2001 SUMMARY REPORT
of
LAKE LEO

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Lake Leo, located in Ela Township, was created in 1965 and originally served as a tackle test site for a fish tackle manufacturer. Construction of homes on the lake began approximately 20 years ago and continues today. The lake has a surface area of 13.7 acres and a mean depth of 5.6 feet. It is located entirely within the village limits of Hawthorn Woods and is used by White Birch Lake Association members for swimming and fishing, with a beach and boat launch on the southeast shore.

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 2001. Phosphorus levels were very low throughout the summer, but a pulse of phosphorus entered the upper water layer between July and August sampling dates, increasing algae density and total volatile solids (TVS) and decreasing Secchi depth by almost five feet. It is hypothesized that this pulse of phosphorus was coming from the sediment and was being released via a stratification-destratification cycle. It appears that Lake Leo stratifies for short periods of time and that phosphorus increases as dissolved oxygen is depleted in the bottom waters. Stratification is then broken by air temperature changes or wind or rain events and the phosphorus is distributed throughout the water column. This cycle may occur several times throughout the summer, sending small pulses of phosphorus to surface waters and increasing algae density.

Chara dominated the plant community in 2001. Very small amounts of curly leaf pondweed, Eurasian watermilfoil, floating leaf pondweed, sago pondweed, slender naiad and wild celery were also observed. Planktonic algae was successfully treated throughout the summer with Clearigate® and Cutrine Plus®. Several herbicides were used to treat curly leaf pondweed, Eurasian watermilfoil and *Chara*, and Aquashade was used to suppress *Chara* as well. The plant management plan for Lake Leo appears to be successfully treating the target plant species, while avoiding overuse of herbicides. However the lake association may want to reconsider the treatment of slender naiad and the use of Aquashade in the treatment of *Chara*. Reducing the health of *Chara*, as well as other native plants in the lake through the use of Aquashade may actually increase algae density, requiring more frequent algaecide treatments over the course of the summer. Treatment of slender naiad, a native plant that does not typically grow to nuisance levles, with herbicides will also increase algae density and decrease water clarity throughout the summer.

Although very little erosion was occurring around Lake Leo, buckthorn, purple loosestrife and reed canary grass were present along 56.3% of the shoreline. These are exotic plant species that out-compete native vegetation and provide poor habitat for wildlife. Additionally, very little wildlife habitat was present along this residential lake and few waterfowl and/or songbirds were observed over the course of the study.

Recommendations and options for lake management techniques to address some of the problems on the lake are described in the report.

LAKE IDENTIFICATION AND LOCATION

Lake Leo is located in Ela Township, north of McHenry Road and west of Fairfield Road (T 43N, R 10E, S 4, 9), and is entirely within the village limits of Hawthorn Woods. Lake Leo has a surface area of 13.7 acres, mean and maximum depths of 5.6 feet and 11.1 feet, respectively, and a calculated volume of 76.0 acre-feet. The lake receives its water input from numerous storm pipes that drain residential and agricultural land during rain events. It has no natural inlet. The lake is located in the Indian Creek sub basin of the Des Plaines River watershed. Water exits over a spillway on the southeast shore, runs under Deerpoint Road and flows into Lake Naomi.

BRIEF HISTORY OF LAKE LEO

Lake Leo was created in 1965. An 85 foot long, 9 foot tall earthen dam was installed and approximately 500,000 cubic yards of dirt were removed to create the lake. The water basin soil consisted of marl and the lake was spring-fed from springs along the western shore. The lake originally served as a tackle test site for a fish tackle manufacturer. Construction of homes on the lake began approximately 20 years ago and continues today. Currently, the lake is managed by the White Birch Lake Association, which was formed more than 15 years ago.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Access to Lake Leo is open to Lake Association members only. The lake's main uses are swimming and fishing and a beach located on the southeast shore is utilized by Association members. No gas motors are permitted on the lake. The White Birch Lake Association meets once a year to discuss and address lake management issues, and each Association member is required to pay a fee of $400-500 per year. Currently, the biggest management concerns include continued control of Eurasian watermilfoil and educating property owners about responsible lawn maintenance.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Lake Leo were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected at 3 foot and 8-9 foot depths (depending on water level) from the deep hole location in the lake (Figure 1). Lake Leo was thermally stratified only on the July 2001 sampling date. 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 in nutrient-enriched lakes. A lake that remains thermally stratified all summer is considered dimictic. Conversely, a polymictic

lake stratifies and destratifies many times during the summer. Stratification occurs after several calm, hot days, but may be broken by a storm or high wind event, causing the lower water layer to mix with the upper water layer. This may result in changes in phosphorus concentrations in the epilimnion that affect many aspects of water quality. Lake Leo appears to be polymictic, and the consequences of this with regard to water quality will be discussed below. Near surface 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. Near-bottom DO concentrations fell below 5.0 mg/l during May and July, when bottom waters became hypoxic (DO<1.0 mg/l) (Table 1, Appendix A).

Phosphorus (P) 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 surface phosphorus concentration in Lake Leo was 0.026 mg/l, substantially less than most of the lakes in the County studied since 1995 (County median = 0.047 mg/l). The P concentration decreased by half from June to July and then doubled from July to August in surface waters. Conversely, in bottom waters, the P concentration increased from June to July and decreased from July to August (Table 1, Appendix A). The source of this pulse of phosphorus into the upper water column in July appears to be internal. Although sampling was not frequent enough to prove it, the data supports the idea that the polymictic nature of Lake Leo lead to a small release of phosphorus from the sediment during the summer. As mentioned above, a polymictic lake will stratify and de-stratify several times during the summer. During calm, hot periods, the lake will become weakly stratified and bottom waters will lose oxygen very quickly. As a result, phosphorus will be released from the sediment and build up in the hypolimnion. Stratification is then broken by air temperature changes or a wind or storm event and the phosphorus is distributed throughout the water column, often producing algae blooms. In June 2001, temperature, oxygen and phosphorus concentrations between the epilimnion and hypolimnion were very similar, indicating that the lake was still mixing. By the middle of July, the temperature and oxygen profiles indicated that the lake was stratified. The epilimnetic waters were isolated from P being released into the hypolimnion, causing the P concentration to decrease in the epilimnion and increase in the hypolimnion. In August, the lake was no longer stratified and P that had built up in the hypolimnion was distributed throughout the water column, resulting in an increase in epilimnetic P and a decrease in hypolimnetic P (Table 1, Appendix A). This pattern of events may have occurred several other times throughout the summer, but may not have coincided with sampling events, and, therefore, were not detected.

Rain data coincided somewhat with increases and decreases of phosphorus concentrations in the lake (Figure 2). Although this does not provide conclusive evidence, it does suggest that external P sources from land surrounding the lake (mostly residential and agricultural fields) may be a secondary source of P via non-point source runoff.

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 such as

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 and hypolimnetic TSS concentrations (2.3 mg/l and 2.7 mg/l, respectively) in Lake Leo were less than half of the County median (5.7 mg/l), and epilimnetic concentrations coincided with increases and decreases in epilimnetic total phosphorus (TP) (Figure 3). Since total volatile solids (TVS), a measure of organic solids such as algae, also coincided with phosphorus concentrations, the majority of detectable TSS in the water column likely consisted of algae. However, visual increases in algae density resulting from increasing TP concentrations were not apparent over the course of the study due to frequent algaecide applications.

Secchi depth (water clarity) in Lake Leo was relatively high throughout the summer, ranging from 4.63 feet in May to 10.27 feet in September. Decreases in Secchi depth coincided with increases in TP (which lead to increased algae densities and TSS concentrations) (Figures 3 & 4). When TP, TSS and TVS decreased in the epilimnion in July as a result of thermal stratification, Secchi depth increased from 6.96 feet to 9.58 feet before decreasing again to 5.12 feet in August when stratification was broken and phosphorus and algae (TVS concentrations) increased in near-surface waters.

Planktonic algae along the shoreline and *Chara* around the beaches and piers of Lake Leo have been treated with the algaecides Clearigate® and Cutrine Plus® for many years. In 2001, Clearigate® and/or Cutrine Plus® was applied four times between May and August. These applications were on an as-needed basis and the limited use of these algaecides could be continued. However, since *Chara* is such a low-lying plant, it is not clear to the Lakes Management Unit why it is being treated around piers, especially since no motorized boats are permitted on the lake. *Chara* provides sediment stabilization along the shoreline and the Lake Association may want to consider reducing or discontinuing the treatment of *Chara* in shallow areas unless it is preventing recreational activity.

Average conductivity in Lake Leo was above the County average (0.7557 mS/cm) in 2001 (Table 1, Appendix A). 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. Epilimnetic total dissolved solids (TDS) concentrations, which have also been shown to be correlated with conductivity, were above the County average (452 mg/l) in Lake Leo 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 or an increase in pollutants entering the lake. High

conductivity levels (which often indicate an increase in sodium chloride) can eventually change the plant community, as more salt tolerant plants 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 high conductivity levels in Lake Leo are most likely the result of increased residential development in the watershed of the lake. More houses mean more impervious surfaces and more roads to be salted each winter. An overall increase in the amount of road salt deposited around Lake Leo will continue to result in an increase in TDS and conductivity. Although the high conductivity levels in the lake are cause for concern, there may not be much that residents can do about it. Non-point source runoff, which picks up road salt and enters the lake during rain events, is very difficult to control. A potentially easy measure that lake shore residents can take to attempt to reduce the amount of road salt entering Lake Leo is to convince the Village of Hawthorn Woods or Ela Township to reduce the amount of road salt laid down each winter. Often, excess road salt is laid down at the end of the winter season (when it is not really necessary) in order to use up left over stores. Residents should appeal to the appropriate government entity to use only the necessary amount of salt to keep roads safe each winter.

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. Lake Leo had an average TN:TP ratio of 43:1. This indicates that the lake is highly phosphorus limited and is the reason that the slight increase in phosphorus in August resulted in higher algae density and lower water clarity. In highly nutrient-enriched lakes, high phosphorus levels have often reached the point where either very large increases or very large decreases in phosphorus would be necessary to trigger changes in algae density. On the other hand, less enriched lakes, such as Lake Leo, are typically more sensitive to increases or decreases in phosphorus, and algae could become a problem with relatively small increases in TP. Care should be taken to ensure that no unnecessary sources of P are created around the lake. This may mean decreasing the amount of fertilizer applied to lawns around the lake, or changing to the use of phosphorus-free fertilizer.

Phosphorus concentrations can also be used to indicate the trophic state (productivity level) of a lake. The Trophic State Index (TSI) uses phosphorus, chlorophyll *a* (algae biomass) 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. Lake Leo had an average phosphorus TSI (TSIp) value of 50.9, indicating slightly eutrophic conditions. Lake Leo has relatively good water quality compared to many other lakes that fall into the eutrophic category, and does not have many of the characteristics of eutrophic lakes (listed above). This is most likely the result of frequent algae treatments and relatively high percent plant coverage (of *Chara*). Typically, a lake is either plant or algae dominated and the TSIp index does not always apply when a lake is plant dominated or when algae treatments keep algae density very low. When the Secchi depth TSI (TSIsd) for Lake Leo (48.4) is used, the lake is classified as mesotrophic, indicating a moderately enriched system with good water quality. As a result of its relatively low average phosphorus concentration, Lake Leo ranks 20th out of 102 lakes in Lake County (TSIp averaged over several years), This is a very high ranking among man-made lakes, which typically fall into the eutrophic and hypereutrophic categories in this geographic area (Table 2, Appendix A).

Most of the water quality parameters just discussed can be used to analyze the water quality of Lake Leo based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Lake Leo provides *Full* support of aquatic life and swimming, and *Partial* support of recreation. The lake has *Full* support of 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. Lake Leo currently has a plant management plan in place. Eurasian watermilfoil was first noted in the lake in 1996 and has been treated since that time. In 2001, spot treatments of Aquathol-K® and Reward® were applied to treat curly leaf pondweed, as needed, throughout June. In August an application of Aquathol-K® and Reward® was carried out to treat slender naiad that was mixed in with the Eurasian watermilfoil. Aquathol-K® is a relatively expensive, nonselective contact herbicide that is typically used to treat pondweeds. It is only effective on submersed plants and causes rapid plant death with dieback in about a week. However, since it is a contact herbicide and only affects the non-rooted portions of the plant, regrowth will occur and the herbicide must be applied repeatedly throughout the summer. Reward® is also a nonselective contact herbicide that is typically used on Eurasian watermilfoil and coontial, and only provides short-term control. Repeat applications will always be necessary when using Reward®, especially in waters with high sediment turbidity, as the herbicide binds quickly to soil particles. At the beginning of August 2001, 150 pounds of Navigate® were applied to treat Eurasian watermilfoil. Navigate® is a formulation of 2,4-D, the most widely used herbicide in the world. Navigate® is a selective, systemic herbicide that is typically used on Eurasian watermilfoil and coontail and does not affect pondweeds. This herbicide is taken up very quickly by the plants and, therefore, does not persist in the environment. Because it is a systemic herbicide (meaning that it attacks the entire plant), plant dieback is slower, but the effect is longer-lasting than with contact herbicides. This means that fewer applications are necessary. Aquashade, a blue dye that serves to shade out plants growing below the water surface, was applied frequently enough to maintain shading throughout the summer. Aquashade is not a chemical herbicide or algaecide, but simply serves to physically reduce plant density through shading.

In 2001, *Chara* dominated the plant community. Small amounts of curly leaf pondweed, Eurasian watermilfoil, floating leaf pondweed, sago pondweed, slender naiad and wild celery were also observed throughout the summer (Tables 3 & 4). During the study, light level was measured at one-foot intervals from the water surface to the lake bottom. When the light level falls below 1% of the level at the water surface, plants are no longer able to grow. Using this information, it can be determined how much of the lake has the potential to support aquatic plant growth. Based on 1% light level, Lake Leo could have supported plants over approximately 100% of the lake, but plants were observed over only about 55% of the lake surface area during 2001. The inability of aquatic plants to grow in all areas as determined by percent light level may be explained by the presence of inadequate substrate in various parts of the lake, the use of Aquashade and/or the use of herbicides.

The plant management plan for Lake Leo appears to be successfully treating the target plant species of Eurasian watermilfoil (EWM) and curly leaf pondweed, as very little of each was observed in the lake during the summer. It also appears that herbicide application is not being overused and that spot treatments of each herbicide have been adequate to treat the target areas. This responsible use of herbicides for EWM and curly leaf pondweed can be continued as needed in Lake Leo. However, the use of herbicides to treat slender naiad should be discontinued in the future. This beneficial native plant is low-lying in the water column, provides both fish habitat and sediment stabilization and does not typically reach nuisance levels. It was not observed at nuisance levels at any time during the 2001 study and should not be treated again in the future. The White Birch Lake Association may also want to reconsider the application of Aquashade to the lake for the treatment and suppression of *Chara* growth. *Chara* is a low-lying macroalgae that also does not typically reach nuisance levels and is, likely, helping to keep the lake clear by preventing sediment resuspension and by competing with planktonic algae in many parts of the lake. Reducing the health and density of *Chara* (as well as other native plants, such as slender naiad, native pondweeds and wild celery) in Lake Leo through Aquashade may actually increase algae density, requiring more frequent copper treatments over the course of the summer. Plants such as these provide many benefits to the lake ecosystem, including habitat for fish, sediment stabilization and competition for resources with planktonic algae. This competition may result in the reduction of algae density, and high water clarity could be maintained with less frequent algaecide applications.

It is recommended that the use of Aquashade be discontinued for the summer of 2002 in order to determine if its use is necessary. Since *Chara* is such a low-lying plant, it should not interfere with boating (especially since gas motors are not permitted on the lake) or swimming activities in deeper water, and treatment should not be necessary. Additionally, most of the native plants found in Lake Leo are not the type to reach nuisance levels and are also relatively low-lying in the water column. If it is determined that neither *Chara* nor native aquatic plants are posing recreational problems, Aquashade applications could be discontinued and copper treatments that target *Chara* could continue to keep it in check only along beaches and piers in the lake.

Of the eight emergent plant and trees species observed along the shoreline of Lake Leo, three (purple loosestrife, reed canary grass, and buckthorn) are invasive species that do not provide ideal wildlife habitat.

FQI (Floristic Quality Index) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). Each floating or submersed aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of plant species found in the lake. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2001 Lake County lakes is 14.0. Lake Leo has an FQI of 12.1, slightly below the County average, as a result of relatively low plant diversity and density of most of the plant species in 2001.

Table 3. Aquatic and shoreline plants on Lake Leo, May-September 2001.

Aquatic Plants	
Chara	*Chara* sp.
Eurasian Watermilfoil	*Myriophyllum spicatum*
Slender Naiad	*Najas flexilis*
Curlyleaf Pondweed	*Potamogeton crispus*
Floatingleaf Pondweed	*Potamogeton natans*
Small Pondweed	*Potamogeton pusillus*
Sago Pondweed	*Stuckenia pectinatus*
Eel Grass	*Vallisneria americana*
Shoreline Plants	
Water Plantain	*Alisma plantago-aquatica*
Blunt Spikerush	*Eleocharis obtusa*
Joe-Pye Weed	*Eupstorium maculatum*
Purple Loosestrife	*Lythrum salicaria*
Reed Canary Grass	*Phalaris arundinacea*
Common Buckthorn	*Rhamnus cathartica*
Common Arrowhead	*Sagittaria latifolia*
Hardstem Bulrush	*Scirpus acutus*

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Lake Leo on July 19, 2001. 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 54% of Lake Leo's shoreline is developed and this number is growing as more of the southern shoreline is developed. The majority of the developed shoreline is comprised of an equal amount of rip rap and buffer (32.4% each) (Figure 5). The remainder consists of manicured lawn (17.8%), beach (15.0%) and woodland (2.4%). The undeveloped portions of the lake (located mostly in the western bay) consist primarily of woodland (47%) and buffer (52.6%). Buffer, if properly maintained, is an ideal shoreline type because it provides wildlife habitat as well as reducing or preventing shoreline erosion and sedimentation. Although rip rap is not an ideal shoreline type with regard to wildlife habitat, it does, typically, also help to prevent shoreline erosion. As a result of the dominance of these two shoreline types around Lake Leo, only 13.4% of the shoreline exhibited erosion, and the majority of the erosion (10.1%) was only slight erosion (Figure 6). Moderate erosion was occurring on approximately 3% of the shoreline. The types of shorelines exhibiting erosion included woodland, rip rap, and buffer. Woodland is a desirable shoreline type for wildlife habitat, and although woodland-dominated lots may seem to provide the ideal shoreline, if the slope is steep or if these lots are not maintained, erosion can occur. Deciduous trees present along these shorelines have very large roots that are 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. Although rip rap is intended specifically to prevent or stop erosion, if improperly installed, rip rapped shorelines can exhibit significant erosion. Often, the rip rap consists of very small rocks that simply end up sloughing into the lake as a result of wave action. If they are not replaced, erosion will occur on the exposed soil. Moderate erosion (the most severe occurring on Lake Leo), was occurring along a rip rapped shoreline. Erosion along all areas of the lake should be addressed. It is recommended that buffer strips be installed along all shorelines exhibiting erosion and along the shoreline of all new homes built on the lake.

Dramatic water level fluctuation can increase shoreline erosion, especially if the fluctuations occur over short periods of time. The water level in Lake Leo dropped no more than one third of a foot between May and September. Erosion occurs when water levels drop and newly exposed soil, which may not support emergent plant growth, is subjected to wave action. The low occurrence of water fluctuation in Lake Leo helped to reduce the likelihood of shoreline erosion, as evidenced by the relatively small amount of erosion around the lake.

Although very little erosion was occurring around Lake Leo, invasive plant species, including reed canary grass, buckthorn and purple loosestrife were present along 56.3% of the shoreline. These plants are extremely invasive and exclude native plants from the areas they inhabit. Buckthorn provides 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. Since the relative density of these three invasive plants was not extremely high along Lake Leo, steps to eliminate these plants around the lake should be carried out before they become a nuisance.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Fish surveys have been performed on Lake Leo by the Illinois Department of Natural Resources (IDNR) since 1965, the year the lake was constructed. Between May and October of that year, 35 rock bass (RB), 3 large mouth bass (LMB), 36 breeder size small mouth bass (SMB), 77 fingerling small mouth bass and 200 pounds of fat head minnows (FHM) were stocked. The first official fish survey was conducted in 1966, when 88 LMB, 9 bluegill (BG), 8 green sunfish (GS), 1 SMB, 30 RB and 2 black bullhead (BB) were found. In 1968, 6 LMB, 5 SMB, 60 RB, 1 BG and 13 pumpkinseed (PS)were found. Measurements indicated that the LMB were not fairing well, the SMB were in average condition and the RB were overabundant. In 1969, 33 LMB, 3 SMB, 29 PS and 70 RB were collected. Recommendations were made to completely rehabilitate the lake and restock the lake with SMB and RB. This was the last fish survey performed on Lake Leo. Five hundred fathead minnows were stocked in Lake Leo in May 2001. It is strongly recommended by the Lakes Management Unit that a new fishery assessment be conducted to determine the status of the fish community.

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See Appendix B for methodology). Although wildlife habitat in the form of woodland and buffer areas was relatively abundant around Lake Leo, a relatively small number of waterfowl and song birds were observed (Table 5). This is likely due to the residential nature of most of the shoreline around Lake Leo, which typically does not support a high diversity of wildlife species. It is, therefore, very important that some of the hardwood forest and buffer areas around the lake be maintained to provide the appropriate habitat for these bird species in the future. It is also important that new homes being built on the lake keep their lots as wooded as possible and establish a buffer strip of native plants along their shorelines to provide additional habitat and reduce erosion.

Table 5. Wildlife species observed at Lake Leo, May-September 2001.

<u>*Birds*</u>	
Mallards	*Anas platyrhnchos*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
American Robin	*Turdus migratorius*
Northern Cardinal	*Cardinalis cardinalis*
<u>*Reptiles*</u>	
Painted Turtle	*Chrysemys picta*

EXISTING LAKE QUALITY PROBLEMS

- *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. Lake Leo does not currently have a bathymetric map or 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.

- *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 Lakes Leo and Naomi would provide valuable historical data and enable lake managers to create baseline information and then track the improvement or decline of lake water quality after lake management techniques are employed.

- *Polymixis Leading to Internal Phosphorus Loading*

  Lake Leo is a polymictic lake, meaning that it stratifies and destratifies many times during a summer. As a result of this stratification cycle, phosphorus was released and built up in bottom waters during stratification and was then distributed throughout the water column during destratification. This resulted in an increase in available phosphorus and an increase in algae density. Fortunately, algae blooms did not occur because the amount of phosphorus released into the surface water was not extremely high and algaecide applications were ongoing throughout the summer. If longer periods of stratification were to occur in the future, the amount of phosphorus distributed through the water column during destratification could be much larger and could result in an algae bloom. However, at this time, no action is necessary to address this issue.

- *Lack of Aquatic Vegetation*

  One key to a healthy lake is a healthy plant community. *Chara* dominated the plant community throughout the summer and is likely contributing to high water clarity through sediment stabilization. However, Aquashade, a nonselective plant management tool, and algaecide treatments were applied consistently during the summer to suppress the growth of *Chara*. Additionally, curly leaf pondweed was being treated with a nonselective herbicide, which may also have affected native plants. Recommendations have been made (1) to temporarily discontinue the use of Aquashade to determine if it is necessary and to reduce effects on nontarget plants, and (2) to reduce the use of algaecides in the treatment of *Chara* unless it is significantly inhibiting recreational activity.

- *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. Reed canary grass is another exotic plant found in wetland habitat. It spreads very quickly, does not provide adequate shoreline stabilization and is not well utilized by wildlife. 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. Purple loosestrife, reed canary grass and buckthorn are present along 56.3% of the shoreline of Lake Leo and attempts should be made to control their spread before they become a large problem.

- *Limited Wildlife Habitat and Slight Shoreline Erosion*

  Although much of the west bay of the lake is dominated by woodland, most of Lake Leo’s shoreline is dominated by residential homes, which do not always encourage a diverse bird and animal community. Many of the residents along Lake Leo already have buffer strips in place along their property’s shoreline. However, many of the residents also have rip rap and beaches along their shoreline. It is recommended that those residents that already have buffer consider widening their strips and that those residents that do not have a buffer strip or are experiencing erosion consider planting a 10-20 foot wide strip of native plants along their shoreline. This would not only increase wildlife habitat, but it could reduce the amount of nutrients and soil particles entering the lake and could decrease shoreline erosion.

POTENTIAL OBJECTIVES FOR THE LAKE LEO MANAGEMENT PLAN

I. Create a Bathymetric Map, Including a Morphometric Table
II. Participate in the Volunteer Lake Monitoring Program
III. Eliminate or Control Invasive Species
IV. Enhance Wildlife Habitat Conditions
V. Control Shoreline Erosion
VI. Conduct a Fisheries Assessment

OPTIONS FOR ACHIEVING THE LAKE MANEMENT PLAN OBJECTIVES

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. 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 euphotic 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:

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Objective III: Eliminate or Control Invasive 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 areas of lake shorelines where the spread of exotic species may go unnoticed for some time. Although exotic species were found along over 56% of the shoreline of Lake Leo, the density of these plant species was not extremely high. Therefore, control measures should be carried out before these exotics reach nuisance levels.

Option 1: No Action

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. Table 6, 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.

Objective IV: Enhance Wildlife Habitat Conditions

The key to increasing wildlife species in and around a lake can be summed up in one word: habitat. Wildlife need the same four things all living creatures need: food, water, shelter, and a place to raise their young. Since each wildlife species has specific habitat requirements, which fulfill these four basic needs, providing a variety of habitats will increase the chance that wildlife species may use an area. Groups of wildlife are often associated with the types of habitats they use. For example, grassland habitats may attract wildlife such as northern harriers, bobolinks, meadowlarks, meadow voles, and leopard frogs. Marsh habitats may attract yellow-headed blackbirds and sora rails, while manicured residential lawns attract house sparrows and gray squirrels. Thus, in order to attract a variety of wildlife, a mix of habitats are needed. In most cases quality is more important than quantity (i.e., five 0.1-acre plots of different habitats may not attract as many wildlife species than one 0.5 acre of one habitat type).

It is important to understand that the natural world is constantly changing. Habitats change or naturally succeed to other types of habitats. For example, grasses may be succeeded by shrub or shade intolerant tree species (e.g., willows, locust, and cottonwood). The point at which one habitat changes to another is rarely clear, since these changes usually occur over long periods of time, except in the case of dramatic events such as fire or flood.

In all cases, the best wildlife habitats are ones consisting of native plants. Unfortunately, non-native plants dominate many of our lake shorelines. Many of them escaped from gardens and landscaped yards (i.e., purple loosestrife) while others were introduced at some point to solve a problem (i.e., reed canary grass for erosion control). Wildlife species prefer native plants for food, shelter, and raising their young. In fact, one study showed that plant and animal diversity was 500% higher along naturalized shorelines compared to shorelines with conventional lawns (University of Wisconsin – Extension, 1999).

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

This option means that the current land use activities will continue. No additional techniques will be implemented. Allowing a field to go fallow or not mowing a manicured lawn would be considered an action.

Pros

Taking no action may maintain the current habitat conditions and wildlife species present, depending on environmental conditions and pending land use actions. If all things remain constant there will be little to no effect on lake water quality and other lake uses.

Cons

If environmental conditions change or substantial land use actions occur (i.e., development) wildlife use of the area may change. For example, if a new housing development with manicured lawns and roads is built next to an undeveloped property, there will probably be a change in wildlife present.

Conditions in the lake (i.e., siltation or nutrient loading) may also change the composition of aquatic plant and invertebrate communities and thus influence biodiversity. Siltation and nutrient loading will likely decrease water clarity, increase turbidity, increase algal growth (due to nutrient availability), and decrease habitat for fish and wildlife.

Costs

The financial cost of this option may be zero. However, due to continual loss of habitats many wildlife species have suffered drastic declines in recent years. The loss of habitat effects the overall health and biodiversity of the lake's ecosystems.

Option 2: Increase Habitat Cover

This option can be incorporated with Option 3 (see below). One of the best ways to increase habitat cover is to leave a minimum 25 foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes (see the table in Appendix A for costs and seeding rates). This will provide cover from predators and provide nesting structure for many wildlife species and their prey. It is important to control or eliminate non-native plants such as buckthorn, purple loosestrife, garlic mustard, and reed canary grass, since these species outcompete native plants and provide little value for wildlife.

Occasionally high mowing (with the mower set at its highest setting) may have to be done for specific plants, particularly if the area is newly established, since competition from weedy and exotic species is highest in the first couple years. If mowing, do not mow the buffer strip until after July 15 of each year. This will allow nesting birds to complete their breeding cycle.

Brush piles make excellent wildlife habitat. They provide cover as well as food resources for many species. Brush piles are easy to create and will last for several years. They should be place at least 10 feet away from the shoreline to prevent any debris from washing into the lake.

Trees that have fallen on the ground or into the water are beneficial by harboring food and providing cover for many wildlife species. In a lake, fallen trees provide excellent cover for fish, basking sites for turtles, and perches for herons and egrets.

Increasing habitat cover should not be limited to the terrestrial environment. Native aquatic vegetation, particularly along the shoreline, can provide cover for fish and other wildlife.

Pros

Increased cover will lead to increased use by wildlife. Since cover is one of the most important elements required by most species, providing cover will increase the chances of wildlife using the shoreline. Once cover is established, wildlife usually have little problem finding food, since many of the same plants that provide cover also supply the food the wildlife eat, either directly (seeds, fruit, roots, or leaves) or indirectly (prey attracted to the plants).

Additional benefits of leaving a buffer include: stabilizing shorelines, reducing runoff which may lead to better water quality, and deterring nuisance Canada geese. Shorelines with erosion problems can benefit from a buffer zone because native plants have deeper root structures and hold the soil more effectively than conventional turfgrass. Buffers also absorb much of the wave energy that batters the shoreline. Water quality may be improved by the filtering of nutrients, sediment, and pollutants in run-off. This has a "domino effect" since less run-off flowing into a lake means less nutrient availability for nuisance algae, and less sediment means less turbidity, which leads to better water quality. All this is beneficial for fish and wildlife, such as sight-feeders like bass and herons, as well as people who use the lake for recreation. Finally, a buffer strip along the shoreline can serve as a deterrent to Canada geese from using a shoreline. Canada geese like flat, open areas with a wide field of vision. Ideal habitat for them are areas that have short grass up to the edge of the lake. If a buffer is allowed to grow tall, geese may choose to move elsewhere.

Cons

There are few disadvantages to this option. However, if vegetation is allowed to grow, lake access and visibility may be limited. If this occurs, a small path can be made to the shoreline. Composition and density of aquatic and shoreline vegetation are important. If vegetation consists of non-native species such as or Eurasian water milfoil or purple loosestrife, or in excess amounts, undesirable conditions may result. A shoreline with excess exotic plant growth may result in a poor fishery (exhibited by stunted fish) and poor recreation opportunities (i.e., boating, swimming, or wildlife viewing).

Costs

The cost of this option would be minimal. The purchase of native plants can vary depending upon species and quantity. Based upon 100 feet of shoreline, a 25-foot buffer planted with a native forb and grass seed mix would cost between $165-270 (2500 sq. ft. would require 2.5, 1000 sq. ft. seed mix packages at $66-108 per package). This does not include labor that would be needed to prepare the site for planting and follow-up maintenance. This cost can be reduced or minimized if native plants are allowed to grow. However, additional time and labor may be needed to insure other exotic species, such as buckthorn, reed canary grass, and purple loosestrife, do not become established.

Option 3: Increase Natural Food Supply

This can be accomplished in conjunction with Option 2. Habitats with a diversity of native plants will provide an ample food supply for wildlife. Food comes in a variety of forms, from seeds to leaves or roots to invertebrates that live on or are attracted to the plants. Plants found in the table in Appendix A should be planted or allowed to grow. In addition, encourage native aquatic vegetation, such as water lily (*Nuphar* spp. and *Nymphaea tuberosa*), sago pondweed (*Stuckenia pectinatus*), largeleaf pondweed (*Potamogeton amplifolius),* and wild celery (*Vallisneria americana*) to grow. Aquatic plants such as these are particularly important to waterfowl in the spring and fall, as they replenish energy reserves lost during migration.

Providing a natural food source in and around a lake starts with good water quality. Water quality is important to all life forms in a lake. If there is good water quality, the fishery benefits and subsequently so does the wildlife (and people) who prey on the fish. Insect populations in the area, including beneficial predatory insects, such as dragonflies, thrive in lakes with good water quality.

Dead or dying plant material can be a source of food for wildlife. A dead standing or fallen tree will harbor good populations of insects for woodpeckers, while a pile of brush may provide insects for several species of songbirds such as warblers and flycatchers.

Supplying natural foods artificially (i.e., birdfeeders, nectar feeders, corn cobs, etc.) will attract wildlife and in most cases does not harm the animals. However, “people food” such as bread should be avoided. Care should be given to maintain clean feeders and birdbaths to minimize disease outbreaks.

Pros

Providing food for wildlife will increase the likelihood they will use the area. Providing wildlife with natural food sources has many benefits. Wildlife attracted to a lake can serve the lake and its residents well, since many wildlife species (i.e., many birds, bats, and other insects) are predators of nuisance insects such as mosquitoes, biting flies, and garden and yard pests (such as certain moths and beetles). Effective natural insect control eliminates the need for chemical treatments or use of electrical “bug zappers” that have limited effect on nuisance insects.

Migrating wildlife can be attracted with a natural food supply, primarily from seeds, but also from insects, aquatic plants or small fish. In fact, most migrating birds are dependent on food sources along their migration routes to replenish lost energy reserves. This may present an opportunity to view various species that would otherwise not be seen during the summer or winter.

Cons

Feeding wildlife can have adverse consequences if populations become dependent on hand-outs or populations of wildlife exceed healthy numbers. This frequently happens when people feed waterfowl like Canada geese or mallard ducks.

Feeding these waterfowl can lead to a domestication of these animals. As a result, these birds do not migrate and can contribute to numerous problems, such as excess feces, which is both a nuisance to property owners and a significant contribution to the lake's nutrient load. Waterfowl feces are particularly high in phosphorus. Since phosphorus is generally the limiting factor for nuisance algae growth in many lakes in the Midwest, the addition of large amounts of this nutrient from waterfowl may exacerbate a lake's excessive algae problem. In addition, high populations of birds in an area can increase the risk of disease for not only the resident birds, but also wild bird populations that visit the area.

Finally, tall plants along the shoreline may limit lake access or visibility for property owners. If this occurs, a path leading to the lake could be created or shorter plants may be used in the viewing area.

Costs

The costs of this option are minimal. The purchase of native plants and food and the time and labor required to plant and maintain would be the limit of the expense.

Option 4: Increase Nest Availability

Wildlife are attracted by habitats that serve as a place to raise their young. Habitats can vary from open grasslands to closed woodlands (similar to Options 2 and 3).

Standing dead or dying trees provide excellent habitat for a variety of wildlife species. Birds such as swallows, woodpeckers, and some waterfowl need dead trees to nest in. Generally, a cavity created and used by a woodpecker (e.g., red-headed or downy woodpecker, or common flicker) in one year, will in subsequent years be used by species like tree swallows or chickadees. Over time, older cavities may be large enough for waterfowl, like wood ducks, or mammals (e.g., flying squirrels) to use. Standing dead trees are also favored habitat for nesting wading birds, such as great blue herons, night herons, and double-crested cormorants, which build stick nests on limbs. For these birds, dead trees in groups or clumps are preferred as most herons and cormorants are colonial nesters.

In addition to allowing dead and dying trees to remain, erecting bird boxes will increase nesting sites for many bird species. Box sizes should vary to accommodate various species. Swallows, bluebirds, and other cavity nesting birds can be attracted to the area using small artificial nest boxes. Larger boxes will attract species such as wood ducks, flickers, and owls. A colony of purple martins can be attracted with a purple martin house, which has multiple cavity holes, placed in an open area near water.

Bat houses are also recommended for any area close to water. Bats are voracious predators of insects and are naturally attracted to bodies of water. They can be enticed into roosting in the area by the placement of bat boxes. Boxes should be constructed of rough non-treated lumber and placed >10 feet high in a sunny location.

Pros

Providing places were wildlife can rear their young has many benefits. Watching wildlife raise their young can be an excellent educational tool for both young and old.

The presence of certain wildlife species can help in controlling nuisance insects like mosquitoes, biting flies, and garden and yard pests. This eliminates the need for chemical treatments or electric “bug zappers” for pest control.

Various wildlife species populations have dramatically declined in recent years. Since, the overall health of ecosystems depend, in part, on the role of many of these species, providing sites for wildlife to raise their young will benefit not only the animals themselves, but the entire lake ecosystem.

Cons

Providing sites for wildlife to raise their young have few disadvantages. Safety precautions should be taken with leaving dead and dying trees due to the potential of falling limbs. Safety is also important when around wildlife with young, since many animals are protective of their young. Most actions by adult animals are simply threats and are rarely carried out as attacks.

Parental wildlife may chase off other animals of its own species or even other species. This may limit the number of animals in the area for the duration of the breeding season.

Costs

The costs of leaving dead and dying trees are minimal. The costs of installing the bird and bat boxes vary. Bird boxes can range in price from $10-100.00. Purple martin houses can cost $50-150. Bat boxes range in price from $15-50.00. These prices do not include mounting poles or installation.

Objective V: 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.

Option 1: No Action

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.

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. Table 6, 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 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. Two invertebrates of particular importance for lake management, the water-milfoil weevils (*Euhrychiopsis lecontei* and *Phytobius leucogaster*), which have been shown to naturally reduce stands of exotic Eurasian water-milfoil (*Myriophyllum spicatum*). Weevils need proper over wintering habitat such as leaf litter and mud which are typically found on naturalized shorelines or shores with good buffer strips. Many species of amphibians, birds, fish, mammals, reptiles, and invertebrates have suffered precipitous declines in recent years primarily due to habitat loss. Buffer strips may help many of these species and preserve the important diversity of life in and around lakes.

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 VI: 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.

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.

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

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