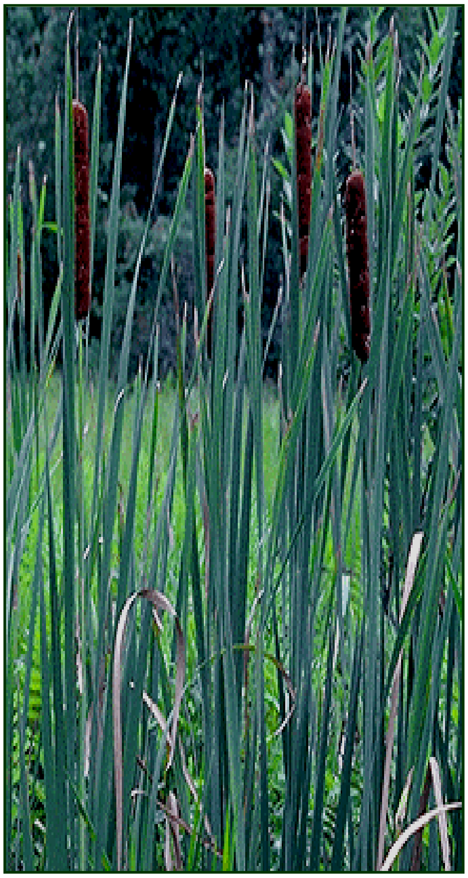
Lake Planning Grant Report



Wetland and Habitat Restoration Planning

Lake Sinissippi, Dodge County

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and

Lake Sinissippi Improvement District

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WETLAND AND HABITAT RESTORATION PLANNING

LAKE SINISSIPPI AND ROCK RIVER
Dodge County, Wisconsin

INTRODUCTION

Lake Sinissippi is located in central Dodge County in southern Wisconsin. Lake Sinissippi is an impoundment on the Rock River. In the past several decades, Lake Sinissippi and the Rock River have experienced a gradual decline in water quality as indicated by reduced water transparency, increased algae populations, loss of aquatic macrophyte beds, loss of wetland fringe vegetation, and a declining sports fishery.

Lake Sinissippi is surrounded by hundreds of acres of riparian wetlands. The lake and these wetlands provide habitat for a variety of wildlife species including eagles, egrets, herons, cormorants, pelicans, wood ducks, blue winged teal and 12 species of frogs. The lake area is designated as a Natural Heritage Inventory Water due to the occurrences of rare species and natural communities, including state and federal endangered and threatened species.

Over the past several decades Lake Sinissippi has lost hundreds of acres of riparian wetlands. Shoreline that was held in place by the wetland vegetation has eroded and washed into open water of the lake. In many of the wetland loss areas, the water depth today is 2 to 3 feet--too deep to allow re-establishment of emergent wetland plants.

Sedimentation from shoreline erosion and watershed runoff into lake tributaries is gradually filling the lake bottom, resulting in a loss of water depth. In some spots on the lake, the sediment depth exceeds 8 feet with 6 feet of water overlaying the sediment.

The purpose of the following project is to prepare a long-range strategy:

- Protect existing sensitive habitat areas
- Restore lost riparian wetlands on the lake

This project is part of a larger lake restoration and management effort being sponsored by the Lake Sinissippi Improvement District ("Lake District"). The goals of the Lake District are:

1. Improve Water Quality of the Lake
2. Maintain and Enhance Boating and Recreational Activities
3. Maintain a Diverse Wildlife Community
4. Develop Community Consensus for Management of the Lake

To accomplish the above goals, the following objectives have been established:

1. Halt the degradation of the lake through the control of nonpoint source pollution
2. Protect and enhance environmentally sensitive areas of wetlands and terrestrial habitat
3. Reduce in-lake phosphorus
4. Reduce the occurrence of nuisance algal blooms
5. Re-establish and maintain a balanced aquatic macrophyte community

6. Prevent nuisance growth of aquatic plants
7. Restore lost wetland areas
8. Reduce sediment deposition
9. Improve navigation on lake and river by sediment removal
10. Rehabilitate the degraded sports fishery

The development of the above objectives is outlined in a report entitled Lake Quality Summary and Management Strategy for Lake Sinissippi, Dodge County (Hey and Associates, 1998). The management strategy for the lake was further refined in the document entitled Long-Range Implementation Strategy for the Lake Sinissippi Improvement District (Hey and Associates, 2002).

LAKE DESCRIPTION

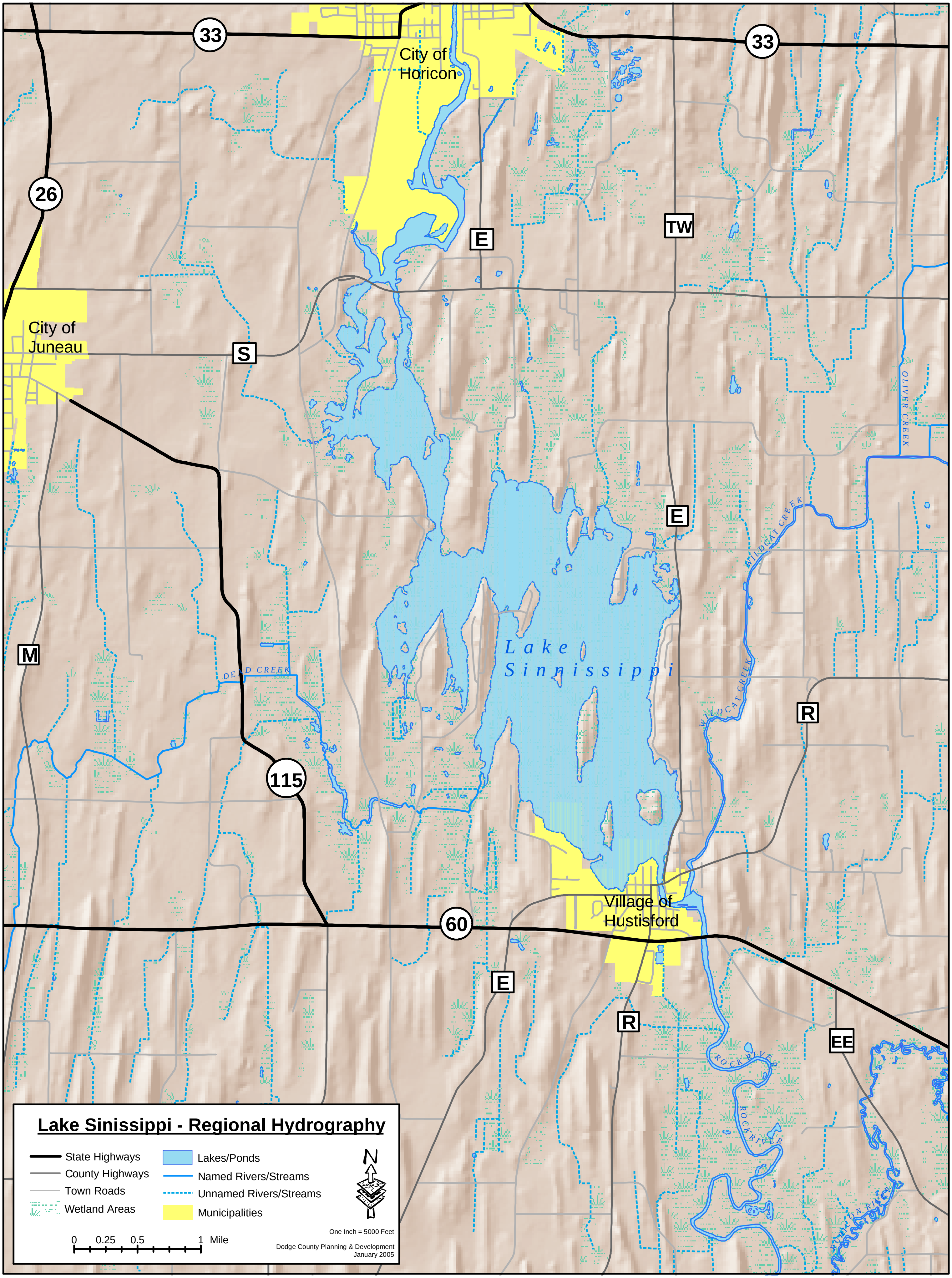
Lake Sinissippi is an impoundment of the Rock River created in 1845 when the dam was built in Hustisford (Figure 1). Prior to construction of the dam, the area was a flat wetland basin through which the Rock River meandered. Soils in the basin were largely peat. The reservoir created by the dam was shallow with unstable, marshy shorelines that eroded rapidly. In 1939, the dam was raised 1.43 feet to its present elevation, adding to shoreline erosion. The size of the lake in 1939 was 2,300 acres. Over the past 6 decades water erosion has caused riparian wetlands and 4 of the original 12 islands to disappear, resulting in the present lake area of 2,855 acres.

Table 1 outlines the general physical characteristics of the lake. A cross-section of the lake would resemble a wide, shallow pan, with average water depth varying between 4 and 5 feet. The maximum water depth is 6 feet, with 8-foot holes in the river north of the Ox-Bo and in the river before the dam in Hustisford. The lake bottom is mainly composed of silt (material washed into the lake from the surrounding watershed and shore erosion). Thickness of the sediment layer covering most of the lake bottom area is 6 inches to 2 ½ feet; several spots have silt depth that exceeds 8 feet. Some shorelines along the eastern shore, around some of the islands and along shores with steeper slopes have firm, gravelly substrates that are beneficial for fish spawning. Due to the large, shallow open water area and silt bottom, periods of high winds and wave action caused by boats re-suspend sediment resulting in murky or turbid water.

Two major water quality problems are poor water clarity and excessive siltation. High nutrient levels, especially that of phosphorus, contribute to excessive algal growth. In-lake phosphorus concentrations range from 230 ug/l to 400 ug/l, indicative of eutrophic conditions. High sediment loading and total suspended solids from watershed tributaries and shoreline erosion cause turbidity and silt deposition on the lake bed.

The Rock River is the major lake tributary, contributing 65% of the water inflow. Groundwater inflow represents 25% of the water budget, with Dead Creek and minor tributaries providing 10%. About 90% of the external sources of sediment and phosphorus to the lake come from the Rock River. Dead Creek and minor tributaries contribute about 8% of the sediment and phosphorus, with the balance of 2% from atmospheric deposition and waste water treatment plants for Clyman, Horicon and Juneau (Hey and Associates, 2003).

The Lake Sinissippi shoreline along the south and east is extensively developed with seasonal and permanent homes. In recent years many of the lower value properties have been improved or replaced by higher value homes. Condominium and apartment complexes have been developed within the Village of Hustisford on the south end of the lake. The undeveloped land that remains along the north and west shores is farmland, marsh and state conservancy. Sanitary sewer districts serve properties on Butternut Island, Sinissippi Point and Arrowhead Point and along the east shoreline. Lake front properties within the Village of Hustisford are served by the village sanitary sewer system.


Lake Sinissippi - Regional Hydrography
State Highways
County Highways
Town Roads
Wetland Areas
Lakes/Ponds
Named Rivers/Streams
Unnamed Rivers/Streams
Municipalities
N
0 0.25 0.5 1 Mile
One Inch = 5000 Feet
Dodge County Planning & Development
January 2005
City of Horicon
City of Juneau
Village of Hustisford
Lake Sinnissippi
33
26
115
60
E
TW
S
M
R
EE
DEAD CREEK
WILDCAT CREEK
OLIVER CREEK
ROCK RIVER

The lake is heavily used for water-oriented recreation, particularly pleasure boating, canoeing, bird watching and water skiing. The marshy bays are used extensively for waterfowl hunting. Some fishing occurs on the lake, but is relatively light due to the poor condition of the fish population. Public boat and lake access is provided by municipal facilities located in Horicon and Hustisford, as well as several small town sites.

TABLE 1
Physical Characteristics of Lake Sinissippi

Parameter	Lake Sinissippi
Surface Area (open water)	2,855 acres
Watershed Area	511 sq. miles
Watershed to Lake Area Ratio	115:1
Maximum Depth	8 feet
Mean Depth	4.5 feet

A HISTORY OF REHABILITATION EFFORTS ON LAKE SINISSIPPI

At one time 53 species of game and forage fish were recorded in Lake Sinissippi, including abundant northern pike (*Esox lucius*), walleye (*Stitzostedion vitreum*), bass (*Micropterus dolomieui*) and perch (*Perca flavescens*). The story changes, however, when carp (*Cyprinus carpio*) were introduced into the Rock River watershed in 1886. The carp populations rapidly increased in the shallow, fertile environment. Though carp were abundant in 1954, some bays on the lake were still covered with vegetation and the water was clear. By 1957, aquatic vegetation was sparse and the lake had heavy algae blooms. The effects of watershed pollution and loss of aquatic habitat led to the loss of all but a few game fish species. A very severe winter in 1959 is reported to have caused a winter fish kill of the remaining game fish, after which carp and bullhead (*Ameiurus* spp.) quickly became the dominant fish species in the system. From 1941 to 1969, serious fish kills occurred 15 times, nearly every other year.

In 1969, the Rock River Reclamation Project was initiated by the Wisconsin Department of Natural Resources ("WDNR") with a goal of restoring sport fish populations and waterfowl habitat in the river system from the headwaters downstream to Lake Koshkonong. On November 19, 1971 the Hustisford Dam was opened to initiate a 4-foot drawdown of Lake Sinissippi, which was to be treated with fish toxicants to eradicate carp during the summer of 1972. The project could not be completed in 1972 because of heavy rains. The lake drawdown was continued through the summer of 1973, a 2-year drawdown. Treatment of the Rock River system above Hustisford Dam with fish toxicant was completed August 27, 1973 and the dam was closed to refill the lake. The planned objective of the treatment upstream of Hustisford was to eliminate carp from the system. While the project eradicated 99 percent of the carp population in the lower river system, it did not eliminate carp from the Rock River headwaters above Lake Sinissippi.

Vegetation began to grow on the exposed lake bottom during the early phase of drawdown in 1972. Newspaper accounts from this period are illustrative.

> "Almost immediately after the opening of the dam at Hustisford, the exposed mud flats began to sprout weed growth as the lake area reverted to its original marshland state. Willow also began to grow, and now much of the lake area is covered with a tall growth of rushes and brush." ("2nd Dry Year for Sinissippi," 1973)

Immediately following the carp eradication and refilling of the lake basin in 1973, suspended sediments quickly settled. The water cleared, allowing sunlight to penetrate to the lake bottom. The nutrient-rich lake water provided ideal conditions for intense and extensive growth of aquatic vegetation. This plant habitat attracted abundant wildlife, but interfered with boating and recreational use of the lake. Three years after the lake was refilled cattail fringe and weed growth had made the lake almost unusable.

> "The green growth on Lake Sinissippi just doesn't quit. It runs from the shoreline right into the middle of the lake. Even on a midsummer afternoon, the lake stood silent. Unused. It was so clogged with weeds that a powerboat could hardly plow through." ("Eerie Silence on Sinissippi," 1976)

It appears as though the WDNR was surprised by the rapidity and extent of weed growth throughout the lake.

> "Before its carp program, the DNR had warned that removing the scavenger fish would stimulate weed growth. 'We expected that there would be vegetation, but I don't think our people visualized this thick a buildup.'" … "When the carp finally was removed, the lake immediately began reversion to what it had been around the turn of the century – a marsh. The trend seems likely to continue. From a boating standpoint, the prospect is not very bright." ("Eerie Silence on Sinissippi," 1976)

Apparently, the WDNR also overestimated the degree of compaction of lake bottom sediment that would result as a consequence of the drawdown.

> "They told us the mud bottom would settle a lot more than it has." ("2nd Dry Year for Sinissippi," 1973)

The wetland cattail fringe and luxuriant aquatic vegetation including coontail, duckweed and milfoil, led to a sharp increase in waterfowl and muskrat populations.

> "Trappers report the best harvest in 25 years. Duck hunters also benefit from the more marshlike ecosystem." ("Eerie Silence on Sinissippi," 1976)

However, the emergent vegetation also provided habitat for freshwater snails, leading to an explosion of the snail population and outbreaks of swimmer's itch, a rash caused by a parasite that uses the snail as a biological vector. Swimming ceased as a lake recreational activity. Residents also complained about the stench from the floating, decaying weed mass and surface slime.

The dense plant growth led to the formation of Sinissippi Harvesting, Ltd., which began operation of a weed harvester June 1979 to maintain navigational channels in the lake.

> "The harvester will clear only 100 acres a year, because the weeds grow back so quickly. Residents reported seeing ducks and dogs walk on floating weed beds without falling through. Sinissippi Harvesting calculates that two more machines will be needed to do the job for the whole lake." ("Lake Weeds Under Attack on Sinissippi," 1979)

Dense plant growth continued for about ten years after the carp eradication.

During this time, attempts were made to re-establish the fishery, but they proved to be unsuccessful. The WDNR stocked game fish in the lake in fall 1973, after the dam was closed, and additional stocking was done in spring of 1974. Evaluation surveys found carp in the West Branch of the Rock River in September 1974. In August 1976, adults and a large number of young-of-year carp were found in the federal section of Horicon Marsh. Spot treatments of several large bay areas with fish toxicant were conducted to try to control the carp in the marsh. At the same time, the game fish stocked in 1973-1974 was under pressure from winter conditions.

> "DNR efforts to restock the lake with game fish have not been successful, due largely to heavy winterkill. The shallow lake freezes deep and the winter oxygen supply is depleted." ("Eerie Silence on Sinissippi," 1976)

A major kill of game fish occurred during the winter 1976-1977.

> "The fish are dead. A severe winterkill … has killed millions of northern, walleyes, bass and panfish. Thick ice and heavy concentrations of decayed vegetation, mostly from Horicon Marsh, have nearly depleted the oxygen in Lake Sinissippi. The fish have suffocated." ("Fish Dying Off by the Millions," 1977)

As the aquatic vegetation began to die and decompose, the amount of dissolved oxygen in the water dropped--leading to winter and summer fish kills. In 1979, 6 years after the drawdown and carp eradication, conditions on the lake were reported to be still quite poor.

> "If swimming and boating are dismal, fishing is worse. Each year since the carp fiasco, the DNR has planted millions of game fish fingerlings. And each year, winter [and summer] kills wipe out the young walleyes, northerns and perch. Decaying weeds deplete oxygen the fish need in the water." ("Lake Weeds Under Attack on Sinissippi," 1979)

By 1983, rooted aquatic plant growth became sparse in the lake. Carp were again abundant throughout the system, disturbing the bottom sediment, uprooting vegetation and causing the water to become turbid. As plant growth declined, wind action further stirred sediment in the lake causing turbidity and decreased water clarity.

The WDNR and the lake property owners' organization, Lake Sinissippi Association, have done periodic stocking of game fish over the past twenty years, with little success. Stocking of walleye, perch and bluegill (*Lepomis macrochirus*) was most recently done in fall 2004 by the lake association.

In 2001 the Lake District conducted a series of spot treatments with fish toxicant in small embayments to assess feasibility of collecting and disposing of carp using a customized weed harvester. Also in 2001 the first habitat protection zone was established by the Lake District for a southwestern embayment of the lake known as "Eagle Bay". This area is home to a nesting pair of eagles, a heron rookery, pelicans and luxuriant growth of aquatic plants such as water lily (*Nuphar* and *Nymphaea* spp.). The protection zone is authorized by WDNR boating ordinance as a slow-no-wake area and enforceable by town authority and the WDNR. Additional habitat protection zones are planned as part of wetland and habitat restoration envisioned under this grant project.

Today Lake Sinissippi is characterized by high levels of plant nutrients, poor water clarity, frequent algal blooms and an abundance of rough fish. While water quality on the lake is classified as eutrophic (nutrient rich), which interferes with some forms of recreational use such as swimming, the lake area is thriving as a wildlife refuge. Lake Sinissippi provides habitat for a variety of unique wildlife species.

WATERSHED DESCRIPTION

Lake Sinissippi has a large watershed area of 511 square miles for a watershed/lake area ratio of 115:1. Impoundments with watershed/lake ratios greater than 10:1 are generally very fertile. The Rock River watershed is intensively farmed for production of agricultural crops. About 90% of the lake watershed area lies above the Horicon Dam, including the Horicon Marsh and Rock River headwaters. The Dead Creek subwatershed and adjacent lake area with smaller tributaries comprise the remaining 10% of the watershed. Much of the once abundant wetlands in the watershed have been converted to cropland by ditching or tiling. The loss of wetlands, combined with exposed soils and intensive farming, contributes to sediment runoff reaching the lake during snowmelt or rain. Agricultural fertilizers, animal waste, eroded soil and marsh sediment are major sources of nutrients entering the river system.

Prior to entering Lake Sinissippi, the Rock River flows through the Horicon Marsh. Dams on the Federal Dike and in Horicon at the outlet of the marsh control the water level in the marsh. The federal dam is operated by the U.S. Fish and Wildlife Service ("USFWS"), the Horicon Dam by the WDNR and the Hustisford Dam by the Village of Hustisford. The USFWS and WDNR manage Horicon Marsh as a wildlife refuge and waterfowl management area for ducks and geese. Due to the low river gradient, the Hustisford dam impounds water as far upstream as the Federal Dike.

Ecologically Lake Sinissippi is located in the Southeast Glacial Plains Ecological Landscape. The landscape makes up the bulk of the non-coastal land area in southeast Wisconsin. This Ecological Landscape is made up of glacial till plains and moraines. Most of this Ecological Landscape is composed of glacial materials deposited during the Wisconsin Ice Age, but the southwest portion consists of older, pre-Wisconsin till with a more dissected topography. Soils are lime-rich tills overlain in most areas by a silt-loam loess cap. Agricultural and residential interests throughout the landscape have significantly altered the historical vegetation. Most of the rare natural communities that remain are associated with large moraines or in areas where the Niagara Escarpment occurs close to the surface.

Historically, vegetation in the Southeast Glacial Plains consisted of a mix of prairie, oak forests and savanna, and maple-basswood forests. Wet-mesic prairies, southern sedge meadows, emergent marshes, and calcareous fens were found in lower portions of the landscape. End moraines and drumlins supported savannas and forests. Agricultural and urban land use practices have drastically changed the land cover of the Southeast Glacial Plains since Euro-American settlement. The current vegetation is primarily agricultural cropland.

Soils

Soils in the Lake Sinissippi area are made of a combination wetland (hydric) soils in the lowland areas and glacial soils on the glacial moraines that form the upland features. Maps of the hydric soils in the four townships surrounding Lake Sinissippi (Towns of Clyman, Hubbard, Hustisford, and Oak Grove) are illustrated in Appendix A.

Wetland soils adjacent to the lake are predominantly Saprists and Aquents (Sk). These very poorly drained, nearly level soils are found in lake basins and on flood plains. They are subject to frequent long periods of inundation. The very organic soil is dark in color and underlain by loam, silty, or sandy layers at a depth of 16 to 51 inches. These soils are not well suited for farming and are best suited for use as recreation land or wildlife habitat.

Most of the upland areas adjacent to Lake Sinissippi are located on glacial moraines. Predominant soil groups on these glacial features are silt loams in the Miami Silt Loam (My), McHenry Silt Loam (Mr), and Kidder Loam (Kr) classifications. These soils are all well drained with upper layers of grayish brown silt loam underlain by sandy loam and glacial till. The soils are well suited to crops such as corn, small grains, and grasses, and pasturing and production tree stands. In the Lake Sinissippi area, most of the upland soils have been or are being used for agricultural production.

Lowland areas away from the lake in the near watershed are made up of hydric soils in Pella Silt Loam (Ph), Houghton Muck (Hu), and Saprists and Aquents (Sk) classifications. These are all made up of an upper dark organic layer that can rank to 32 inches thick. Most of the Pella and Houghton soil are drained by drainage ditches and drain tiles. Drained areas are used for production of corn and canning crops. When not drained, these soils are typically wetlands that are well suited for wildlife habitat. Drained areas of these soils provide opportunities for wetland and wildlife habitat restoration through simple measures such as damming of ditches or blocking of tiles.

Land Use and Population

Lake Sinissippi lies in the municipal boundaries of the Towns of Hubbard, Hustisford, and Oak Grove and the Village of Hustisford. No detailed land use inventory has been done for the watershed area that drains to Lake Sinissippi. However, the population and land use for the adjacent municipalities can provide a picture of the local landscape. Table 2 summarizes the available land use information for the townships adjacent to Lake Sinissippi.

TABLE 2
Available Land Use for Townships Near Lake Sinissippi

Municipality	Agriculture (ac) (1997)	Wetland (ac) (1982)	Other (ac)	Total (ac)
Town of Clyman	15,335	2,657	4,846	22,838
Town of Hubbard	14,625	4,489	4,317	23,431
Town of Hustisford	14,229	5,871	2,853	22,953
Town of Oak Grove	15.843	1,929	5,705	23,477

Source: Dodge County and Wisconsin Wetland Inventory (WDNR)

As can be seen in Table 2, 61 to 67 % of the land use in the adjacent townships to Lake Sinissippi is made up of agricultural land cover. Wetlands make up between 8 to 25 % of the land use, with the greatest wetlands to the west and north of the lake. Zoning for the Towns of Oak Grove, Hubbard and Hustisford are illustrated in Appendix B. Future land use in these townships is shown in Appendix C, and Overlay Zoning districts are illustrated in Appendix D

Table 3 summarizes the population for the five adjoining municipalities to Lake Sinissippi.

TABLE 3
Population in Municipalities Adjacent to Lake Sinissippi

Municipality	Population by Year					Percent Change from 1990 to 2000
	1960	1970	1980	1990	2000	
Town of Hubbard	1079	1301	1508	1390	1643	18.2%
Town of ustisford	891	1034	1262	1209	1379	14.1%
Town of Oak Grove	1543	1326	1333	1200	1126	-6.2%
Village of Hustisford	708	789	874	979	1135	15.9%

Source: Wisconsin Department of Administration

The projected population increase for Dodge County from 1997 through 2020 is estimated at 3.26 % (Dodge County, 2002), indicating that limited urban growth is expected in the larger geographic region. However, it should be noted that the demand for recreation property near or on lakes has been steadily growing. With the availability of sanitary sewer service provided by two sanitary districts and the Village of Hustisford, demand for urban land near Lake Sinissippi may exceed the countywide growth projections.

Wetlands

Wetland acreages for the adjoining townships to Lake Sinissippi are summarized in Table 2 above. Locations of existing wetlands in the townships adjacent to Lake Sinissippi are illustrated in Appendix E. Wetlands riparian to Lake Sinissippi are classified predominantly E2H wetlands. These wetlands are emergent/wet meadows, made up of narrow leaf persistent plant communities, located in standing water (Palustrine environment). These wetlands are dominated by a plant community made up almost exclusively by cattails (*Typha sp*.)

The wetlands shown in Appendix E represent a portion of the original wetland complex that existed adjacent to Lake Sinissippi prior to European settlement and draining of hydric soils for farming. Appendix F illustrates the drained hydric soils in the townships adjacent to Lake Sinissippi. These drained hydric soils represent areas that, through changes in drainage, could easily be restored to wetland communities.

The riparian wetlands to Lake Sinissippi have undergone varied expansion and contraction during the 160 years that the impoundment has been in place. Documentation of the changes is available through historical aerial photographs and map (Appendix G). The 1960 and 1968 photographs of the lake between the Ox-Bo and the dam show a similar lake shoreline to that seen in a recent 1999 photo of the lake. However, river shoreline and associated wetland habitat north of the Ox-Bo have experienced significant loss over the years. Wetlands in several small embayments in the lake have contracted over the years due primarily to high water levels. Expansions of marsh fringe have generally been associated with lowering of the lake level as a consequence of either drought or a planned drawdown.

Following the lake drawdown that began in 1972, vegetation growing on the exposed lake bottom covered over 1,400 acres. The vegetation areas shown in Figure 2 were comprised predominantly of cattails (*Typha* spp.), whose beds expanded out onto the exposed mudflats. The balance of the lake bottom under drawdown condition was covered with water to a depth of an inch to a couple of feet. Following return to normal lake levels, nearly 10 years of inundation was necessary to cause recession of the cattail marsh to the edge configuration as seen today.

FIGURE 2

LAKE SINISSIPPI

Vegetation Areas on Exposed Lake Bottom Following 1972-1973 Drawdown

SCALE:
Not to Scale

N

CRITICAL SPECIES AND THEIR HABITAT NEEDS

Lake Sinissippi is both the home and feeding grounds for a variety of wildlife species. To protect or enhance the habitat for these species, it is important to first understand their habitat needs. To survive, a species has the following needs:

- Habitat to reproduce
- Habitat to nurse young
- Food sources
- Habitat that protects the adults and young from predators

Table 4 outlines the general habitat, food, and breeding needs of the important wildlife species that inhabit or use Lake Sinissippi. One of these species, the Bald Eagle, is listed on both the federal and state Endangered Species List. Two species, the Great Egret and Blandings Turtle, are listed on the Wisconsin Threatened Species List; and one specie, the Double Crested Cormorant, is protected under the Federal Migratory Bird Treaty Act of 1918.

The following five critical bird species nest in trees:

- Bald Eagle
- Great Egret
- Great Blue Heron
- Double Crested Cormorant
- Wood Duck

These trees, which are critical to providing protection to the nest, are generally lowland species such as silver maples, cottonwoods, elms and ash. A major food source of many of the larger bird species is fish.
Sinissippi Public Hunting Grounds, a 300-acre preserve owned by WDNR, is located on the north shore of the lake. There are no designated State Natural Areas located in the Lake Sinissippi area. Lake Sinissippi is listed as Natural Heritage Inventory Water because of the presence of an endangered and two threatened species.

TABLE 4
Habitat Needs of Important Wildlife Species in the Lake Sinissippi Area

Species	Habitat	Food	Reproduction Sites	Protected Status
Bird Species				
BALD EAGLE (Haliaeetus leucocephalus)	Large rivers, lakes, reservoirs; found in concentration near dams along the Mississippi and Wisconsin Rivers.	Fish is the staple food item and preferred when available. Generally prey on small fish which they can swallow whole, such as, suckers, northern pike, bullheads, carp. Occasionally feed on geese and ducks and carrion (dead animals) such as deer, small livestock, waterfowl, fish during winter	Roost and nest in large trees. Choose mature tall trees for nests, often the largest tree in the stand. Nest most often in upper branches of deciduous trees with leaves camouflaging nest. However, also frequently use dead trees., Prefer trees which have 1 or 2 open edges; ex. riverbank, rangeland, cropland in which they roost or nest in the upper open branches, allowing for easy surveillance for food and accessibility. Usually nest near water for food access.	Endangered Species on both Federal and State list.
GREAT EGRET (Casmerodius albus)	Marsh, river bottomlands, shallow lakes, bays and streams.	Fish, insects, frogs, crayfish, salamanders, snakes, snails and small mammals.	Build large stick nests in trees 1-40 feet above ground. Nests are generally associated with silver maple, cottonwood, black willow, slippery elm and green ash. Two habitat types must be present for the breeding success of this species: 1) shallow, clear lagoons, backwaters, marshes, ponds etc. to provide foraging sites; 2) lowland forest, thickety growth forms that provide support and sticks/twigs for building material are essential for nesting habitat. The great egret is a very social species and invariably nests colonially with other herons.	Threatened Species in Wisconsin

Species	Habitat	Food	Reproduction Sites	Protected Status
GREAT BLUE HERON (Ardea herodias)	Common in marshes, rivers and stream. Migrate south in winter	Fish, crayfish, frogs, salamanders, snakes, insects, leeches and small mammals. The great blue heron feeds in wetland situations, shallow waters, but also forages in open meadows and fields. It is suggested this species will feed on anything it can swallow.	Build large stick nests in trees often above 50 feet. Nesting trees are usually typical floodplain species (cottonwood, sycamore, silver maple, etc.). Most nesting colonies are found on major rivers. When nesting, size of trees appear an important factor. This species usually nests in the largest tree available. Adults will abandon nests if disturbed and therefore must be protected from human encroachment. The break-up of extensive tracts of timber may reduce concealment and protection from high winds which, because of the heron's great weight, destroy many nests and contents.	Not protected
DOUBLE-CRESTED COMORANT (Phalacrocorax auritus)	Larger lakes, ponds, rivers, and swamps with older dead timber provide essential habitat.	A diving species that feeds mainly on non-commercial fish. Amphibians, crustaceans and mollusks are minor sources of food.	Nesting done in both living and dead coniferous or deciduous trees, between 1 and 65 ft above the surface of the ground or water. Artificial nesting structures have proven to be beneficial. Gravel/cobble shorelines along islands, lakes, and rivers are important for nesting. Public access disrupts needed privacy	Federal Migratory Bird Treaty Act, 1918
MALLARDS (Anas platyrhynchos)	Marshes, ponds, rivers, farmlands	Pondweeds, smartweeds, bulrushes, millet, wild rice, insects, mollusks.	Nests primarily in upland grasses, yet can be found nesting in cattails. Female mallards lay an average of 9 eggs.	Not protected

Species	Habitat	Food	Reproduction Sites	Protected Status
WOOD DUCK (Aix sponsa)	Prefer areas of northern hardwoods within approximately 1/2 mi. of rivers or marshes.	During the breeding season and egg laying, females eat primarily insects and some vegetative matter. Males during this period eat predominantly plants and some insects. During the fall, males and females eat primarily vegetative matter. Preferred plant food includes acorns, seeds of bald cypress, hickories, buttonbush, arrow arum, bur reed et al. Also utilize waste corn from harvested fields. Insects commonly consumed include Coleoptera and Diptera.	Breed in floodplain river bottom areas. Are cavity nesters. Utilize tree cavities and nesting boxes. Drakes remain with hen after eggs are layed, usually until eggs are hatched. Predation on wood duck eggs and incubating hens by raccoons has been a significant limiting factor for wood duck populations. Brooding hens require cover and water. Herbaceous emergents and trees over hanging the water are particularly important.	Not protected
BLUE-WINGED TEAL (Anas discors)	Wetland in farmland	Duckweed, grasses, smartweed, sedges, wild rice, corn, invertebrates	Nests in short grass around edges of wetlands, especially in ungrazed fields, semi-permanent shallow potholes surrounded by hayfields or grasslands	Not protected
WHITE PELICAN (Pelecanus erythrorhynchos)	Freshwater locations, Estuaries, and Bays.	Fish and crustaceans.	Builds a rim of soil and debris 4-10 in. high on the ground, or a saucer like nest of sticks, grass, and reeds in the top of a mangrove tree.	Not protected

Species	Habitat	Food	Reproduction Sites	Protected Status
SANDHILL CRANE (Grus canadensis)	Grasslands, sedge meadows, marshes, farmlands, bogs, lakes, ponds and river deltas.	Mice, frogs, insects, shoots of grain, grasses, seeds.	Nests on mounds of emergent vegetation, grasses, moss, or mud among rushes, sedges, and other tall dense vegetation.	Not protected
Mammals				
MUSKRATS	Marshes, ponds, slow streams, banks of larger rivers.	Roots of cattails, arrowheads, water lilies, rushes, periodically eats frogs, turtles, fish, crayfish, mussels.	Builds dens in banks or a hut of mud, cattail and bulrush.	Not protected
MINK	Wetlands and forested streams.	Muskrats, rabbits, mice, squirrels, snakes.	Burrows into banks of lakes, marshes, rivers.	Not protected
FOX (Gray and Red)	Red fox prefer farmland, mixed woodlands; grey fox prefers forests to open brush land.	Mice, rabbits, pheasants, wild grapes, and other berries and fruit, snakes, turtles, woodchucks, grass hoppers, carrion.	Dens in hollow logs or trees or under rock piles. Many use deserted woodchuck burrows in hillsides or may dig their own burrows.	Not protected
BEAVERS	Wetlands and rivers	Bark and twigs of aspen, cottonwood and willow; roots, grasses.	Lodges made of saplings, practically underwater, or dens built into stream banks.	Not protected
RIVER OTTERS	Rivers, streams and lakes.	Fish, crayfish, birds, small mammals.	Creates dens in stream banks with underwater entrance of den in hollow logs.	Not protected
WHITETAIL DEER	Boarder areas between forests and clearings, wetland, tamarack and cedar swamps, urban areas.	Broadleaf plants, acorns, fungi, field corn, apples, alfalfa; in winter, twigs, especially hemlock, white cedar.	Hides fawn in thickets or dense grassy areas.	Not protected
Amphiphians				
BLANDINGS TURTLES	Shallow, weedy bays, of rivers, lakes, marshes.	Prefers crayfish, insects, earthworms, vegetation berries.	Seeks shelter inside shell or on marsh bottom or in submerged vegetation.	State Threatened.

Species	Habitat	Food	Reproduction Sites	Protected Status
PAINTED TURTLES	Ponds, shallow lakes, and slow moving rivers.	Aquatic vegetation, snails, crayfish, insects, fish, carrion, tadpoles.	Burrows or lays eggs on bottom during winter, hides in dense submerged vegetation	Not protected

MANAGEMENT ALTERNATIVES FOR LOST RIPARIAN WETLANDS

Existing Aquatic Plant Community

Information gathered from the aquatic plant survey suggests that Lake Sinissippi has low species diversity and minimal biomass (total plant material). Three general species of vascular plants and one species of macroalgae (filamentous) were identified during past plant surveys. The species identified were yellow water lily (*Nuphar* spp.), cattail (*Typha* spp.), and water shield (*Brasenia schreberi*). Water shield and cattail were the most abundant species. The photic zone (the depth to which sufficient light penetrates to permit photosynthesis and colonization of aquatic plants) for Lake Sinissippi generally limits plant growth to a depth of 3 feet.

Floating and emergent vegetation were the types of plants found in Lake Sinissippi. Floating and emergent plants are those that can tolerate turbid water conditions. In general, the aquatic plant community that is present in Lake Sinissippi is a poor source of food and cover for fish and wildlife. Aquatic plants were found at only 11 of the 104 sampling locations surveyed. Lake Sinissippi has very little aquatic plant growth. The lake is known to have a large population of carp, which stir up the bottom sediment while feeding, resulting in poor water clarity and the uprooting of plants. The turbidity caused by the carp and suspended sediment from the Rock River minimize light penetration, further inhibiting aquatic plant establishment and growth.

Typical wetland plant species in the lake shoreline area include cattails, dogwoods (*Cornus* spp.) and black willow (*Salix nigra*). The upland areas are dominated by red oak (*Quercus rubra*), white oak (*Q. alba*) and aspen (*Populus tremuloides*).

Wetland Restoration Issue

The dominant emergent wetland plant on Lake Sinissippi is cattail (*Typha* spp.). This plant is tolerant of continuous inundation and seasonal drawdowns but generally restricted to areas where the water depth never exceeds about 2 ½ feet , and typically restricted to water depth less than 1½ feet. It spreads extensively by rhizomes so that an acre of cattail may consist of only a few individual plants. Broad-leaved cattail can also form floating mats. Cattail stands provide important food and cover for wildlife. For example, the rhizomes are eaten by geese and muskrats. Muskrats also use the foliage to construct their lodges, which in turn can provide resting and nesting sites for water birds. In some cases, cattails can form extensive monotypes that may be considered undesirable because they lack diversity.

Cattails typically establish new growth on moist mudflats. Expansion of beds typically takes place during periods of lower lake levels during drought or artificial drawdown conditions. Cattail will not establish new growth in water deeper than a few inches, and will not remain established in areas typically deeper than 1 ½ feet. The Lake District recently conducted a bathometric mapping of the lake. The bottom contour map in Figure 3 shows that most of the water depth adjacent to riparian wetlands is greater than 2 feet, a depth too deep for the permanent establishment of emergent vegetation.

Expansion of emergent macrophyte beds on Lake Sinissippi would require one of the following:

- Permanently lower lake level
- Periodic lake drawdowns
- Filling in a contained area thereby reducing water depth

Permanent lowering of lake levels on Lake Sinissippi is not a viable option, as this activity would dramatically reduce riparian access to and use of the lake.

Periodic drawdowns of the lake could provide temporary expansion of emergent macrophyte beds, but the benefits, if any, would last only a few years. To maintain longer-term benefits to emergent aquatic plants, drawdowns would need to be repeated on a frequent basis. More frequent drawdowns, however, would impact negatively recreational use of the lake and have the potential of creating a nuisance weed situation that would require weed cutting or spraying.

Use of a containment dike or breakwater offshore of former riparian wetland would allow sediment to be pumped or otherwise deposited behind the barrier, effectively reducing water depth. Emergent and submergent aquatic vegetation in the sediment seed bank would grow within the embayment and area of shallow water. Alternatively, a variety of aquatic and wetland vegetation could be planted to restore lost wetland habitat.

Lake Drawdown

Lake drawdown is the process of lowering water levels to expose bottom sediment to drying and compaction and to allow for germination and growth of vegetation. When the water level is decreased, several management procedures can be carried out: sediment compaction, sediment removal, shoreline stabilization, removal of hazards and fish management. A drawdown period can vary from one season to a year or more depending on the management objectives.

Sediment compaction may be aided by freezing and thawing of saturated sediment, which causes some of the water bound to silt particles to separate from the sediment. Further desiccation of sediment may occur during warm weather. If sediment compaction occurs, then lake depth is correspondingly increased. The degree of sediment compaction is dependent on a number of factors, including type and composition of the sediment, depth of drawdown, weather conditions and location of springs within the lake bed.

Reports of the effects of drawdown on sediment compaction vary. Kadlec (1962) reported a consolidation of sediments in a Canadian lake as a result of drawdown. The drawdown of Lake Sinissippi in 1972-1973 is reported to have had minimal effect on sediment compaction ("2nd Dry Year for Sinissippi," 1973). Drawdowns on Beaver Dam Lake and Fox Lake are reported to have had little effect on increasing water depth ("Drawdown Issues Summary," 2002). Refilling of the lake basin following drawdown will rehydrate the dry sediment. Whether the compacted sediment layer remains intact or undergoes partial resuspension and expansion depends on the process of rehydration, mixing of the water from wind action and boating and the effect of carp on the lake bottom.

A complete drawdown of the lake may have an impact on private drinking water wells. Many older cottages have shallow wells that could go dry if the water table is reduced. An evaluation to determine potential effects to private wells would be necessary if a full drawdown is considered.

Figure 4 illustrates the area of Lake Sinissippi that would be exposed during drawdown of various depths. Gravity drainage of more than 4 feet is not feasible by just opening the dam. A rock ledge near the lake outlet prevents drawdowns below 4 feet. Drawdown beyond this depth would require removal of the rock ledge. Table 5 summarizes the surface area in acres and percent of total lake bottom that would be exposed during various depths of drawdown. As can be seen, to achieve significant lakebed exposure, drawdown of 3 to 4 feet is required.

Blue areas shown on Figure 4 illustrate submerged areas that would remain under a 4-foot drawdown. These areas would not experience any compaction of soft sediment.

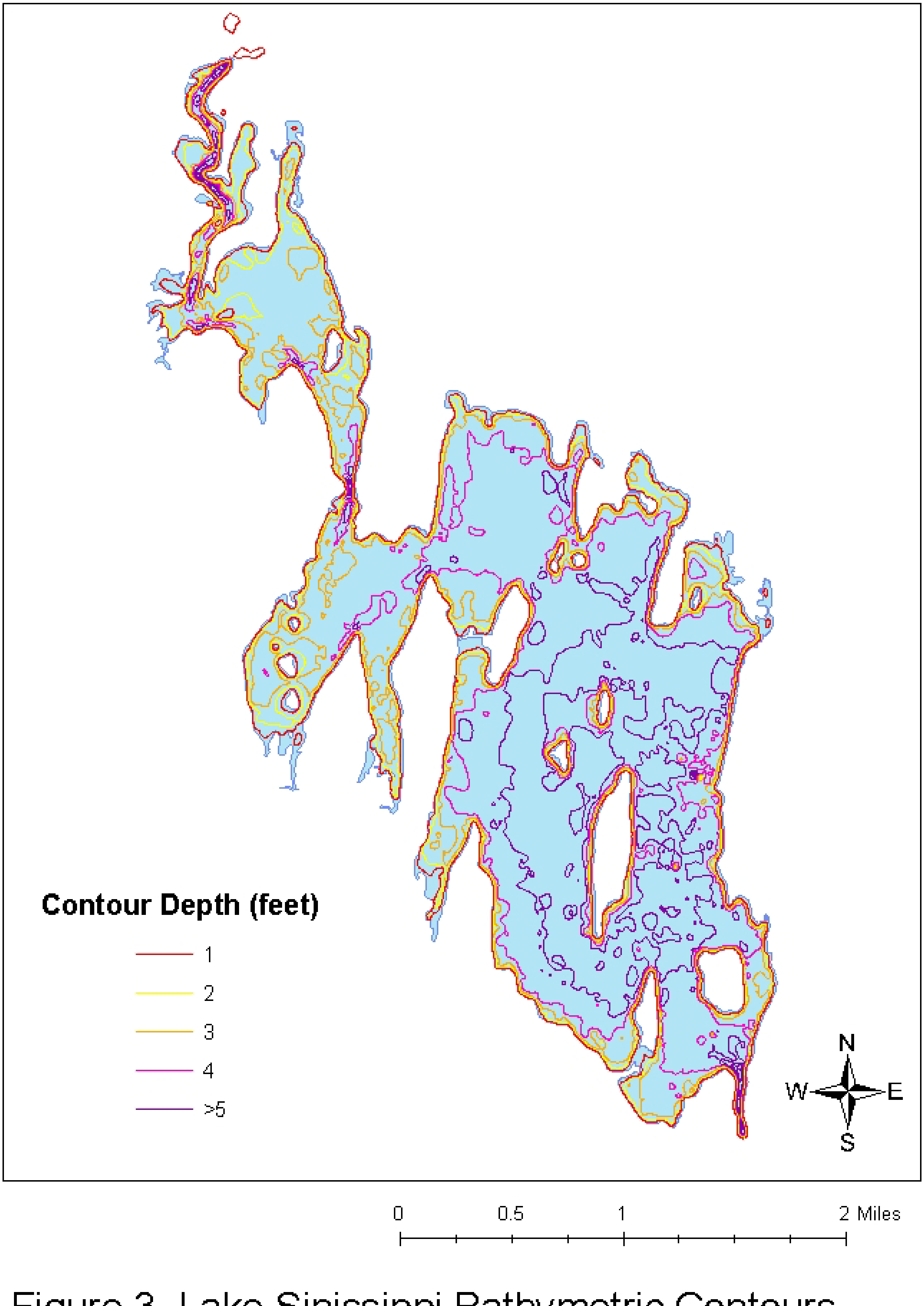
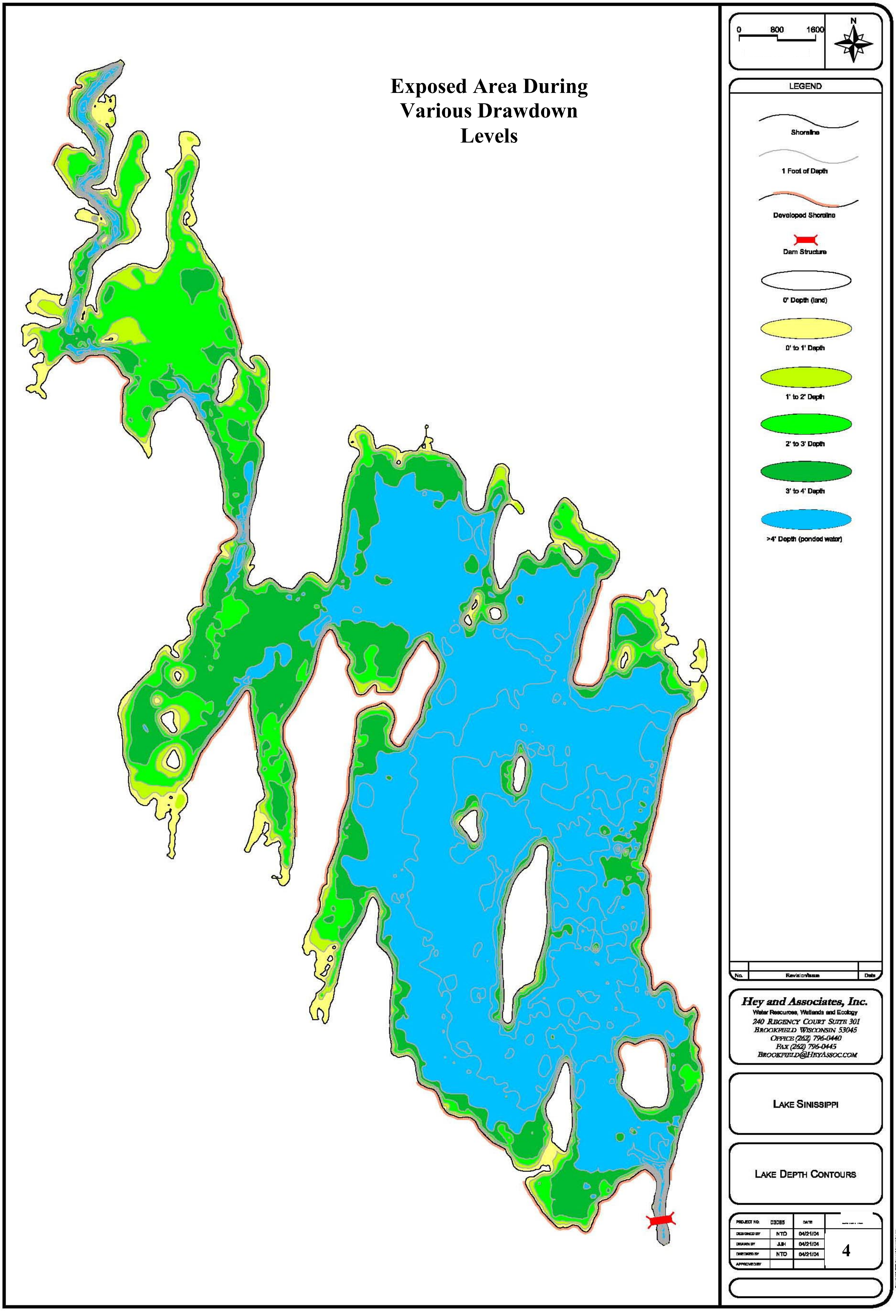


Figure 3. Lake Sinissippi Bathymetric Contours



Exposed Area During Various Drawdown Levels
0
800
1600
N
LEGEND
Shoreline
1 Foot of Depth
Developed Shoreline
Dam Structure
0' Depth (land)
0' to 1' Depth
1' to 2' Depth
2' to 3' Depth
3' to 4' Depth
>4' Depth (ponded water)
No.
Revision/Issue
Date
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Lake Sinissippi
Lake Depth Contours
PROJECT NO. 03085
DATE
DESIGNED BY NTO 04/21/04
DRAWN BY JJH 04/21/04
CHECKED BY NTO 04/21/04
APPROVED BY
4

TABLE 5
Area of Potential Lake Bottom Exposure Based on Depth of Drawdown

Depth of Drawdown (ft)	Area Exposed (acres)	Percent of Total Lake (%)
1	222	7.5%
2	410	13.8%
3	950	32.1%
4	1427	48.2%

Source: Hey and Associates, Inc.

Winter Drawdown

A winter drawdown would take place beginning in late summer (September/October) and last until early spring (April/May). Winter drawdown may facilitate some sediment compaction, shoreline stabilization and some aquatic plant control.

The effect of winter drawdown on aquatic plants can be both positive and negative. Some plants show decreased abundance after winter drawdown, while others increase in density. Table 6 is a listing of responses for the plants found in Wisconsin lakes based on past winter drawdown studies.

To protect hibernating amphibians and reptiles, the drawdown needs to take place before they find their over-wintering sites. These animals over-winter in burrows that are close to the water table to minimize freezing during periods of frost. If the drawdown takes place too late in the season, after the organisms have established their over-wintering sites, the hibernating animals could be exposed to freezing conditions and would not survive.

Winter drawdown has the advantage that it does not interfere with summer recreation on the lake, however fall hunting activities could be adversely affected. Winter activities such as snowmobiling can still take place on the drained lake surface. Lower water levels will decrease the available refuge areas for fish and may increase the potential for a winter fish kill. Unlike a summer drawdown, a winter drawdown will not have any beneficial effects on wetland plants near the lake.

The value and benefits of a winter drawdown appear to be minimal.

TABLE 6
Aquatic Plants' Response to Winter Drawdown

Decreased Abundance
Coontail (*Ceratophyllum demersum*)
Eurasian Water Milfoil (*Myriophyllum spicatum*)
Native Milfoil (*Myriophyllum sibericum*)
Yellow Water Lily (*Nuphar variegatum*)
Yellow Pond Lily (*Nuphar variegatum*)
White Water Lily (*Nymphaea ordonatra-tuberosa*)
Musk Grass (Chara) (*Chara* sp.)
Curley Leaf Pondweed (*Potamogeton crispus*)
Floating Pondweed (*Potamogeton natans*)
Bladderwort (*Utricularia* sp.)
Water Celery (Eel Grass) (*Vallisneria americana*)
Increased Abundance
Bushy Pondweed (*Najas flexilis*)
Clasping Leaf Pondweed (*Potamogeton richarsonii*)
Sago Pondweed (*Potamogeton pectinatus*)
Flat-Stem Pondweed (*Potamogeton zosteriformis*)
Variable Pondweed (*Potamogeton gramineus*)
Soft-Stem Bulrush (*Scirpus validus*)
Lesser Duckweed (*Lemna minor*)
Variable Response
Algae
Waterweed - Elodea (*Elodea canadensis*)
Cattail (*Typha latifolia*)
Needle Spike Rush (*Eleocharis acicularis*)

Source: WDNR, USEPA, & Cooke et al. 1993

Winter/Summer Drawdown

A winter/summer drawdown would take place over a full-year period, typically beginning in late summer (September/October) and lasting through the following summer into late August. A winter/summer drawdown presents more opportunities for management of the lake and the nearshore area. Wetland plant communities and associated wildlife habitat may be enhanced with the longer drawdown period. Several beneficial wetland plants, such as water plantain, bulrush, and rice cut grass, require periodic exposure of their seeds to the atmosphere to germinate. Maintaining a lake at a constant water level tends to allow certain wetland species, such as cattails, to dominate. If the drawdown period is dry, sediments have the opportunity to dewater and consolidate.

Drawdown followed by reflooding has an effect on the totality of the system. Linde (1969), working in temperate marshes, reported elevated decomposition of organic matter during drawdown, but Kadlec (1989) working in far northern wetlands in Manitoba, Canada reported no effect of drawdown on decomposition. Increases in nutrients especially nitrogen during drawdown and reflooding have been reported by a number of researchers (Klopatek 1978, Kadlec 1962, Kadlec 1989), but studies by Cook and Powers (1958) suggest that drawdown may lead to a reduction in the fertility of the system.

The beneficial effects of drawdown on the production of waterfowl and furbearers are well documented (Weller and Spatcher 1965, Weller 1978, Suring and Knighton 1982, Weller 1987). Generally, waterfowl and furbearers benefit from drawdown because the botanical resource is restructured in a way that favors their survival and reproductive success.

The response of the botanical resource to drawdown depends on the composition of the seed bank and seed rain interacting with the season of drawdown, the length of time of drawdown, the rapidity of dewatering and the depth of reflooding. For drawdown to be effective in re-establishment of emergents, the substrate must be exposed so the seed receives stimuli required to induce germination. The required stimuli are species specific. Annuals germinate on exposed substrate, persistent emergents germinate under conditions of shallow inundation and exposed substrate and submersed species germinate when shallowly inundated.

An evaluative study of germination from lake seed bank was conducted by the Lake District. Sediment samples were obtained from the littoral zone (water depth 2 feet or less) at six sites on Lake Sinissippi. An Eckman dredge was used for sediment collection and the samples were placed into plastic trays for germination tests. Unfortunately, problems were encountered with maintaining consistent moisture levels in the test trays and results, therefore, are inconclusive.

The results of a seed bank study conducted on Fox Lake may provide guidance as to the potential seed bank that exists at Lake Sinissippi. The Fox Lake study found predominately cattail, bulrush, smartweed (*Polygonum pensylvanicum*), waterweed, spike rush and sedge (*Cyperus* spp.).

A review of the experiences at Big Muskego Lake, Wisconsin, following an extended drawdown in 1996 may be instructive (Big Muskego Lake/Bass Bay Protection and Rehabilitation District, 2003). Lake Sinissippi and Big Muskego Lake share some characteristics and have differences and are managed for different objectives.

1. Big Muskego Lake (2,177 acres) is shallow (less than 4 feet), with extensive cattail marsh and wetlands, and limited residential, shoreline development. In 2002 there were 165 riparian landowners on Big Muskego Lake and adjoining Bass Bay; most of the development is around Bass Bay. Residential development along portions of Big Muskego Lake is generally set back of the open water due to the extensive cattail fringe and wetlands. The watershed covers 28 square miles, with residential uses comprising the largest percentage of land use. The main tributary is Muskego Creek, which is the outlet of Little Muskego Lake. The major recreational activities on the lake include fishing, hunting and wildlife viewing. Due to shallow water and muck bottom, the lake is not well suited for swimming, water skiing and personal watercraft operation. Bass Bay is a deeper basin (23 feet) and is used for these recreational activities.
2. Lake Sinissippi (2,855 acres) is shallow (average depth 4.5 feet) with some cattail fringe and wetlands, and more intensive residential, shoreline development. Most residential development is near the lake. Developed shorelines are protected with riprap and are maintained for open lake access with piers, boat lifts, etc. Within the boundaries of the Lake District there are over 450 riparian landowners and additional shore development within the Village of Hustisford. The watershed is 511 square miles of primarily intensively farmed agricultural land. The main tributaries are Rock River, which drains the Horicon Marsh, and Dead Creek. The major recreational activities on the lake include pleasure boating and water sports.

The 18-month drawdown (winter-summer-winter) of Big Muskego Lake included rough fish eradication, extensive dredging of lake channels and ditches, construction of three nesting islands, burning of cattail marsh and chemical treatment for nutrient inactivation of Bass Bay. Some of the results of the drawdown were:

- The lake shifted from turbid, carp-dominated shallow water with cattail fringe to a marsh/shallow lake complex with numerous islands of emergent vegetation (cattails, bulrushes). The clearer water supported a fishery that includes panfish and Northern Pike.

- Emergent vegetation coverage increased from 9 % of the surface area to 56 %. Stands of emergent vegetation served to reduce wave action, thereby minimizing sediment resuspension. This helped promote the growth of submergent aquatic macrophytes.
- Phosphorus concentrations and Secchi disk readings improved, however they still indicated eutrophic condition.
- Some consolidation of sediment occurred (not quantified), with an increase in sediment density and a decrease in content of organic matter. These sediment responses have been shown to encourage growth of rooted macrophytes, which was the experience on this project.
- Wildlife habitat improved as a result of the restoration project. Duck nesting activity increased and numbers of Egret, Great Blue Heron and Sandhill Crane were reported to be higher. Muskrat numbers increased greatly as a result of the prolific cattail growth.
- Fishery response after restocking was reported to be good, although a major winterkill occurred in 2000-2001.
  Aerators were installed in Bass Bay to maintain oxygen levels. Because of its deeper basin, Bass Bay provides refuge for fish in the winter and a diverse habitat for fish that seek the cooler water found below the thermocline in the summer.
- Aquatic plant control, including both chemical control and mechanical weed harvesting, has been necessary to control nuisance growths of Eurasian Water Milfoil, filamentous algal blooms, cattail growth and bogs and weed debris. In 2001 the Big Muskego Lake District purchased a weed harvester.

The most significant problem the Lake Sinissippi community would face with a drawdown would be the loss of access to and recreational use of the lake. The loss of opportunity costs to riparian homeowners, recreational users, tourism services and the local community would be high.

Growth of cattail and other emergent plants in front of developed properties could cause nuisance problems. On Lake Sinissippi there are over 10 miles of developed shoreline. Methods to control nuisance plant growth include cutting, rototilling and chemical treatment. Use of mechanical equipment for cutting and rototilling may not be possible on the exposed lakebed. Application of herbicides to control nuisance vegetation would cost about $400 per acre or a total cost of over $75,000 per treatment. Consideration would need to be given to possible environmental and public health effects of widespread use of herbicides, disposal of weeds and the effects of organic decomposition of the biomass.

After refilling of the lake basin, growth of submergent and floating vegetation could also cause nuisance problems and limit lake use, as seen following the 1972 drawdown of Lake Sinissippi and the more recent experience of Big Muskego Lake. Depending on the extent of weed growth, the cost to the lake community for weed cutting, disposal and control could be significant. Any drawdown consideration would require a comprehensive contingency plan, including financing, to deal with weed control.

Summer drawdown has other potentially negative impacts. After drawdown and refilling, algal blooms have occurred. The causes are not clear, but may be related to nutrient release from sediments or an absence of nutrient competition from rooted aquatic plants. Desiccation and freezing of sediment may affect benthic organisms that are an essential part of fish diets. In addition, dissolved oxygen may be depleted as a result of decay and decomposition of plant biomass, leading to fish kill. Dissolved oxygen would need to be monitored and aerators installed and operated as necessary.

Lake Sinissippi is inhabited by several unique bird species including eagles, egrets, herons, pelicans and cormorants. Each of these birds is a fish feeder. If the lake were drawn down for an extended period of time, these birds would need to go outside of the Lake Sinissippi area to find food. Studies of their behavior show that these birds will travel as far as 20 miles to feed. Figure 5 illustrates the feeding areas within a 20-mile radius.

Benefits from drawdown on sediment compaction will vary, as discussed previously. If a hard freeze does not occur during the winter of the drawdown, water may not separate from the sediment particles. In addition, if the sediments do not dewater and desiccate during the summer, compaction would be negligible.

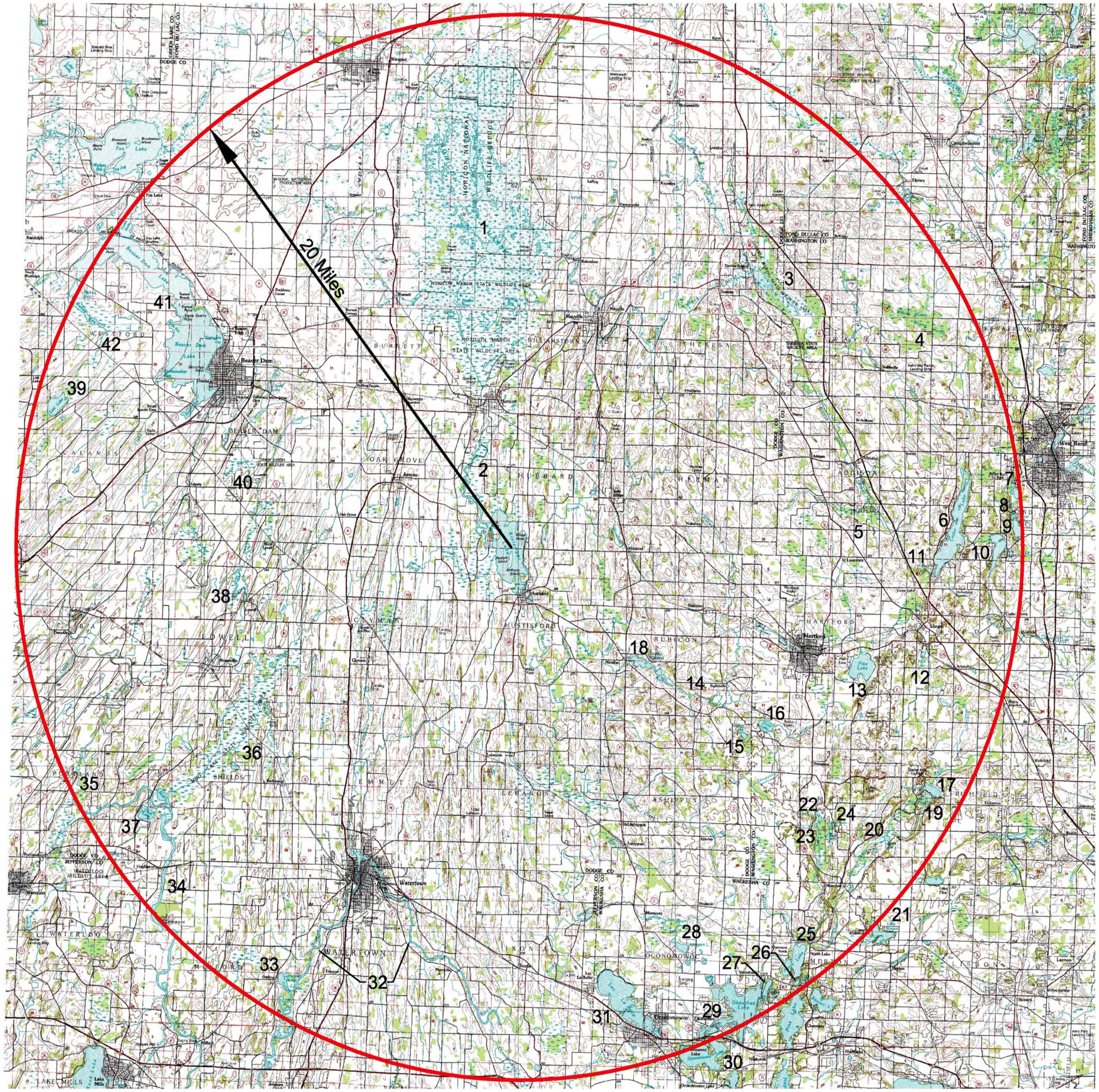
Given current conditions, the benefits to wetland and habitat restoration from an extended lake drawdown appear to not outweigh the risks and disadvantages. Experience on Lake Sinissippi suggests that a drawdown will not necessarily conform to a plan, with unintended and serious consequences. Development of wetland habitat may also be short-lived as high water levels, carp and wind erosion slowly degrade newly established wetland vegetation. Repeated complete drawdowns would be necessary, each with its own risks and consequences. On the other hand, partial drawdowns of short duration may be part of lake level management to support wetland fringe and reduce shoreline erosion.

Development of aquatic habitat necessary to support game fish appears to be a particularly difficult challenge, given existing lake characteristics. The lake basin is wide and shallow and is susceptible to winter kill due to low dissolved oxygen and to summer kill due also to low oxygen content and hyperthermic conditions. The shallow depth also means that rooted aquatic plants would tend to become established throughout much of the lake following a complete drawdown.

Suitable game fish habitat would require:

- Deep water with sufficient dissolved oxygen content and temperature optima to support game fish over winter and during warm summer months.
- Sufficient spatial area and volume of submerged aquatic plants or artificial cover such as evergreen trees, fish cribs, etc to provide food, cover, etc.
- Significant reduction of rough fish so the population level can be maintained by predation.
- Reduction of sediment layer to minimize turbidity and in-lake recycling of nutrients.
- Significant reduction of phosphorus in tributary waters to reduce algal blooms.
- Lake bottom substrate suitable for fish spawning.

Of the above requirements, the *sine qua non* to establish game fish habitat would appear to be cool, oxygenated deep water. Without deep water access, game fish stocked following any lake drawdown and rough fish eradication would more than likely not survive the first few years, succumbing to either winter kill or hyperthermia during summer. This was the experience on Lake Sinissippi following the 1972-1973 drawdown, carp eradication and game fish stocking. The other important lesson from that period is that the consequences of a major perturbation to the lake, such as a drawdown, will probably be felt for many years.



MAP KEY
1. Horicon Marsh State Wildlife Area
2. Rock River
3. Theresa State Wildlife Area
4. Wayne Marsh
5. Allenton State Wildlife Area
6. Big Cedar Lake
7. Lucas Lake
8. Valley Lake
9. Silver Lake
10. Little Cedar Lake
11. Meuler Lake
12. Mud Lake
13. Pike Lake
14. Rubicon River
15. Collins River
16. Druid Lake
17. Friess Lake
18. Neoscho Pond
19. Little Friess Lake
20. Lowes Lake
21. Lake Keesus
22. Murphy Lake
23. Malloy Lake
24. McConville Lake
25. North Lake
26. Correll Lake
27. Moose Lake
28. Ashippun Lake
29. Okauchee Lake
30. Oconomowoc Lake
31. Lac LaBelle
32. Rock River - South
33. Hahns Lake
34. Crawfish River
35. Waterloo State Wildlife Area
36. Mud Lake State Wildlife Area
37. Chub Lake
38. Beaver Dam River
39. Lost Lake
40. Shaw Marsh State Wildlife Area
41. Beaver Dam Lake
42. Westford State Wildlife Area

0 2 4

N

LEGEND

Refer to MAP KEY

No.	Revision/Issue	Date

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LAKE SINISSIPPI
WETLAND RESTORATION PLAN

WILDLIFE HABITAT ADJACENT TO
LAKE SINISSIPPI

PROJECT NO:	03085	DATE	EXHIBIT NO:
DESIGNED BY	NTO	04/21/04	5
DRAWN BY	JJH	04/21/04	
CHECKED BY	NTO	04/21/04	
APPROVED BY			

Potential Restoration Areas

The Lake District identified 13 areas on Lake Sinissippi that could be considered for potential restoration of wetland and aquatic habitat. The criteria for selecting these areas are as follows:

- Adjacent to undeveloped properties
- Riparian areas that had emergent vegetation following the 1972 drawdown
- Near areas of known sensitive wildlife

The lake and associated wetlands are part of the Horicon Marsh flyway. Restoration efforts that encourage development of this habitat for migrating waterfowl benefit the marsh flyway. Conversely, efforts to improve the water quality of the Horicon Marsh and Rock River headwaters will inevitably benefit Lake Sinissippi.

The potential restoration areas are illustrated on Figure 6. Table 7 summarizes the size and length of opening to open water of each potential restoration area.

TABLE 7
Potential Areas for Wetland Restoration on Lake Sinissippi

Area	Surface Area (acres)	Length of Opening to Open Water
A	10.27	1470
B	44.65	1070
C	29.73	2810
D	26.33	540
E	7.17	415
F	15.99	1412
G	52.85	2445
H	96.62	2920
I	15.48	675
J	7.37	405
K	24.49	990
L	41.27	1400
M	17.94	385
Total	**390.16**	**16937**

Source: Hey and Associates, Inc.

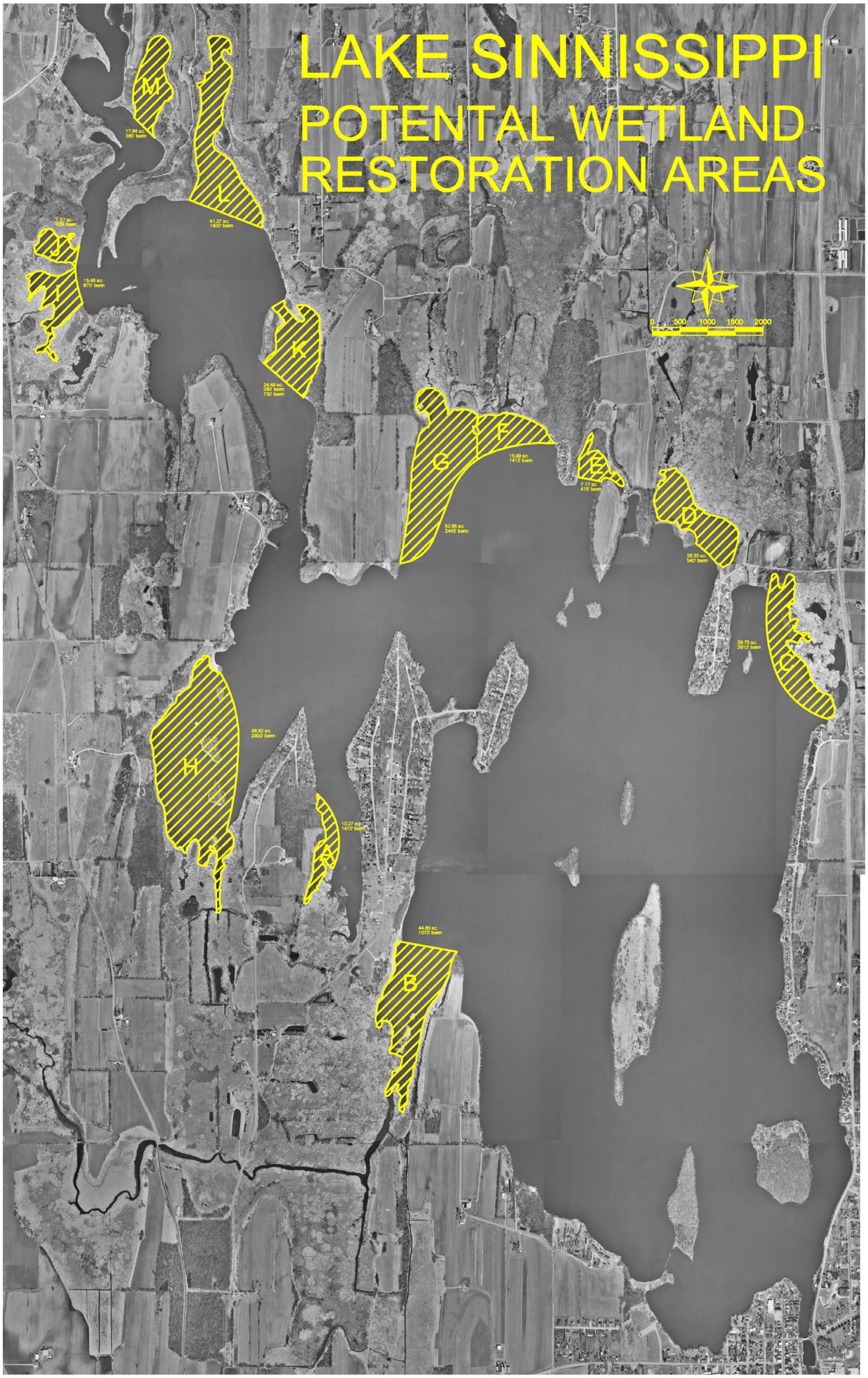

FIGURE 6

LAKE SINISSIPPI

POTENTIAL WETLAND RESTORATION AREAS

SCALE:
Not to Scale

N

Artificial Planting

Artificial planting of wetland vegetation could be used to enhance the diversity of the plant community at Lake Sinissippi. Since plant diversity is low in the marsh areas, consideration could be given to herbiciding sections of the marsh to kill the cattail and embarking on a planting program. This planting effort would install new native species such as bulrushes and burreeds into the herbicided areas. The planting could help to diversify the marsh, although the long-term effectiveness of the planting is unknown due to the aggressiveness of the cattail and germination from the existing seed bank. Plantings have application in wetland, marsh and moist soil habitat restoration.

Artificial planting would be restricted to areas with water depth 1½ foot or less. Cost for seed is about $200 per acre; costs for contract planting and installation is an additional $100 - $300 per acre.

Burning of Marsh Fringe Areas

Consideration could be given to periodic prescribed burning of portions of the marsh fringe. Although the burning itself would not get rid of the cattail, burning tends to make most herbaceous vegetation grow better, thus promoting the overall health of the marsh ecosystem. Also, the burning would help in limiting woody vegetation along the marsh perimeter, which would likely promote additional native species with the increased sunlight availability. Standard safety practices would need to be used if a limited burning program were to be attempted.

Construction of Breakwaters and/or Revetments

Establishment of new wetland areas on Lake Sinissippi is limited by water depth to shallow areas adjacent to the existing marsh fringe. If water depth exceeds 1 ½ to 2 ½ feet, then emergent and floating vegetation cannot become rooted. Also, areas of the lake have long wind fetches that can create intensive wave action on the marsh edge. One option to reduce wave attack on the marsh fringe and create areas of shallow water for the establishment of new wetland vegetation is to construct breakwaters and/or revetments off shore and back fill in the isolated area behind the structures with sediment to create new wetland habitat. Breakwaters can be constructed out of earthen fill, rock riprap or Geotube® geotextile fabric tubes, which are filled with dredged sediment.

In 2001 the Lake District worked with WDNR authors of Wisconsin Administrative Code Chapter NR328, subchapter II Municipal Breakwater Permits, to include Lake Sinissippi as an eligible waterway. Under this subchapter the Lake District is a designated public entity that can apply to the WDR for breakwater permits for erosion control and habitat restoration measures (Appendix H).

The geotextile tube system offers significant benefits as a storage container for sediment, a cost-effective breakwater/riprap structure for shoreline protection and a containment structure for wetland and habitat restoration. A number of reports on the use of geotextile systems in ecosystem restoration work are available in the literature. Pioneering work in the use of geotextile tubes for erosion control and habitat restoration has been done in Illinois and Iowa by the Departments of Natural Resources and in Illinois, Tennessee and other states, including marine coastal regions, by the US Army Corps of Engineers. Geotextile tubes have been used for over 15 years in diverse marine, riverine and lacustrine environments.

In 1995 the Fox Waterway Agency for the Fox River Chain of Lakes in northern Illinois installed a pilot-scale sediment containment system using Geotube geotextile tubes (Bhowmik and Demissie, 2002). This was one of the first times in the US that a tube containment system was used in an inland lake. In 2000, the Agency commenced a large-scale, 5-year project to restore a 27-acre wetland island in Grass Lake. The project uses geotextile tubes as the island perimeter berm with hydraulically dredged lake sediment pumped into the interior volume. Partners in this major restoration project include the Illinois Department of Natural Resources, US

Army Corps of Engineers and the Illinois Environmental Protection Agency. Figure 7 is a stylized illustration of the Geotube breakwater/revetment structure used to restore the 27-acre Grass Island on Grass Lake, Fox Chain of Lakes.

Another major application of Geotube systems in Illinois is a joint ecosystem restoration project within Peoria Lake and the Farm Creek watershed conducted by the Illinois Department of Natural Resources and US Army Corps of Engineers (2002a). Some of the objectives of this work include:

- Provide structures for aquatic organisms
- Increase habitat diversity
- Improve habitat value for migratory waterfowl and shorebirds, and
- Improve water quality

Pictures of the restoration work with geotextile tubes on the Illinois River and Peoria Lake are available (Marlin, 2001, Appendix I).

FIGURE 7
Geotube Restoration of Grass Island on Grass Lake, Illinois

The Iowa Department of Natural Resources detailed restorative alternatives and recommendations for Crystal Lake (Downing et al, 2001). Crystal Lake is a shallow lake, located within a watershed that is predominately agriculture. Long-term sedimentation has reduced lake volume to 52 % of its original volume. One of the key restoration options is use of Geotube-formed containment systems for embayments and wetlands and dredging of excess lake sediment.

US Army Corps of Engineers (2002b) is conducting an ecosystem restoration project on Drakes Creek, a major tributary of the Cumberland River in north central Tennessee. Phase one of the project consisted of creating a Geotube containment dike to establish a 13-acre embayment of the creek and dredging to restore lost fish habitat and environmental aesthetics. The diked embayment was planted with a variety of emergent and submergent aquatic vegetation. The Geotube dike itself was planted with a variety of native trees, wildflowers and grasses. Phase one was completed in 2001. Phase two began in June 2002 and consists of placing and filling Geotubes to create sediment disposal areas and dredging the creek channel and fish habitat areas.

Table 8 summarizes the length of Geotube breakwater and the current volume of water contained within the basin for each of the potential restoration areas identified in Figure 6. Establishing wetland habitat would require pumping dredged sediment to various depths to displace some of the contained water. Creating an irregular depth profile would maximize the variety of aquatic vegetation within the area – emergent, submergent and floating aquatic plants, and open water.

TABLE 8
Length of breakwater and current volume of water contained within the basin of each restoration area identified in Figure 6.

Area Number	Berm Length (ft)	Surface Area (ac)	Volume in Geotube, 3-ft (cu-yd)	Volume in Geotube, 5-ft (cu-yd)	Volume Behind Berm (cu-yd)*
A	1,470	10.27	735.0	2,793.0	33,138
B	1,070	44.65	535.0	2,033.0	144,071
C	2,810	29.73	1,405.0	5,339.0	95,929
D	540	26.33	270.0	1,026.0	84,958
E	415	7.17	207.5	788.5	23,135
F	1,412	15.99	706.0	2,682.8	51,594
G	2,445	52.85	1,222.5	4,645.5	170,529
H	2,920	96.82	1,460.0	5,548.0	312,406
I	675	15.46	337.5	1,282.5	49,884
J	405	7.37	202.5	769.5	23,781
K	990	24.49	495.0	1,881.0	79,021
L	1,400	41.27	700.0	2,660.0	133,165
M	365	17.94	182.5	693.5	57,886
Total	**16,917**	**390.34**	**8,458.5**	**32,142.3**	**1,259,497**

Source: Hey and Associates, Inc.

Cost for installation of the Geotubes will vary depending of the height of tube used (3 or 5 foot in height) and equipment access. Costs for the Geotube installation range from $20 to $40 per foot depending on the diameter of tube used. Contract dredging costs could range from $7 to $12 per cubic yard depending on the volume of material dredged. Alternatively, the Lake District may investigate lease or purchase of dredging equipment.

Slow-No-Wake Zones

Wetland fringe areas are susceptible to erosion from boat wakes and fast moving boats can disturb sensitive wildlife species such as eagles, egrets, and herons. To minimize potential impacts to sensitive habitat, the Lake District in 2001 established the first slow-no-wake, habitat protection zone in a bay on the west side of the lake known as "Eagle Bay". This zone corresponds to restoration area "H" in Figure 6. The area is home to a nesting pair of eagles, a heron rookery, pelicans and luxuriant growth of aquatic plants such as water lily (*Nuphar* and *Nymphaea* spp.). The protection zone is authorized by WDNR boating ordinance and waterway marker permit as a slow-no-wake area and is enforceable by town authority and the WDNR.

In 2003, as part of the work envisioned under this grant project, three additional slow-no-wake, habitat protection zones were established under WDNR boating ordinance and permit. These areas are located at the mouth of Dead Creek (restoration area "B"), offshore of the WDNR Public Hunting Grounds (restoration area "G") and at a small embayment to the west of Kinkel Point (restoration area "D"). Establishment of a fifth habitat protection zone is planned for the bay east of Kinkel Point. This bay has wetland and marsh fringe (restoration area "C").

This work has been particularly successful and continues to meet the objectives of the Lake District for protection of existing wetland, habitat and sensitive bird species. The costs associated with the work are purchase of marker buoys, installation and retrieval of buoys and infrequent enforcement action. The minimal presence of boat traffic in the bays allows some settling of suspended sediment and improves water clarity. Submergent and floating vegetation, such as water lily, appear to thrive. The response from the lake community has generally been good, as most boaters are respectful of and observe the regulation markers. Only a few enforcement actions have been necessary. The Lake District may consider in the future an additional site(s) for slow-no-wake, habitat protection.

A map of the habitat protection zones on Lake Sinissippi is given in the Appendix G.

Floating Islands

Floating islands are becoming popular in areas where natural wetland establishment cannot be achieved. The islands are made from either natural or man-made materials. The island acts as a floating platform for the establishment of wetland plants. The plants grow through the floating substrate and set their roots into the water column below the island. Several companies, such as Floating Island International, construct and install floating islands. Prices for a custom designed and planted island range from $29 to $52 per square foot.

Activities Local Property Owners Can Do To Improve Wildlife Habitat on Their Shorelines

To improve wildlife habitat and increase the enjoyment of wildlife observers, plants that will attract a variety of birds, butterflies, and insects are recommended along the disturbed edges of the lake. Table 9 summarizes some of the potential plants that could be integrated into a native landscaping plan on developed properties to improve wildlife habitat.

TABLE 9
Plants to Attract Wildlife

Common Name	Species Name
Shrubs	
Red-twig dogwood	*Cornus stolonifera*
Silky dogwood	*Cornus amomum*
Nannyberry	*Viburnum lentago*
Hazelnut	*Corylus Americana*
Forbs (Upland)	
Pale purple coneflower	*Echinacea pallida*
Yellow coneflower	*Ratibida pinnata*
Butterflyweed	*Asclepias tuberose*
Blazingstar	*Liatris spicata*
Wild bergamot	*Monarda fistulosa*
New England aster	*Aster novae-angliae*
Stiff goldenrod	*Solidago rigida*
Compass plant	*Silphium laciniatum*
Wetland	
Joe-pye weed	*Eupatorium maculatum*
Boneset	*Eupatorium perfoliatum*
Cupplant	*Silphium perfoliatum*
Turtlehead	*Chelone glabra*

The Wisconsin Department of Natural Resources and the University of Wisconsin Extension offer several publications on how riparian lake residents can landscape their shorelines to improve wildlife habitat. In 2001 the Lake District sponsored a shoreline restoration program for lake residents. A restoration specialist from WDNR presented a number of options for shoreline habitat restoration, including natural plantings and Biologs. The Lake District may sponsor similar programs in the future for the lake community.

MANAGEMENT ALTERNATIVES TO RESTORE NON-RIPARIAN WETLANDS

Introduction

Many historic wetlands in the Lake Sinissippi area have been drained for conversion to agricultural production. Locations of these converted wetlands can be found by overlaying the hydric soils maps with existing wetland maps in a GIS program. The figures in Appendix G illustrate the areas of hydric soils that are no longer wetland. The farmed wetlands are illustrated in the color red on the figures. It is estimated that 17,902 acres of wetland have been converted to farm land in the four townships surrounding Lake Sinissippi.

Restoration Options for Farmed Wetlands

Farmed wetlands can be restored back to wetland status through restoration of the hydrology. Restoration techniques can include tile modification by either the placement of valves on the tile to restrict flow or breakage to eliminate the tile as a drainage device. Drainage ditches can be plugged with earthen fill or small dam structures. Many farmed wetlands have limited historic wetland plant seed banks due to year of tillage and disturbance. Re-flooded areas can be seeded with wetland plants to facilitate the restoration process. Seeding can range from $800 to $2,000 per acre depending on seed mixture and equipment available.

There are over 500 isolated drained wetland parcels in the four townships surrounding Lake Sinissippi. Many of these parcels are too small for cost-effective management. To better isolate those parcels that would provide the greatest wetland area if restored, the parcels 40 acres and larger in size were identified. Appendix E list the name of landowners who have parcels of farmed wetlands that are 40 acres or larger in size. This list included 164 parcels and provides a reasonable starting point for targeting areas for potential restoration.

Financial Assistance for Restoration of Farmed Wetlands

<u>Wetland Reserve</u>

The Wetlands Reserve Program (WRP) is a voluntary program to restore and protect wetlands on private property. The Program is administered through the US Department of Agriculture, Natural Resources Conservation Service (NRCS). It is an opportunity for landowners to receive financial incentives to restore wetlands that have been drained for agriculture.

Landowners who choose to participate in WRP may sell a conservation easement or enter into a cost-share restoration agreement with NRCS to restore and protect wetlands. The landowner voluntarily limits future use of the land, yet retains private ownership. The landowner and NRCS develop a plan for the restoration and maintenance of the wetland.

The program offers landowners three options: permanent easements, 30-year easements, and restoration cost-share agreements of a minimum 10-year duration.

<u>Glacial Habitat Restoration Area</u>

The Glacial Habitat Restoration Area Project is a regional approach to wildlife habitat management that focuses on establishing a patchwork of restored wetlands and grasslands in combination with croplands to provide all of the elements necessary for the life cycle of waterfowl, wild pheasants and non-game songbirds. The program is administered through the WDNR. The goals of the program are to establish 38,600 acres of permanent grassland nesting cover and restore 11,000 acres of wetlands within 24 townships in Columbia, Dodge, Fond du Lac and Winnebago Counties, which totals about 530,000 acres. With this additional habitat restored on the landscape, existing wildlife populations will be allowed to increase and expand. In order to attain these goals, the WDNR is purchasing, as well as securing perpetual easements, on properties ranging in size from ten acres up to a few hundred acres. Only those properties that are purchased by the state become public property and are open to public hunting. Those properties that have perpetual easements are still under the control of the landowner and access is only granted by permission of that landowner.

Other Conservation Programs

The NRCS also offers the Wildlife Habitat Incentives Program that provides technical assistance and cost sharing to improve fish and wildlife habitat.

The USFWS offers Natural Resource Assistance Grant Programs, under auspices of the North American Wetlands Conservation Act, to promote conservation of wetlands and associated habitat for migratory birds and other wildlife. The Service also offers cost-share landowner partnerships through the Cooperative Conservation Initiative.

PROTECTION OF EXISTING SENSITIVE AREAS

Protections Under Existing Zoning

Land use in most of the Lake Sinissippi area is protected under the **Dodge County Land Use Code**, with the exception of those areas in the Village of Hustisford. In addition, the Towns of Hubbard and Hustisford have land use plans and building ordinances that may affect habitat protection.

The county code provides several layers of protection for existing wildlife habitat. Protections include:

1. Designation of "Prime Agricultural Districts" under section 3.4.2 designed to protect farmland in perpetuity.
2. Designation of "Wetland District" under 3.5.1 designed to prohibit land disturbing activities in mapped wetlands.
3. Designation of "Shoreland Wetland Overlay Districts" under section 4.2 to control building within 300 feet of navigable streams and 1000 feet of the lake.
4. Designation of "Floodplain Overlay District" under section 4.3 to control building in mapped regulatory floodplains.
5. Designation of "Environmental Protection Overlay Districts" under section 4.4.1 to protect wooded areas of environmental importance, significant archaeological sites, slopes in excess of 12 percent, soil depths greater than 60 inches, or other areas in which the public has interest in preserving or protecting.
6. Requirement of permits under section 6.2.10 to create ponds and wetland scraps.
7. Requirement for "vegetative buffer zones" under section 6.4.1 as part shoreland development plans.
8. Requirement for "Buffer/Setback Areas" from streams or river corridor, wetland and lakes under section 8.4.3.
9. Establishment of "Wildlife Habitat Protection" areas under section 8.4.6.

The county also has several plans that pertain to or otherwise impact wildlife and habitat protection.

- Dodge County Park, Outdoor Recreation and Open Space Plan 2003
- Dodge County Agricultural Preservation Plan 2002
- Dodge County Comprehensive Plan 1999
- Dodge County Land and Water Resources Management Plan 1999

Copies of these plans and the Land Use Code are available at county departments of Planning, Development and Parks and Land Conservation. The plans and code are also accessible online at www.co.dodge.wi.us/planning/

Identification of Properties

A mapping overlay of tax parcels over 10 acres in size and within 500 feet of lakeshore was prepared by Dodge County Land Information Department (Appendix K). The map overlay was used to identify individual tax parcels of undeveloped land of sufficient size to warrant possible protection. A list of parcel ownership is included. The existing zoning and ownership of each parcel was reviewed. Initial strategies for long-term protection have been prepared for some of the parcels (see Von Schledorn property below). Protection of three of the parcels located within section 29, Town of Hubbard, is an objective of the proposed breakwater project for wetland restoration. Protection of parcels located within sections 32 and 33, Town of Hubbard, is an objective of a new slow-no-wake, habitat protection zone, as discussed above. Most of the remaining undeveloped parcels are part of larger residential properties. The Lake District will review the status of these parcels periodically to determine whether additional protection can be established.

Non-Zoning Protections of Land

Non-zoning options to protect existing wildlife habitat fall into three categories: purchase of the land, acquisition of conservation easements, or public education.

Purchase of land or what is called "fee purchase" is the greatest option for the protection of wildlife habitat. By outright ownership of the land, the owner holds all of the rights to the property that are allowed under the local zoning code. Land can be purchased by private individuals, land trusts or local units of government for protection. Grants from the State of Wisconsin under the Stewardship or Lake Protection Grant programs may be available to eligible organizations.

Dodge County has designated one parcel, the Von Schledorn property, section 30 of Town of Hubbard, on the north side of the lake, as potential public recreational area (See map of future land use in Appendix C). Acquisition of this parcel would protect over 270 acres of riparian land and prime wildlife habitat near a known pelican breeding area. The Lake District has indicated to the county and WDNR its interest in cooperating on acquisition (Appendix L).

A conservation easement (or conservation restriction) is a legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values. It allows the owner to continue to own and use the land and to sell it or pass it on to heirs.

Public education is a way to encourage private landowners to be good stewards on their own property. Several public education programs are sponsored through the Wisconsin Department of Natural Resources, U. S. Fish and Wildlife Service, and several conservation organizations.

Land Trust

The Lake District was a co-sponsor of two meetings in 2004 to explore the feasibility of establishing a land trust for Dodge County. Other sponsors included WDNR, USFWS, UW-Extension, Gathering Waters and Rock River Headwaters (Appendix L). While those in attendance expressed a positive view towards having a land trust for the county, there was not a sufficient and necessary critical mass of committed persons to establish and manage a land trust. Therefore, other conservation easement options were explored.

Land trusts in neighboring counties have indicated their interest and willingness to hold and administer lands within Dodge County. These trusts include Waukesha Land Trust, Ozaukee-Washington Land Trust, Jefferson Land Trust and Gathering Waters. Arrangements can be made that when and if a land trust for Dodge County is established, trust ownership of selected properties can be transferred to the new trust.

The Lake District will also prepare an information brochure about "land and your legacy" to be made available to interested property owners within the lake watershed.

RECOMMENDED PLAN

The Lake District board of commissioners is responsible for preparing and implementing a long-range management plan for lake protection and rehabilitation. Evaluation of wetland and habitat restoration options was conducted by a Lake District subcommittee comprised of commissioners and lake residents. Recommendations for wetland and habitat restoration were reviewed and approved at annual meetings of Lake District electors in 2003 and 2004 (Appendix L). Parts of the management plan for habitat restoration have been implemented or are in the process of implementation. A major project envisioned under the plan requires water regulatory permits. Applications for this project have been filed with the appropriate agencies. Another part of the management plan involves on-going participation in state, county and municipal affairs to advocate for lake protection and rehabilitation. Lastly, the plan will require the Lake District to educate and promote conservation practices and programs within the lake community and lake watershed.

Plan Recommendations

1. The establishment of rehabilitation projects in which designated restoration areas are contained with geotextile tube systems as breakwaters for shoreline erosion control, and as revetments with back filling of dredged sediment to create shallow water depth for development of wetland habitat.

2. Continuation and expansion of the slow-no-wake, habitat protection zones under WDNR boating ordinance and permit to restrict boat traffic within sensitive habitat areas.

3. Encouragement of private landowners in the watershed with drained wetland to consider voluntary enrollment of lands in the Wetlands Reserve Program or the Glacial Habitat Restoration Area.

4. Work with Dodge County and WDNR on potential acquisition of undeveloped riparian property in the Town of Hubbard for use as public recreational area.

5. Actively participate in zoning and variance decisions by Dodge County and local townships and village to assure that environmentally sensitive areas near the lake are protected.

6. Encourage lake property owners to integrate natural shoreline protection and wildlife habitat into their shoreline landscape plans.

7. Work with USFWS, WDNR and conservation organizations to promote habitat protection and ecotourism measures, such as establishing an official Wisconsin Bird Trail for the Upper Rock River Basin.

8. Determine whether one or more riparian sites of sensitive habitat qualify as State Natural Area.

9. Further refine alternatives for and feasibility of dredging and rough fish control to provide suitable aquatic habitat for development of a self-sustaining game fish population.

Community Information and Education

The following activities are part of the Lake District's efforts under this project to inform and educate the lake community and local residents about the wetland and habitat restoration program for Lake Sinissippi (See Appendix L).

- News release and articles in local media regarding WDNR Lake Planning Grant to Lake District for wetland and habitat restoration, April 30, 2003.

- Presentation of wetland and habitat restoration issues by Hey and Associates to Lake District annual meeting of electors on August 9, 2003.

- News article regarding approval of habitat restoration plans at Lake District annual meeting, August 14, 2003.

- Newsletter to Lake District residents regarding habitat restoration grant, Summer-Fall 2003.

- News article regarding meeting to explore formation of a land trust for Dodge County, March 25, 2004.

- Newsletter to Lake District residents regarding publication and distribution of Lake Sinissippi Citizen's Handbook, Spring-Summer 2004. [A copy of the Citizen's Handbook is part of this report]

- Presentation of wetland and habitat restoration program to Lake District annual meeting of electors on August 14, 2004.

- Newsletter to Lake District residents regarding Geotube project for restoration of wetlands at Kinkel Point site, Spring-Summer 2005.

- Prepared, distributed and posted lake maps showing areas of slow-no-wake, habitat protection zones.

- Interested persons are also encouraged to visit the Lake District's website at www.lakesinissippi.org for additional information on activities.

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