2002 SUMMARY REPORT
of
ST. MARY'S LAKE

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

St. Mary's Lake, located in Libertyville Township is an elongated man-made lake that was created sometime between 1915 and 1920. Approximately ¾ of the lake is located in Mundelein, while the eastern ¼ of the lake is in Libertyville. The lake is contained entirely on the grounds of the Mundelein Seminary, and is surrounded by woodland. The lake is not open to the public. St. Mary's Lake has a surface area of 105.7 acres with mean and maximum depths of 9.0 and 18.0 feet, respectively. The lake receives water from Loch Lomond from the west and empties over a dam into Butler Lake to the east. It is used by seminary students for fishing, boating and aesthetics.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature and water clarity were measured and the plant community was assessed each month from May-September 2002. St. Mary's Lake was thermally stratified all summer and epilimnetic oxygen concentrations remained high. The epilimnetic phosphorus (P) concentration was nearly twice the county median, but hypolimnetic concentrations remained below the county median. Hypolimnetic P concentrations were nearly twice as high as the epilimnetic concentrations, but this phosphorus remained isolated in the hypolimnion throughout the summer, preventing planktonic algae blooms in the surface waters. Total suspended solids (TSS) levels were also relatively high all summer and, as a result, Secchi depths (water clarity) were lower than the county average all summer. Conductivity in both the epilimnion and the hypolimnion was much higher than the county average and had increased dramatically since 1995. Since conductivity is related to chloride ions in urban areas, the chloride concentrations of the June-August water samples were measured and found to be moderately high. These elevated conductivity and chloride levels are cause for some concern, but there may not be much that lake managers can do to reduce them.

Aquatic plants were completely absent in St. Mary's Lake, but a large number of terrestrial plant and tree species were present along the shoreline. Although the majority of the shoreline consists of woodland, 44% is exhibiting slight to severe erosion. Most of the erosion is occurring along unmaintained wooded shoreline and those areas with manicured lawn to the lake edge. Buffer and woodland shorelines should be improved and maintained as much as possible, and the presence of manicured lawn should be discouraged. These areas can be replaced by buffers made up of native plants. Invasive plant and tree species, including wild grape, enchanters nightshade, bull thistle, honeysuckle, multiflora rose, white sweet clover, reed canary grass, purple loosestrife, scotch pine and common buckthorn were present along 88.1% of the shoreline. Steps should be taken to rid the lake of these plant species, as they do not provide quality wildlife habitat or erosion control.

LAKE IDENTIFICATION AND LOCATION

St. Mary's Lake is located in Libertyville Township, just east of U.S. Hwy 45 and north of IL State Rte. 176 (T 44N, R 11E, S 19, 20). Most of the lake (3/4ths) is located in Mundelein, while the eastern tip of the lake is located in Libertyville. St. Mary's Lake is an elongated lake with a surface area of 105.7 acres with an estimated mean and maximum depth of 9.0 feet and 18.0 feet, respectively. It has an estimated volume of 951.3 acre-feet and a shoreline length of 3.64 miles. St. Mary's Lake receives water from Loch Lomond from the southwest and empties into Butler Lake through the dam on the eastern shore. St. Mary's Lake also receives effluent from a private sewage treatment plant that services Mundelein Seminary. Current sewage plant discharge data indicate that the amount of CBOD in the water leaving the plant is 75% below permit level and the amount of TSS in the water discharged from the plant is 92% below permit levels. This is excellent and indicates that the sewage treatment facility provides no threat to the water quality of St. Mary's Lake. Nonpoint source runoff enters from the woodland surrounding it, residential land around Loch Lomond and from a relatively large area of corporate development, north of the lake along U.S. Hwy 45. The lake is located in the Bull Creek sub basin, within the Des Plaines River watershed.

BRIEF HISTORY OF ST. MARY'S LAKE

St. Mary's Lake is a man-made lake, created sometime between 1915 and 1920 by dredging and damming a low-lying area. Development of the University of St. Mary of the Lake (Mundelein Seminary) began at approximately the same time the lake was created. The lake is entirely contained on the grounds of the seminary and is surrounded by woodland. The lake is not open to the public. Currently, the lake is managed by the seminary, but no management techniques have been carried out on the lake in its entire history.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Access to St. Mary's Lake, as controlled by the Mundelein Seminary, is completely closed to the public and only seminary students are allowed access to the lake. Its main uses are boating and fishing. No motors are permitted on the lake, but residents can fish from the shore or use rowboats provided by the university. Currently, the only management concern on St. Mary's Lake is the fish community.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from St. Mary's Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected at 3 foot and 12-13 foot depths (depending on water level) from the 2002 deep hole location in the lake (Figure 1). St. Mary's Lake was thermally stratified from May-September. Thermal stratification occurs when a lake divides into an upper, warm water layer (epilimnion) and a lower, cold water layer (hypolimnion). When stratified, the epilimnetic and hypolimnetic waters do not mix, and the hypolimnion typically becomes anoxic (dissolved oxygen = 0 mg/l) by mid-summer. This phenomenon is a natural occurrence in deep lakes and is not necessarily a bad thing if enough of the lake volume remains oxygenated. During most of the summer, stratification in St. Mary's Lake was strongest at a depth of approximately 6-8 feet and hypoxia (DO<1.0 mg/l) began to occur at 10-12 feet. Since a current bathymetric map does not exist for St. Mary's Lake, it is impossible to know what volume of the lake lies below 10 feet.

The surface waters of St. Mary's Lake were well oxygenated during the summer, and dissolved oxygen (DO) concentrations did not fall below 5.0 mg/l (a level below which aquatic organisms become stressed) at any time during the study period. Hypolimnetic DO concentrations were below 1.0 mg/l from June-September. However, this is expected in a deep lake which stratifies, and, as mentioned above, is only a problem if too much of the water column becomes part of this anoxic volume.

Phosphorus is a nutrient that can enter lakes through runoff or be released from lake sediment, and high levels of phosphorus typically trigger algal blooms or produce high plant density. The average near surface phosphorus concentration in St. Mary's Lake was 0.075 mg/l, while the hypolimnetic average phosphorus concentration was 0.132 mg/l (Table 1, Appendix A). The epilimnetic concentration was well above the county median of 0.056 mg/l, while the hypolimnetic concentration was well below the county median of 0.170 mg/l. The hypolimnetic phosphorus concentration was nearly twice as high as the epilimnetic concentration. This is expected in a stratified lake. During stratification, oxygen is depleted (or nearly depleted) in the hypolimnion, triggering chemical reactions at the sediment surface. These reactions result in the release of phosphorus from the sediment into the water column and is known as internal phosphorus loading. Since the hypolimnion is thermally isolated from the epilimnion during the summer, phosphorus builds up in the bottom waters and does not reach the sunlit surface waters of the epilimnion until fall turnover. Unless external sources are significant, total phosphorus (TP) concentrations in the epilimnion can remain low, preventing surface algae blooms. However, this was not the case in St. Mary's Lake, as epilimnetic TP concentrations were relatively high. Fall turnover distributes the hypolimnetic phosphorus throughout the water column and can produce late season algae blooms. Fortunately, a large lake volume may dilute the redistributed phosphorus to a low enough concentration that no algae bloom occurs.

The average epilimnetic phosphorus concentration in 1995 (0.065 mg/l) was approximately 13% lower than in 2002 (0.075 mg/l), but monthly concentrations were relatively similar until September (Table 1, Appendix A). A large pulse of phosphorus was detected in the epilimnion in September 2002. The source of this phosphorus was not entirely clear. However, since the lake had not destratified, the source was likely external. Although 1.33 inches of rain had fallen a week prior to the September sampling, the summer of 2002 had been very dry, and much of the rain likely soaked into

the ground before ever reaching the lake. Therefore, nonpoint sources of phosphorus were probably insignificant. The main point source of water to St. Mary's Lake is Loch Lomond. The epilimnetic TP concentration in Loch Lomond during September 1999 was 0.356 mg/l (Table 2, Appendix A). This is an extremely high TP level and, since no phosphorus reduction efforts have been carried out on Loch Lomond since 1999, it can be assumed that 2002 TP concentrations were very similar. It is possible that water from Loch Lomond entered St. Mary's Lake during this rain event, increasing the epilimnetic TP concentration by over 40%. However, without adequate data regarding this event, the source and cause of the high September 2002 TP concentration can only be speculated. The average hypolimnetic TP concentration in 1995 (0.080 mg/l) was also lower (by 40%) than the average 2002 concentration (0.132 mg/l) (Table 1, Appendix A). The difference in the hypolimnetic phosphorus concentrations between the two years is believed to be the function of sampling at different depths. In 1995, samples were taken at a depth of 8-9 feet, where DO levels never fell below 3.0 mg/l. The 2002 samples were taken at 12-13 feet, depths which experienced near anoxia from June-September. As mentioned above, chemical reactions triggered by very low oxygen conditions cause phosphorus to be released from sediment into the hypolimnion. Therefore, is it not surprising that higher TP levels were detected at the deeper sampling site in 2002. A difference in sampling location and depth, rather than a difference in the amount of phosphorus being released from the sediment, is a possible reason for the TP variation between the two years.

Total suspended solids (TSS) is a measure of the amount of suspended material, such as algae or sediment, in the water column. High TSS values are typically correlated with poor water clarity and can be detrimental to many aspects of the lake ecosystem, including the plant and fish communities. A large amount of material in the water column can inhibit successful predation by sight-feeding fish, such as bass and pike, or settle out and smother fish eggs. High turbidity caused by sediment or algae can shade out native aquatic plants, resulting in their reduction or disappearance from the littoral zone. This eliminates the benefits provided by plants, such as habitat for many fish species and stabilization of the lake bottom. The average epilimnetic TSS concentration on St. Mary's Lake (11.8 mg/l) was nearly twice the median value for Lake County lakes (6.0 mg/l) and was very similar to the average TSS county concentration (11.9 mg/l). The relatively high TSS values resulted in low water clarity, as evidenced by lower than average Secchi depth measurements that coincided with high TSS concentrations (Figure 2). A strong relationship existed between TP and TSS concentrations, suggesting that as TSS increased, TP increased, and visa versa (Figure 3). In many lakes, this indicates that the source of TSS is algae. An increase in TP will cause an algae bloom, which causes an increase in TSS. However, in St. Mary's Lake, total volatile solids (TVS, a measure of organic matter, such as algae, in the water column) concentrations were not strongly correlated with TSS concentrations. This indicates that organic material did not make up much of the TSS in the water column. The relationship between TP and TSS may therefore indicate that clay particles with attached phosphorus (P) may have made up much of the TSS in the water column. As TSS in the water column increased, P attached to the clay particles making up the TSS was released into the water column, resulting in a corresponding increase in TP. A large European carp

population is present in St. Mary's Lake. These bottom-feeding fish can stir up a large amount of bottom sediment during feeding and spawning activities, and are likely contributing to the high density of clay and sediment particles in the water column. TSS concentrations have remained virtually unchanged when compared to 1995 TSS concentrations. The average TSS epilimnetic concentration decreased slightly (-3%) and the hypolimnetic concentration increased slightly (+8%) in 2002 (Table 1, Appendix A).

As a result of the high TP and TSS concentrations throughout the summer, Secchi depth (water clarity) on St. Mary's Lake was lower than the county median (3.81 feet) every month during the summer of 2002, and reached a minimum of 1.97 feet in September (Figures 2 & 4). The low Secchi depth, along with the steep-sided nature of St. Mary's Lake, contributed to the absence of an aquatic plant community. Average Secchi depth had increased slightly since 1995, but monthly readings were very similar between 1995 and 2002.

Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Conductivity has been shown to be highly correlated (in urban areas) with chloride ions found in road salt mixtures. Water bodies most subject to the impacts of road salts are streams, wetlands or lakes draining major roadways, and St. Mary's Lake receives runoff from Hwy. 45. Average 2002 epilimnetic and hypolimnetic conductivities (1.0272 mS/cm and 1.0436 mS/cm, respectively) had increased substantially (73%) since sampling in 1995 when averages were 0.5958 mS/cm and 0.6012 mS/cm, respectively. Because 2002 epilimnetic and hypolimnetic conductivities were much higher than the county averages (0.7570 mS/cm and 0.7994 mS/cm, respectively) throughout the summer, a chloride test was run on the water samples collected June-August 2002. Average chloride levels were found to be approximately 193 mg/l in both the epilimnion and hypolimnion. In a study by Environment Canada (equivalent to our USEPA), it was estimated that 5% of aquatic species such as fish, zooplankton and benthic invertebrates would be affected at chloride concentrations of about 210 mg/l. Additionally, shifts in algae populations in lakes were associated with chloride concentrations as low as 12 mg/l. Epilimnetic total dissolved solids (TDS) concentrations, which have also been shown to be correlated with conductivity, were well above the county average (449 mg/l) during every month of the study (Table 1, Appendix A). Conductivity changes can occur seasonally and even with depth, but over the long term, increased conductivity levels can be a good indicator of potential watershed or lake problems and an increase in pollutants entering the lake if the increasing trend is noted over a period of years. High conductivity levels (which often indicate an increase in sodium chloride) can eventually change the plant and algae community, as more salt tolerant plants and algae take over. Sodium and chloride ions can bind substances in the sediment, preventing their uptake by plants and reducing native plant densities. Additionally, juvenile aquatic organisms may be more susceptible to high chloride concentrations.

The increase in conductivity levels in St. Mary's Lake is most likely the result of a small amount of increased commercial development in the watershed of the lake and of potentially heavy winter salting of Hwy. 45. The high conductivity levels are cause for concern, but there may not be much that can be done about it. Non-point runoff, such as that which picks up road salt and enters the lake during rain events, is very difficult to control. It is unlikely that any control could be placed on the amount of road salt dispersed along Hwy. 45 each winter without policy changes in quantity or type of de-icer by the Illinois Department of Transportation.

Typically, lakes are either phosphorus (P) or nitrogen (N) limited. This means that one of these nutrients is in short supply relative to the other and that any addition of phosphorus or nitrogen to the lake might result in an increase of plant or algal growth. Other resources necessary for plant and algae growth include light or carbon, but these are typically not limiting. Most lakes in Lake County are phosphorus limited, but to compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than or equal to 10:1 indicate nitrogen is limiting. Ratios greater than or equal to 15:1 indicate that phosphorus is limiting. Ratios greater than 10:1, but less than 15:1 indicate that there are enough of both nutrients to facilitate excess algal or plant growth. St. Mary's Lake had an average TN:TP ratio of 18:1. This indicates that the lake is phosphorus limited and that an increase in phosphorus concentrations in the epilimnion could result in algae blooms in the future. As a result of higher TKN + NO_3^- concentrations in 2002 as compared to 1995, the average TN:TP ratio in 1995 was 16:1. Although TP increased in 2002 as well, TKN concentrations increased to a relatively greater degree, making the lake more phosphorus limited than it had been in 1995. Current water quality may not last if TP levels increase further, and care should be taken to maintain or reduce current TP concentrations as much as possible.

Phosphorus levels can also be used to indicate the trophic state (productivity level) of a lake. The Trophic State Index (TSI) uses phosphorus levels, chlorophyll *a* (algae biomass) levels and Secchi depth to classify and compare lake trophic states using just one value. The TSI is set up so that an increase in phosphorus concentration is related to an increase in algal biomass and a corresponding decrease in Secchi depth. A moderate TSI value (TSI=40-49) indicates mesotrophic conditions, typically characterized by relatively low nutrient concentrations, low algae biomass, adequate DO concentrations and relatively good water clarity. High TSI values indicate eutrophic (TSI=50-69) to hypereutrophic (TSI ≥70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO levels, a rough fish population, and low water clarity. St. Mary's Lake had an average phosphorus TSI (TSIp) value of 66.4, indicating eutrophic conditions. This means that the lake is an enriched system with relatively poor quality. The lake ranked 60th out of 103 lakes studied in Lake County. Although this is not a high ranking, it is not unusual for a man-made lake in Lake County. Most man-made lakes in this region fall into the eutrophic and hypereutrophic categories, while many of the glacial lakes and borrow pits rank higher (Table 3, Appendix A).

Most of the water quality parameters just discussed can be used to analyze the water quality of St. Mary's Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, St. Mary's Lake provides *Full* support of aquatic life and *Partial* support of swimming and recreational activities (such as boating) as a result of high TP and nonvolatile suspended solids (clay particles) in the water column. The lake provides *Partial* overall use.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See Appendix B for methodology). Shoreline plants of interest were also recorded. However, no quantitative surveys were made of these shoreline plant species and these data are purely observational). Light level was measured at one-foot intervals from the water surface to the lake bottom. When light intensity falls below 1% of the level at the water surface, plants are no longer able to grow. If a quality bathymetric map exists, this information can be used to determine how much of the lake has the potential to support aquatic plant growth. Based on 1% light level, St. Mary's Lake could have supported plants to a depth of 8.0 feet from May-July, a depth of 6.0 feet in August and a depth of 4.0 feet in September. However, due to the carp activity, the morphometry of the lake (very steep sided) and the hard, rocky substrate that makes up the lake bottom, no aquatic plants are present in St. Mary's Lake. Despite the absence of aquatic plants in St. Mary's Lake, a large number of upland plants and trees were observed along the shoreline. These plants and trees provide very valuable habitat for a large number of birds and other wildlife species and should be preserved as much as possible.

Table 4. Shoreline plants on St. Mary's Lake, May-September 2002.

Shoreline Plants	
Nodding Onion	*Allium cernuum*
Marsh Milkweed	*Asclepaias incaruta*
*Enchanters Nightshade	*Circaea lutetiana*
*Bull Thistle	*Cirsium vulgare*
Blue Flag Iris	*Iris hexagona*
Common Juniper	*Juniperus communis*
*Honeysuckle	*Lonicera* sp.
*Purple Loosestrife	*Lythrum salicaria*
*White Sweet Clover	*Meliotus alba*
Hop Hornbeam	*Ostrya virginiana*
Virginia Creeper	*Parthenocissus quinquefolia*
*Reed Canary Grass	*Phalaris arundinacea*
*Multiflora Rose	*Rosa multiflora*
Common Arrowhead	*Sagittaria latifolia*
Blue Vervain	*Verbena hastate*
*Wild Grape	*Vitis aestivalis*
Trees/Shrubs	
Box Elder	*Acer negundo*
Birch	*Betula* sp.
Shagbark Hickory	*Carya ovata*
Honey Locust	*Gelditsia triacanthos*
Black Walnut	*Juglans nigra*
Mulberry	*Morus* sp.
Ash	*Oleaceae* sp.
Blue Spruce	*Picea pungens*
White Pine	*Pinus strous*
*Scotch Pine	*Pinus sylvestris*
White Poplar	*Populus alba*
Wild Black Cherry	*Prunus serotina*
Bur Oak	*Quercus macrocarpa*
Pin Oak	*Quercus palustris*
Red Oak	*Quercus rubra*
*Common Buckthorn	*Rhamnus cathartica*
Sumac	*Rhus* sp.
Black Locust	*Robinia pseudoacacia*
Willow	*Salix* sp.
White Cedar	*Taxodium occidentalis*
Basswood	*Tilia americana*
Elderberry	*Sambucus* sp.
American Elm	*Ulmus Americana*
Wisteria	*Wisteria frutescens*

*Exotic plant or tree species

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at St. Mary's Lake on August 1, 2002. The shoreline was assessed for a variety of criteria (See Appendix B for methods), and based on these assessments, several important generalizations could be made. Approximately 34% of St. Mary's Lake's shoreline is developed and the majority of the developed shoreline is comprised of lawn (42.1%), rip rap (29.5%) and seawall (14.4%) (Figure 5). The remainder of the developed shoreline consists of woodland (11.4%) and buffer (2.6%). The undeveloped portions of the lake are primarily woodland and a small amount of rip rap and lawn. Manicured lawn is considered undesirable because it provides a poor shoreline-water interface due to the poor root structure of turf grasses. These grasses are incapable of stabilizing the shoreline and typically lead to erosion. Ninety-eight percent of the lawn around St. Mary's Lake was slightly to severely eroded. Although riprap is not an appealing shoreline type with regard to wildlife habitat, it does help to prevent shoreline erosion if it is properly installed and maintained. The riprap along St. Mary's Lake was not properly installed with filter fabric and has not been maintained over time. As a result, 41.8% of the rip rapped shoreline was exhibiting slight erosion. Typically, buffer and woodland are ideal shoreline types because they prevent shoreline erosion, as well as provide wildlife habitat. However, if these types of shoreline are not properly maintained, and exotic plant or tree species such as buckthorn are allowed to colonize, buffered and woodland shorelines can succumb to erosion. Thirty five percent of the wooded shoreline around St. Mary's Lake had slight to severe erosion along it. Although buffer did not make up a large percentage of total shoreline (0.9%), 100% of the buffered shoreline was exhibiting slight to moderate erosion (Figure 6). As a result of large areas of unmaintained woodland and the moderate amount of manicured lawn, 43% of St. Mary's Lake's shoreline was exhibiting erosion of some degree. Buffer and woodland shorelines should be improved and maintained as much as possible with re-grading and removal of some or all of the exotic plant and tree species. Additionally, old, deteriorating riprap and manicured lawn areas should be removed and replaced with new riprap (properly installed with filter fabric) or a buffer of native plants.

Dramatic water level fluctuation can increase shoreline erosion, especially if the fluctuations occur over short periods of time. The water level in St. Mary's Lake did not vary by more than 0.61 feet throughout the summer. Erosion occurs when water levels drop and newly exposed soil, which may not support emergent plant growth, is subjected to wave action. However, at this time, there does not appear to be a problem with significant lake level fluctuations in St. Mary's Lake.

Invasive plant and tree species, including wild grape, enchanters nightshade, bull thistle, honeysuckle, multiflora rose, white sweet clover, reed canary grass, purple loosestrife, scotch pine and common buckthorn were present along 88.1% of the shoreline. These plants and trees are extremely invasive and exclude native plants from the areas they inhabit. Buckthorn and honeysuckle provide very poor shoreline stabilization and may lead to increasing erosion problems in the future. Reed canary grass and purple loosestrife inhabit mostly wetland areas and can easily outcompete native plants.

Additionally, they do not provide the quality wildlife habitat or shoreline stabilization that native plants provide. Steps to eliminate these plant and tree species should be carried out in order to reduce shoreline erosion and enhance the wildlife habitat already present around St. Mary's Lake.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

A fish survey by the Illinois Department of Natural Resources (IDNR) has never been conducted on St. Mary's Lake. According to lake managers at the Mundelein Seminary, no official stocking of any kind has ever taken place. An unofficial report of the type of fish caught by Tim Cook of the Lake County Stormwater Management Commission, who fishes St. Mary's Lake on a regular basis, include channel catfish, blue catfish, crappie, European carp and largemouth bass. The report that blue catfish, a non-native fish in Lake County, have been caught in St. Mary's Lake indicates that the lake has been stocked by some interested party other than the Mundelein Seminary. Tim reported that he typically fishes for bass in the lake and that the largemouth bass population is very healthy. The population includes fish of sizes ranging from quite small to ten pounds.

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See Appendix B for methodology). As a result of the dominance of woodland around the entire perimeter of St. Mary's Lake, a very large number of wildlife species were observed, including the Illinois endangered black-crowned night heron (which may be nesting on the lake) and osprey (Table 5). It is, therefore, very important that the woodland and buffer areas around the lake be improved and maintained to provide the appropriate habitat for birds and other animals in the future. It is also important that eroded areas of manicured lawn establish a buffer strip of native plants to provide additional habitat and reduce the possibility of additional erosion.

Table 5. Wildlife species observed at St. Mary's Lake, May-September 2002.

<u>*Birds*</u>	
Double-crested Cormorant	*Phalacrocorax auritus*
Canada Goose	*Branta canadensis*
Caspian Tern	*Sterna caspia*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Black-crowned Night Heron*	*Nycticorax nycticorax*
Spotted Sandpiper	*Actitis macularia*
Red-tailed Hawk	*Buteo jamaicensis*
Osprey*	*Pandion haliaetus*
Belted Kingfisher	*Megaceryle alcyon*
Red-bellied Woodpecker	*Melanerpes carolinus*
Downy Woodpecker	*Picoides pubescens*

*Endangered in Illinois

Table 5. Wildlife species observed at St. Mary's Lake, May-September 2002 (cont'd).

Hairy Woodpecker	*Picoides villocus*
Great Crested Flycatcher	*Myiarchus crinitus*
Barn Swallow	*Hirundo rustica*
Tree Swallow	*Iridoprocne* bicolor
Rough-wing Swallow	*Stelgidopteryx ruficollis*
Chimney Swift	*Chaetura pelagica*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Black-capped Chickadee	*Poecile atricapillus*
White-Breasted Nuthatch	*Sitta carolinensis*
House Wren	*Troglodytes aedon*
Catbird	*Dumetella carolinensis*
American Robin	*Turdus migratorius*
Cedar Waxwing	*Bombycilla cedrorum*
Red-eyed Vireo	*Vireo olivaceus*
Warbling Vireo	*Vireo gilvus*
Black-throated Green Warbler	*Dendroica virens*
Yellow-rumped Warbler	*Dendroica coronata*
Red-winged Blackbird	*Agelaius phoeniceus*
Brown-headed Cowbird	*Molothrus ater*
Common Grackle	*Quiscalus quiscula*
Scarlet Tanager	*Piranga olivacea*
House Sparrow	*Passer domesticus*
Northern Cardinal	*Cardinalis cardinalis*
Rose-breasted Grosbeak	Pheucticus ludovicianus
House Finch	Carpodacus mexicanus
American Goldfinch	*Carduelis tristis*
Indigo Bunting	*Passerina cyanea*
Mammals	
Eastern Chipmunk	*Tamias striatus*
Fox Squirrel	*Sciurus niger*
White-tailed Deer	*Odocoileus virginianus*
Amphibians	
American Toad	*Bufo americanus*
Bull Frog	*Rana catesbeiana*

EXISTING LAKE QUALITY PROBLEMS

- *Lack of Participation in the Volunteer Lake Monitoring Program (VLMP)*

  In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) was established by the Illinois Environmental Protection agency (Illinois EPA) to gather fundamental information on Illinois inland lakes, and to provide an educational program for citizens. Annually, 150-200 lakes (out of 3,041 lakes in Illinois) are sampled by approximately 250 citizen volunteers. The volunteers are primarily lake shore residents, lake owners/managers, members of environmental groups, public water supply personnel, and citizens with interest in a particular lake. The establishment of a VLMP on St. Mary's Lake would provide valuable historical data and enable lake managers to create baseline information and then track the improvement or decline of lake water quality over time.

- *Lack of a Quality Bathymetric Map*

  A bathymetric (depth contour) map is an essential tool in effective lake management, especially if the long term lake management plan includes intensive treatments, such as fish stocking, dredging, chemical application or alum application. The most recent bathymetric map of St. Mary's Lake was created in 1960 and does not include morphometric data. Morphometric data obtained in the creation of a bathymetric map is necessary for calculation of equations for correct application of many types of treatments. It is also necessary to determine the volume of water affected by low DO levels.

- *Lack of Aquatic Vegetation*

  One key to a healthy lake is a healthy aquatic plant community. Lack of a significant littoral zone, poor substrate for plant growth, carp activity and relatively low water clarity contribute to the complete absence of plants in St. Mary's Lake. The absence of plants, in turn, reduces the water clarity even further because sediment stabilization is not provided. Plants provide many benefits to a lake ecosystem, including stabilizing bottom sediment, providing habitat for fish, and competing with algae for resources. Without plants, St. Mary's Lake is turbid and may not support a diverse and healthy sport fish population. However, even if water clarity is increased, the lake may never support plants. The sediment is very hard and rocky along the shoreline, and the lake is very steep-sided, dropping off to a depth of six feet within 10 feet of the shore in some areas. Additionally, it appears that the lake has no aquatic plant seed bank to speak of. In several of the small bays of the lake, depth and sediment conditions are much more conducive to plant growth and LMU staff expected to find a plant community in these bays. However, aquatic plants were absent from these areas as well. It might be worthwhile to attempt emergent or submersed aquatic plant revegetation in these areas, but it is unlikely that the plants will spread into the main lake. At this time, there are no control recommendations regarding the plant community in St. Mary's Lake, but aquatic plant revegetation is highly recommended in appropriate areas.

- *Carp*

It appears that common carp dominate the fish community in St. Mary's Lake. This fish species reproduces at a high rate and its spawning and feeding activities disturb bottom sediment. The presence of these fish in St. Mary's Lake is contributing to high TSS and TP levels, as well as very low Secchi depths, and, most likely, the lack of aquatic plants. A fish assessment should be conducted to determine the diversity and health of the fish community and to obtain an estimate of the size of the current carp population.

- *Shoreline Erosion*

Approximately 44% of the shoreline along St. Mary's Lake was exhibiting slight to severe erosion that was mostly concentrated along unmaintained wooded areas and manicured lawn. As mentioned above, manicured lawn provides poor shoreline stabilization due to its shallow root structure and it is not uncommon to see significant erosion along this type of shoreline. Buffered shoreline is much more desirable than manicured lawn and should replace lawn wherever possible. Wooded areas can provide exceptional wildlife habitat and, if maintained properly, erosion control. However, if the slope is steep or if these areas are not maintained, severe erosion can occur. Deciduous trees present along these shorelines have very large roots that are also unable to stabilize soil as well as native grasses and plants. If these trees become so large that they shade out all understory plants (whose roots provide the best stabilization) beneath them, the shoreline will become eroded.

- *Invasive Shoreline Plant Species*

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. The outcome is a loss of plant and animal diversity. Purple loosestrife is responsible for the "sea of purple" seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. A relatively large number of exotic species, including purple loosestrife and buckthron are present along 88.1% of the shoreline of St. Mary's Lake and attempts should be made to control their spread.

POTENTIAL OBJECTIVES FOR THE ST. MARY'S LAKE MANAGEMENT PLAN

I. Create a Bathymetric Map, Including a Morphometric Table
II. Participate in the Volunteer Lake Monitoring Program
III. Re-vegetate With Native Aquatic Plants
IV. Control Excessive Number of Carp
V. Conduct a Fisheries Assessment
VI. Control Shoreline Erosion
VII. Eliminate or Control Exotic Species

Objective I: Create a Bathymetric Map, Including a Morphometric Table

A bathymetric (depth contour) map is an essential tool in effective lake management since it provides information on the morphometric features of the lake, such as depth, surface area, volume, etc. The knowledge of this morphometric information would be necessary if lake management treatments such as fish stocking, dredging, alum application or aeration were part of the overall lake management plan. St. Mary's Lake does have a bathymetric map. However, it is outdated (1960), may not accurately represent the lake features, and does not include morphometric data (which are pertinent for certain calculations). Maps can be created by the Lake County Health Department – Lake Management Unit or other agencies for costs that vary from $3,000-$10,000, depending on lake size.

Objective II: Participate in the Volunteer Lake Monitoring Program

In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) was established by the Illinois Environmental Protection agency (Illinois EPA) to gather fundamental information on Illinois inland lakes, and to provide an educational program for citizens. Annually, 150-200 lakes (out of 3,041 lakes in Illinois) are sampled by approximately 250 citizen volunteers. The volunteers are primarily lake shore residents, lake owners/managers, members of environmental groups, public water supply personnel, and citizens with interest in a particular lake.

The VLMP relies on volunteers to gather a variety of information on their chosen lake. The primary measurement is Secchi disk transparency or Secchi depth. Analysis of the Secchi disk measurement provides an indication of the general water quality condition of the lake, as well as the amount of usable habitat available for fish and other aquatic life.

Microscopic plants and animals, water color, and suspended sediments are factors that interfere with light penetration through the water column and lessen the Secchi disk depth. As a rule, one to three times the Secchi depth is considered the lighted or photic zone of the lake. In this region of the lake there is enough light to allow plants to survive and produce oxygen. Water below the lighted zone can be expected to have little or no dissolved oxygen. Other observations such as water color, suspended algae and sediment, aquatic plants, and odor are also recorded. The sampling season is May through October with volunteer measurements taken twice a month. After volunteers have completed one year of the basic monitoring program, they are qualified to participate in the Expanded Monitoring Program. In the expanded program, selected volunteers are trained to collect water samples that are shipped to the Illinois EPA laboratory for analysis of total and volatile suspended solids, total phosphorus, nitrate-nitrite nitrogen and ammonia-nitrogen. Other parameters that are part of the expanded program include dissolved oxygen, temperature, and zebra mussel monitoring. Additionally, chlorophyll *a* monitoring has been added to the regiment of selected lakes. These water quality parameters are routinely measured by lake scientists to help determine the general health of the lake ecosystem.

For more information about the VLMP contact the VLMP Regional Coordinator:

Holly Hudson
Northeast Illinois Planning Commission
222 S. Riverside Plaza, Suite 1800
Chicago, IL 60606
(312) 454-0401 ext. 302

Objective III: Re-vegetate With Native Aquatic Plants

A healthy native plant population can reduce algal growth and sediment resuspension. Many lakes with long-standing turbidity problems have a very sparse plant population or none at all. This is due to reduction in light penetration brought about by years of excessive algal blooms and/or sediment resuspension. Revegetation should only be done when existing high turbidity conditions are under control or areas of the lake exist that would be suitable for revegetation. If the lake has poor clarity due to excessive algal growth or turbidity, these problems must be addressed before a revegetation plan is undertaken. Without adequate light penetration, revegetation will not work. At maximum, planting depth light levels must be greater than 1-5% of the surface light levels for plant growth and photosynthesis. If aquatic herbicides are being used to control what vegetation does exist there use should be scaled back or abandoned all together. This will allow the vegetation to grow back, which will help in controlling the algae in addition to other positive impacts associated with a healthy plant population.

There are two methods by which reestablishment can be accomplished. The first is use of existing plant populations to revegetate other areas within the lake. Plants from one part of the lake are allowed to naturally expand into adjacent areas thereby filling the niche left by the nuisance algae. Another technique utilizing existing plants is to transplant vegetation from one area to another. Since there are currently no plants present in St. Mary's Lake, this would not be a possibility. The second method of reestablishment is to import native plants from an outside source. A variety of plants can be ordered from nurseries that specialize in native aquatic plants. These plants are available in several forms such as seeds, roots, and small plants. These two methods can be used in conjunction with one another in order to increase both quantity and biodiversity of plant populations. Additionally, plantings must be protected from herbivory by waterfowl and other wildlife. Simple cages made out of wooden or metal stakes and chicken wire should be erected around planted areas for at least one season. The cages can be removed once the plants are established and less vulnerable. If large-scale revegetation is needed it would be best to use a consultant to plan and conduct the restoration. Table 6 (Appendix A) lists common, native plants that should be considered when developing a revegetation plan. Included in this list are emergent shoreline vegetation (rushes, cattails, etc) and submersed aquatic plants (pondweeds, *Vallisneria*, etc). Prices, planting depths, and planting densities are included and vary depending on plant species. Table 7 (Appendix A) lists a number of local nurseries that provide these types of plants to consumers.

Pros

By revegetating open areas, the lake will benefit in several ways. Once established, expanded native plant populations will help to control growth of nuisance algae by shading and competition for resources. This provides a more natural approach as compared to other management options. Expanded native plant populations will also help with sediment stabilization. This in turn will have a positive effect on water clarity by reducing suspended solids and nutrients that decrease clarity and cause excessive algal growth. Properly revegetating shallow water areas with plants such as cattails, bulrushes, and water lilies can help reduce wave action that can lead to shoreline erosion. Increases in desirable vegetation will increase the plant biodiversity and also provide better quality habitat and food sources for fish and other wildlife. Recreational uses of the lake such as fishing and boating will also improve due to the improvement in water quality.

Cons

There are few negative impacts to revegetating a lake. One possible drawback is the possibility of new vegetation expanding to nuisance levels and needing control. However, this is an unlikely outcome, especially in St. Mary's Lake where it is unlikely that plants will spread into the main body of the lake from the bays. Another drawback could be high costs if extensive revegetation is needed using imported plants. If a consultant were used costs would be substantially higher. Additional costs could be associated with constructing proper herbivory protection measures.

Costs

Table 6 (Appendix A) lists plants specific to different areas of the littoral zone, and includes prices for seeds and plant plugs and rates of application. Table 7 (Appendix A) provides a list of companies and nurseries in the vicinity of Lake County that sell the types of plants listed in Table 6. Residents on Lake Linden in Lindenhurst have had very good success in planting emergent plant species along several areas of shoreline. Through correspondence with one of the residents there, it was determined that the cost for building 10 cages to protect the plants was $300. Mesh cloth was purchased at $18 per 50 feet and 4x8 foot cages were built. Posts to which the cloth was attached cost $1 per post and were placed every four feet along the shoreline. The residents at Lake Linden chose to plant arrowhead, blue flag iris and pickerelweed and paid $3.50 per plant plug and $170 per seed bag. Despite using cages, there has still been some disturbance by raccoons and muskrats and the Lake Linden residents have found that there is less predation on blue flag iris than on arrowhead or pickerelweed. The above-mentioned prices are to serve merely as an estimate of cost as prices may differ depending on plant species, on the choice of seed or plant plugs and on the vendor used.

Objective IV: Control Excessive Number of Carp

A frequent problem that plagues many of the lakes in the County is the presence of common carp (*Cyprinus carpio*). Common carp were first introduced into the United States from Europe in the early 1870's, and were first introduced into Illinois river systems in 1885 to improve commercial fishing. The carp eventually made their way into many inland lakes and are now so wide spread that many people do not realize that they are not native to the U.S.

Carp prefer warm waters in lakes, streams, ponds, and sloughs that contain high levels of organic matter. This is indicative of many lakes in Lake County. Carp feed on insect larvae, crustaceans, mollusks, and even small fish by rooting through the sediment. Immature carp feed mainly on small crustaceans. Because their feeding habits cause a variety of water quality problems, carp are very undesirable in lakes. Rooting around for food causes resuspension of sediment and nutrients, which can both lead to increased turbidity. Additionally, spawning, which occurs near shore in shallow water, can occur from late April until June. The spawning activities of carp can be violent, further contributing to turbidity problems. Adult carp can lay between 100,000 –500,000 eggs, which hatch in 5-8 days. Initial growth is rapid with young growing 4 ¾" to 5" in the first year. Adults normally range in size from 1-10 lbs., with some as large as 60 lbs. Average carp lifespan is 7-10 years, but they may live up to 15 years.

There are several techniques to remove carp from a lake. However, rarely does any technique completely eradicate carp from a lake. Commonly, once a lake has carp, it has carp forever. However, it is up to the management entity to dictate how big the problem is allowed to become. Rotenone is the only reliable piscicide (fish poison) on the market at this time, but it kills all fish that is comes into contact with. Currently, there is a rotenone laced baiting system that can selectively remove carp. While the process is a step in the right direction, several factors still need to be worked out in order for it to be a viable alternative to the whole lake treatment. Until this baiting technique is further developed and produces consistent results, it is not being recommended by the LMU.

Option 1: No Action

By following a no action management approach, nothing would be done to control the carp population of the lake. Populations will continue to expand and reach epidemic proportions if they do not already exist.

Pros

There are very few positive aspects to following a no action plan for excessive carp populations. The only real advantage would be the money saved by taking no action.

Cons

There are many negative aspects to a no action management plan for carp management. The feeding habits of carp cause most of the associated problems. As carp feed they root around in the lake sediment. This causes resuspension of sediment and nutrients. Increased nutrient levels can lead to increased algal blooms, which, combined with resuspended sediment, lead to increased turbidity (reduced clarity). Additionally, the fishery of the lake may decline and/or become stunted due to predation issues related to decreased water clarity and loss of habitat. Other wildlife, such as waterfowl, which commonly forage on aquatic plants and fish, would also be negatively impacted by the decrease in vegetation.

Costs
There is no cost associated with the no action option.

Option 2: Rotenone

Rotenone is a piscicide that is naturally derived from the stems and roots of several tropical plants. Rotenone is approved for use as a piscicide by the USEPA and has been used in the U.S. since the 1930's. It is biodegradable (breaks down into CO_2 and H_2O) and there is no bioaccumulation. Because rotenone kills fish by chemically inhibiting the use of oxygen in biochemical pathways, adult fish are much more susceptible than fish eggs (carp eggs are 50 times more resistant). Other aquatic organisms are less sensitive to rotenone. However, some organisms are effected enough to reduce populations for several months. In the aquatic environment, fish come into contact with the rotenone by a different method than other organisms. With fish, the rotenone comes into direct contact with the exposed respiratory surfaces (gills), which is the route of entry. In other organisms this type of contact is minimal. More sensitive nonfish species include frogs and mollusks but these organisms typically recover to pretreatment levels within a few months. Rotenone has low mammalian and avian toxicity. For example, if a human consumed fish treated with normal concentrations of rotenone, approximately 8,816 lbs. of fish would need to be eaten at one sitting in order to produce toxic effects. Furthermore, due to its unstable nature, it is unlikely that the rotenone would still be active at the time of consumption. Additionally, warm-blooded mammals have natural enzymes that would break down the toxin before it had any effects.

Rotenone is available in 5% and 2.5% concentrations. Both concentrations are available as synergized formulations. The synergist (piperonal butoxide) is an additive that inhibits fish detoxification of rotenone, making the rotenone more effective. Rotenone has varying levels of toxicity on different fish species. Some species of fish can detoxify rotenone quicker than it can build up in their systems. Unfortunately, concentrations to remove undesirable fish, such as carp, bullhead and green sunfish, are high enough to kill more desirable species such as bass, bluegill, crappie, walleye, and northern pike. Therefore, it is difficult to selectively remove undesirable fish while leaving desirable ones. Typically, rotenone is used at concentrations from 2 ppm (parts per million) – 12 ppm. For removal of undesirable fish (carp, bullhead and green sunfish) in lakes with alkalinities in the range found in Lake County, the target concentration should be 6 ppm. Sometimes concentrations will need to be increased based on high alkalinity and/or high turbidity. Rotenone is most effectively used when waters are cooling down (fall) not warming up (spring) and is most effective when water temperatures are $<50^{o}$F. Under these conditions, rotenone is not as toxic as in warmer waters but it breaks down slower and provides a longer exposure time. If treatments are done in warmer weather they should be done before spawn or after hatch as fish eggs are highly tolerant to rotenone.

Rotenone rarely kills every fish (normally 99-100% effective). Some fish can escape removal and rotenone retreatment needs to occur about every 10 years. At this point in time, carp populations will have become reestablished due to reintroduction and reproduction by fish that were not removed during previous treatment. To ensure the best results, precautions can be taken to assure a higher longevity. These precautions include banning live bait fishing (minnows bought from bait stores can contain carp) and making sure every part of the lake is treated (i.e.,, cattails, inlets, and harbored shallow areas). Restocking of desirable fish species may occur about 30-50 days after treatment when the rotenone concentrations have dropped to sub-lethal levels. Since it is best to treat in the fall, restocking may not be possible until the following spring. To use rotenone in a body of water over 6 acres a *Permit to Remove Undesirable Fish* must be obtained from the Illinois Department of Natural Resources (IDNR), Natural Heritage Division, Endangered and Threatened Species Program. Furthermore, only an IDNR fisheries biologist licensed to apply aquatic pesticides can apply rotenone in the state of Illinois as it is a restricted use pesticide.

Pros

Rotenone is one of the only ways to effectively remove undesirable fish species. This allows for rehabilitation of the lake's fishery, which will allow for improvement of the aquatic plant community, and overall water quality. By removing carp, sediment will be left largely undisturbed. This will allow aquatic plants to grow and help further stabilize the sediment. As a result of decreased carp activity and increased aquatic plant coverage, fewer nutrients will be resuspended, greatly reducing the likelihood of nuisance algae blooms and associated dissolved oxygen problems. Additionally, reestablishment of aquatic plants will have other positive effects on lake health and water quality, and will increase fish habitat and food source availability for wildlife such as waterfowl.

Cons

There are no negative impacts associated with removing excessive numbers of carp from a lake. However, in the process of removing carp with rotenone, other desirable fish species will also be removed. The fishery can be replenished with restocking and quality sport fishing normally returns within 2-3 years. Other aquatic organisms, such as mollusks, frogs, and invertebrates (insects, zooplankton, etc.), are also negatively impacted. However, this disruption is temporary and studies show that recovery occurs within a few months. Furthermore, the IDNR will not approve application of rotenone to waters known to contain threatened and endangered fish species. Another drawback to rotenone is the cost. Since the whole lake is treated and costs per gallon range from $50.00 - $75.00, total costs can quickly add up. This can be off-set with lake draw down to reduce treatment volume. Unfortunately, draw down is not an option on all lakes. An additional problem for St. Mary's Lake is possible reinvasion of carp from Loch Lomond. Steps to prevent carp from entering St. Mary's Lake from

Loch Lomond through the creek inlet would have to be taken after rotenone treatment of St. Mary's Lake.

Costs

As with most intensive lake management techniques, a good bathymetric map is needed so that an accurate lake volume can be determined. To achieve a concentration of 6 ppm, which is the rate needed for most total rehabilitation projects (remove carp, bullhead and green sunfish), 2.022 gal/AF is required.

(Lake volume in Acre Feet)(2.022 gallons) = Gallons needed to treat lake
(951.3 acre feet)(2.022 gallons) = 1923.5 gallons

(Gallons needed)(Cost/gallon*) = Total cost
(1923.5 gallons)($50-$75) = $96,176-$144,265

*Cost/gallon = $50-75 range

In waters with high turbidity and/or planktonic algae blooms, such as St. Mary's Lake, the ppm concentration may have to be higher. An IDNR fisheries biologist will be able to determine if higher concentrations will be needed.

Objective V: Conduct a Fisheries Assessment

Many lakes in Lake County have a fish stocking program in which fish are stocked every year or two to supplement fish species already occurring in the lake or to introduce additional fish species into the system. However, very few lakes that participate in stocking check the progress or success of these programs with regular fish surveys. Lake managers should have information about whether or not funds delegated to fish stocking are being well spent, and it is very difficult to determine how well stocked fish species are surviving and reproducing or how they are affecting the rest of the fish community without a comprehensive fish assessment. Officially, St. Mary's Lake has not been stocked by the Mundelein Seminary. However, unofficial reports of blue catfish and channel catfish being caught in the lake suggest that someone with a vested fishing interest has stocked fish in the lake without the permission of lake managers. In order to determine what species of fish have been stocked without the knowledge of the Mundelein Seminary and to determine the relative size of the carp population in St. Mary's Lake, it is highly recommended that a fish assessment is carried out.

A simple, inexpensive way to derive direct information on the status of a fishery is to sample anglers and evaluate the types, numbers and sizes of fish caught by anglers actively involved in recreational fishing on the lake. Such information provides insight on the status of fish populations in the lake, as well as a direct measure of the quality of fishing and the fishing experience. However, the numbers and types of fish sampled by anglers are limited, focusing on game and large, catchable-sized fish. Thus, in order to obtain a comprehensive assessment of the fish community status, including non-game fish species, more quantitative methods must be employed. These include gill netting, trap netting, seining, trawling, angling (hook and line fishing) and electroshocking. Each method has its advantages and limitations, and frequently multiple gear and approaches are employed. The best gear and sampling methods depend on the target fish species and life stage, the types of information desired and the environment to be sampled. The table below lists examples of suitable sampling gear for collecting adults and young of the year (YOY) of selected fish species in lakes.

Typically, fish populations are monitored at least annually. The best time of year depends on the sampling method, the target fish species and the types of data to be collected. In many lakes and regions, the best time to sample fish is during the fall turnover period after thermal stratification breaks down and the lake is completely mixed because (1) YOY and age 1+ (one year or older) fish of most target species should be present and vulnerable to most standard collection gear, including seines, trap nets and electroshockers; (2) species that dwell in the hypolimnion during the summer may be more vulnerable to capture during fall overturn; and (3) lower water temperatures in the fall can help reduce sampling-related mortality. Sampling locations are also species-, life stage-, and gear-dependent. As with sampling methods and time, locations should be selected to maximize capture efficiency for the target species of interest and provide the greatest gain in information for the least amount of sampling effort.

The Illinois Department of Natural Resources (IDNR) will perform a fish survey at no charge on most public and some private water bodies. In order to determine if your lake is eligible for a survey by the IDNR, contact Frank Jakubecik, Fisheries Biologist at (815) 675-2319. If a lake is not eligible for an IDNR fish survey, or if a more comprehensive survey is desired, two known consulting firms have previously conducted fish surveys in Lake County: EA Engineering, Deerfield, IL, (847) 945-8010 and Richmond Fisheries, Richmond, IL, (815) 675-6545.

		GEAR[a]	
TAXON	**FISH LIFE STAGE**	**STANDARD**	**SUPPLEMENTAL**
Trout, salmon, whitefish, char (except lake trout)	YOY Adult	Electrofishing Trap nets	Gill nets, trawls, seine Gill nets, electrofishing (F)
Lake trout	YOY Adult	Electrofishing (F) Trap nets (F)	Seine (F), trawls
Pike, pickerel, muskellange	YOY Adult	Seine (Su) Trap nets (S), gill nets (S,F)	
Catfish, bullheads	YOY Adult	Seine Gill nets, trap nets[b]	Baited traps Slat nets, angling
Bass, sunfish, crappie	YOY Adult	Seine, electrofishing Electrofishing	 Trap nets, angling
Minnows, carp, dace, chub, shiners	YOY Adult	Electrofishing Electrofishing	Seine Seine
Yellow perch	YOY Adult	Seine (Su), electrofishing Gill net, trap net	Trawls (S)
Walleye	YOY Adult	Seine (S), electrofishing Trap nets (S), gill nets (S, F), electrofishing (S, F)	Trawls (S)

[a]Letter codes indicate seasonal restrictions on gear use to the spring (S), summer (Su), or fall (F).
[b]Bullheads only.

Objective VI: Control Shoreline Erosion

Erosion is a potentially serious problem to lake shorelines and occurs as a result of wind, wave, or ice action or from overland rainwater runoff. While some erosion to shorelines is natural, human alteration of the environment can accelerate and exacerbate the problem. Erosion not only results in loss of shoreline, but negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. This effect is felt throughout the food chain since poor water quality negatively affects everything from microbial life to sight feeding fish and birds to people who want to use the lake for recreational purposes. The resulting increased amount of sediment will over time begin to fill in the lake, decreasing overall lake depth and volume and potentially impairing various recreational uses.

<u>Option 1: No Action</u>

Pros

There are no short-term costs to this option. However, extended periods of erosion may result in substantially higher costs to repair the shoreline in the future.

Eroding banks on steep slopes can provide habitat for wildlife, particularly bird species (e.g. kingfishers and bank swallows) that need to burrow into exposed banks to nest. In addition, certain minerals and salts in the soils are exposed during the erosion process, which are utilized by various wildlife species.

Cons

Taking no action will most likely cause erosion to continue and subsequently may cause poor water quality due to high levels of sediment or nutrients entering a lake. This in turn may retard plant growth and provide additional nutrients for algal growth. A continual loss of shoreline is both aesthetically unpleasing and may potentially reduce property values. Since a shoreline is easier to protect than it is to rehabilitate, it is in the interest of the property owner to address the erosion issue immediately.

Costs

In the short-term, cost of this option is zero. However, long-term implications can be severe since prolonged erosion problems may be more costly to repair than if the problems were addressed earlier. As mentioned previously, long-term erosion may cause serious damage to shoreline property and in some cases lower property values.

Option 2: Create a Buffer Strip

Another effective method of controlling shoreline erosion is to create a buffer strip with existing or native vegetation. Native plants have deeper root systems than turfgrass and thus hold soil more effectively. Native plants also provide positive aesthetics and good wildlife habitat. Cost of creating a buffer strip is quite variable, depending on the current state of the vegetation and shoreline and whether vegetation is allowed to become established naturally or if the area needs to be graded and replanted. Allowing vegetation to naturally propagate the shoreline would be the most cost effective, depending on the severity of erosion and the composition of the current vegetation. Non-native plants or noxious weedy species may be present and should be controlled or eliminated. Additionally, trees may need to be thinned along the wooded shorelines of St. Mary's Lake to allow shade intolerant plants to become established in areas where they can help prevent erosion.

Stabilizing the shoreline with vegetation is most effective on slopes no less than 2:1 to 3:1, horizontal to vertical, or flatter. Usually a buffer strip of at least 25 feet is recommended, however, wider strips (50 or even 100 feet) are recommended on steeper slopes or areas with severe erosion problems. Areas where erosion is severe or where slopes are greater than 3:1, additional erosion control techniques may have to be incorporated such as biologs, A-Jacks®, or rip-rap.

Buffer strips can be constructed in a variety of ways with various plant species. Generally, buffer strip vegetation consists of native terrestrial (land) species and emergent (at the land and water interface) species. Terrestrial vegetation such as native grasses and wildflowers can be used to create a buffer strip along lake shorelines. A table in Appendix A gives some examples, seeding rates and costs of grasses and seed mixes that can be used to create buffer strips. Native plants and seeds can be purchased at regional nurseries or from catalogs. When purchasing seed mixes, care should be taken that native plant seeds are used. Some commercial seed mixes contain non-native or weedy species or may contain annual wildflowers that will have to be reseeded every year. If purchasing plants from a nursery or if a licensed contractor is installing plants, inquire about any guarantees they may have on plant survival. Finally, new plants should be protected from herbivory (e.g., geese and muskrats) by placing a wire cage over the plants for at least one year.

A technique that is sometimes implemented along shorelines is the use of willow posts, or live stakes, which are harvested cuttings from live willows (*Salix* spp.). They can be planted along the shoreline along with a cover crop or native seed mix. The willows will resprout and begin establishing a deep root structure that secures the soil. If the shoreline is highly erodible, willow posts may have to be used in conjunction with another erosion control technique such as biologs, A-Jacks ®, or rip-rap.

Emergent vegetation, or those plants that grow in shallow water and wet areas, can be used to control erosion more naturally than seawalls or rip-rap. Native emergent vegetation can be either hand planted or allowed to become established on its own over time. Some plants, such as native cattails (*Typha* sp.), quickly spread and help stabilize shorelines, however they can be aggressive and may pose a problem later. Other species, such as those listed in a Table 6, Appendix A should be considered for native plantings.

Pros

Buffer strips can be one of the least expensive means to stabilize shorelines. If no permits or heavy equipment are needed (i.e., no significant earthmoving or filling is planned), the property owner can complete the work without the need of professional contractors. Once established (typically within 3 years), a buffer strip of native vegetation will require little maintenance and may actually reduce the overall maintenance of the property, since the buffer strip will not have to be continuously mowed, watered, or fertilized. Occasional high mowing (1-2 times per year) for specific plants or physically removing other weedy species may be needed.

The buffer strip will stabilize the soil with its deep root structure and help filter run-off from lawns and agricultural fields by trapping nutrients, pollutants, and sediment that would otherwise drain into the lake. This may have a positive impact on the lake's water quality since there will be less "food" for nuisance algae. Buffer strips can filter as much as 70-95% of sediment and 25-60% of nutrients and other pollutants from runoff.

Another benefit of a buffer strip is potential flood control protection. Buffer strips may slow the velocity of flood waters, thus preventing shoreline erosion. Native plants also can withstand fluctuating water levels more effectively than commercial turfgrass. Many plants can survive after being under water for several days, even weeks, while turfgrass is intolerant of wet conditions and usually dies after several days under water. This contributes to increased maintenance costs, since the turfgrass has to be either replanted or replaced with sod. Emergent vegetation can provide additional help in preserving shorelines and improving water quality by absorbing wave energy that might otherwise batter the shoreline. Calmer wave action will result in less shoreline erosion and resuspension of bottom sediment, which may result in potential improvements in water quality.

Many fish and wildlife species prefer the native shoreline vegetation habitat. This habitat is an asset to the lake's fishery since the emergent vegetation cover may be used for spawning, foraging, and hiding. Various wildlife species are even dependent upon shoreline vegetation for their existence. Certain birds, such as marsh wrens (*Cistothorus palustris*) and endangered yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) nest exclusively in emergent vegetation like cattails and bulrushes. Hosts of other wildlife like waterfowl, rails, herons, mink, and frogs to mention just a few, benefit from healthy stands of shoreline vegetation. Dragonflies, damselflies, and other beneficial invertebrates can be found thriving in vegetation along the shoreline as well.

In addition to the benefits of increased fish and wildlife use, a buffer strip planted with a variety of native plants may provide a season long show of various colors from flowers, leaves, seeds, and stems. This is not only aesthetically pleasing to people, but also benefits wildlife and the overall health of the lake's ecosystem.

Cons

There are few disadvantages to native shoreline vegetation. Certain species (i.e., cattails) can be aggressive and may need to be controlled occasionally. If stands of shoreline vegetation become dense enough, access and visibility to the lake may be compromised to some degree. However, small paths could be cleared to provide lake access or smaller plants could be planted in these areas.

Costs

If minimal amount of site preparation is needed, costs can be approximately $10 per linear foot, plus labor. Cost of installing willow posts is approximately $15-20 per linear foot. The labor that is needed can be completed by the property owner in most cases, although consultants can be used to provide technical advice where needed. This cost will be higher if the area needs to be graded. If grading is necessary, appropriate permits and surveys are needed. If filling is required, additional costs will be incurred if compensatory storage is needed. The permitting process is costly, running as high as $1,000-2,000 depending on the types of permits needed.

Option 3: Install Biolog, Fiber Roll, or Straw Blanket with Plantings

These products are long cylinders of compacted synthetic or natural fibers wrapped in mesh. The rolls are staked into shallow water. Once established, a buffer strip of native plants can be planted along side or on top of the roll (depending if rolls are made of synthetic or natural fibers). They are most effective in areas where plantings alone are not effective due to already severe erosion. In areas of severe erosion, other techniques may need to be employed or incorporated with these products.

Pros

Biologs, fiber rolls, and straw blankets provide erosion control that secure the shoreline in the short-term and allow native plants to establish which will eventually provide long-term shoreline stabilization. They are most often made of bio-degradable materials, which break down by the time the natural vegetation becomes established (generally within 3 years). They provide additional strength to the shoreline, absorb wave energy, and effectively filter run-off from terrestrial sources. These factors help improve water quality in the lake by reducing the amount of nutrients available for algae growth and by reducing the sediment that flows into a lake.

Cons

These products may not be as effective on highly erodible shorelines or in areas with steep slopes, as wave action may be severe enough to displace or undercut these products. On steep shorelines grading may be necessary to obtain a 2:1 or

3:1 slope or additional erosion control products may be needed. If grading or filling is needed, the appropriate permits and surveys will have to be obtained.

Costs

Costs range from $25 to $35 per linear foot of shoreline, including plantings. This does not include the necessary permits and surveys, which may cost $1,000 – 2,000 depending on the type of earthmoving that is being done. Additional costs may be incurred if compensatory storage is needed.

Objective VII: Eliminate or Control Exotic Species

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. Plants such as purple loosestrife (*Lythrum salicaria*), buckthorn (*Rhamnus cathartica*), and reed canary grass (*Phalaris arundinacea*) are three examples. The outcome is a loss of plant and animal diversity. This section will address terrestrial shoreline exotic species.

Purple loosestrife is responsible for the "sea of purple" seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million seeds per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Reed canary grass is an aggressive plant that if left unchecked will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of purple loosestrife, buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Allilaria officianalis*) or honeysuckle (*Lonicera* spp.) as well as some aggressive native species, such as box elder (*Acer negundo*).

Presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself. However, problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. A monitoring program should be established, problem areas identified, and control measures taken when appropriate. This is particularly important in remote or undeveloped areas of lake shorelines where the spread of exotic species may go unnoticed for some time. This is most certainly the case on St. Mary's Lake.

<u>Option 1: No Action</u>

No control will likely result in the expansion of the exotic species and the decline of native species. This option is not recommended if possible.

> ***Pros***
>
> There are few advantages with this option. Some of the reasons exotics were brought into this country are no longer used or have limited use. However, in some cases having an exotic species growing along a shoreline may actually be preferable if the alternative plant is commercial turfgrass. Since turfgrass has shallow roots and is prone to erosion along shorelines, exotics like reed canary

grass or common reed (*Phragmites australis*) will control erosion more effectively. Native plants should take precedent over exotics when possible. A table in Appendix A lists several native plants that can be planted along shorelines.

Cons

Native plant and wildlife diversity will be lost as stands of exotic species expand. Exotic species are not under the same stresses (particularly diseases and predators) as native plants and thus can out-compete the natives for nutrients, space, and light. Few wildlife species use areas where exotic plants dominate. This happens because many wildlife species either have not adapted with the plants and do not view them as a food resource, the plants are not digestible to the animal, or their primary food supply (i.e.,, insects) are not attracted to the plants. The result is a monoculture of exotic plants with limited biodiversity.

Recreational activities, especially wildlife viewing, may be hampered by such monocultures. Access to lake shorelines may be impaired due to dense stands of non-native plants. Other recreational activities, such as swimming and boating, may not be effected.

Costs

Costs with this option are zero initially, however, when control is eventually needed, costs will be substantially more than if action was taken immediately. Additionally, the eventual loss of ecological diversity is difficult to calculate financially.

Option 2: Control by Hand

Controlling exotic plants by hand removal is most effective on small areas (< 1 acre) and if done prior to heavy infestation. Some exotics, such as purple loosestrife and reed canary grass, can be controlled to some degree by digging, cutting, or mowing if done early and often during the year. Digging may be required to ensure the entire root mass is removed. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored. Many exotic species, such as purple loosestrife, buckthorn, and garlic mustard are proficient at colonizing disturbed sites.

Pros

Removal of exotics by hand eliminates the need for chemical treatments. Costs are low if stands of plants are not too large already. Once removed, control is simple with yearly maintenance. Control or elimination of exotics preserves the ecosystem's biodiversity. This will have positive impacts on plant and wildlife presence as well as some recreational activities.

Cons

This option may be labor intensive or prohibitive if the exotic plant is already well established. Costs may be high if large numbers of people are needed to remove plants. Soil disturbance may introduce additional problems such as providing a seedbed for other non-native plants that quickly establish disturbed sites, or cause soil-laden run-off to flow into nearby lakes or streams. In addition, a well-established stand of an exotic like purple loosestrife or reed canary grass may require several years of intense removal to control or eliminate.

Costs

Cost for this option is primarily in tools, labor, and proper plant disposal.

Option 3: Herbicide Treatment

Chemical treatments can be effective at controlling exotic plant species. However, chemical treatment works best on individual plants or small areas already infested with the plant. In some areas where individual spot treatments are prohibitive or unpractical (i.e.,, large expanses of a wetland or woodland), chemical treatments may not be an option due to the fact that in order to chemically treat the area a broadcast application would be needed. Since many of the herbicides that are used are not selective, meaning they kill all plants they contact; this may be unacceptable if native plants are found in the proposed treatment area.

Herbicides are commonly used to control nuisance shoreline vegetation such as buckthorn and purple loosestrife. Herbicides are applied to green foliage or cut stems. Products are applied by either spraying or wicking (wiping) solution on plant surfaces. Spraying is used when large patches of undesirable vegetation are targeted. Herbicides are sprayed on growing foliage using a hand-held or backpack sprayer. Wicking is used when selected plants are to be removed from a group of plants. The herbicide solution is wiped on foliage, bark, or cut stems using a herbicide soaked device. Trees are normally treated by cutting a ring in the bark (called girdling). Herbicides are applied onto the ring at high concentrations. Other devices inject the herbicide through the bark. It is best to apply herbicides when plants are actively growing, such as in the late spring/early summer, but before formation of seed heads. Herbicides are often used in conjunction with other methods, such as cutting or mowing, to achieve the best results. Proper use of these products is critical to their success. Always read and follow label directions.

Pros

Herbicides provide a fast and effective way to control or eliminate nuisance vegetation. Unlike other control methods, herbicides kill the root of the plant, which prevents regrowth. If applied properly, herbicides can be selective. This allows for removal of selected plants within a mix of desirable and undesirable plants.

Cons

Since most herbicides are non-selective, they are not suitable for broadcast application. Thus, chemical treatment of large stands of exotic species may not be practical. Native species are likely to be killed inadvertently and replaced by other non-native species. Off target injury/death may result from the improper use of herbicides. If herbicides are applied in windy conditions, chemicals may drift onto desirable vegetation. Care must also be taken when wicking herbicides as not to drip on to non-targeted vegetation such as native grasses and wildflowers. Another drawback to herbicide use relates to their ecological soundness and the public perception of them. Costs may also be prohibitive if plant stands are large. Depending on the device, cost of the application equipment can be high.

Costs

Two common herbicides, triclopyr (sold as Garlon ™) and glyphosate (sold as Rodeo® or Round-up™), cost approximately $100 and $65 per gallon, respectively. Only Rodeo® is approved for water use. A Hydrohatchet®, a hatchet that injects herbicide through the bark, is about $300.00. Another injecting device, E-Z Ject® is $450.00. Hand-held and backpack sprayers costs from $25-$45 and $80-150, respectively. Wicking devices are $30-40.