classifications between the 1977 Master Plan and this Master Plan can be found in Appendix A, section 3.3 of the EA.

8.2 Historic Property Management Plans

Develop Historic Property Management Plans: One of the key tools that would aid the Corps in effective land management activities is the development of Historic Property Management Plans for each of the sites in the Headwaters. These plans would provide a comprehensive guide to the historic preservation activities and objectives by providing background information on all cultural and historical resources, while ensuring Corps' compliance with updated regulations. The plans would address the future need for cultural resource investigations and effective strategies for management of these resources. Effort is underway to develop and update Historic Property Management Plans.

8.3 Partnerships and Volunteers

Build partnerships and develop opportunities for volunteers: Partnership and volunteers are one way for the Corps to keep a high standard of service along with expanding programs within its authorized missions. In today's challenging fiscal environment, it is imperative for the Corps to work with local, state, and other federal agencies, special interest groups, and individuals towards common goals. These goals can range from combating invasive species, growing community events, to watershed based efforts (i.e., water quality efforts). These partnership and volunteering efforts are a win-win situation for all parties involved and, by pooling together knowledge and resources, all parties involved can do more with less.

8.4 Recreation Modernization

Modernize recreation facilities: One of the goals of the Master Plan is to determine the appropriate balance between recreational development and protection of the resources. Modernization of recreation facilities help people access the water and enjoy the outdoors. These projects outlined in Chapter 3 often allow both traditional and nontraditional users a chance to connect to the environment. The projects also help attract a more diverse user base so more people can benefit from accessing federal lands. Modernization also allows the Corps to adapt to the ever-changing recreation trends and demands, while better protecting the resources.

8.5 Further Management Studies

Further studies focused on management of the resources and services provided at the Headwaters' sites should be conducted in the near future. At this time, the effects of high visitation on both the environment and facilities is unknown. A recreational carrying capacity study would determine whether the existing visitation rates create the appropriate balance between recreation and environmental stewardship, or if additional visitation would have similar effects on wildlife. The Corps also needs to work closely with its partners to determine a more in-depth natural resource inventory on project lands. Once the inventories are established, the Corps can create plans on how to better manage lands for wildlife.

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