2003 SUMMARY REPORT
of
CEDAR LAKE

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Cedar Lake is a 302-acre glacial lake in the Village of Lake Villa with a maximum depth of 44 feet. The Village of Lake Villa owns and operates Lehmann Park, with a beach, boat launch, playground and picnic area. In addition, two private homeowner's associations on the north shore of the lake, Cedar Lake Park and Belmoral Park Association, offers a beach, playground and picnic areas for each of their association members. The Belmoral Park Association has a boat launch suitable for small boats such as canoes or rowboats. Although the Illinois Department of Natural Resources (IDNR) owns some of the lake bottom, most of the lake bottom is privately owned. The parcel owned by the IDNR also contains the Cedar Lake Bog, which is a dedicated Illinois Nature Preserve. The lake is the headwaters of the Sequoit Creek watershed, and drains to a small creek that reaches Deep Lake, which eventually flows to the Fox River/Chain O'Lakes.

The water quality in Cedar Lake is good. The water quality parameters have remained relatively stable since 1990. Total Kjeldahl nitrogen concentrations have increased in both the epilimnion and the hypolimnion since 1992. Overall, phosphorus and suspended solids concentrations are also low, resulting in a lake with good water clarity. The water clarity has fluctuated somewhat over the years, but has remained better than most lakes within Lake County. During 2003 the water clarity averaged 12.15 feet deep for the season. Cedar Lake has a plentiful supply of dissolved oxygen for its aquatic life; with at least 80% of the lake volume containing 5.0 mg/L or more of dissolved oxygen.

Cedar Lake has an excellent plant community. Twenty nine aquatic plant species were identified in 2003. We found several locations harboring Illinois endangered plants, including water marigold (*Bidens beckii*) white-stemmed pondweed (*Potamogeton praelongus*) and fernleaf pondweed (*Potamogeton robbinsii*). According to the Illinois Department of Natural Resources, the water marigold is present in only two lakes in Illinois, the other being neighboring Deep Lake. Grass-leaved pondweed (*Potamogeton gramineus*), an Illinois threatened species, was not found during 2003, but was identified by botanist Linda Curtis in 2002. In 2003, the estimated coverage of plants that grew to the water's surface was about 51 acres, with approximately 29 of these acres dominated by Eurasian water milfoil (EWM). Native plants and EWM together cover approximately 82 % of the lake bottom, but not all of these plants reach the water's surface. EWM has been periodically controlled by the milfoil weevil, *Euhrychiopsis lecontei*, which feeds exclusively on milfoil species.

The shoreline along Cedar Lake is in excellent condition. Nearly 43% of the lakeshore is classified as undeveloped. Very little erosion is occurring, with exceptions most notably along the south shore of the island and a section on the west shore owned by Allendale School. The most common shoreline type is buffer, which helps with stabilizing the shoreline and offering wildlife habitat. Unfortunately, Cedar Lake also is home to a new population of zebra mussels, which were found on the Lehmann Park beach in 2003. Zebra mussels may negatively impact the water quality and the food chain of the lake in the future.

LAKE IDENTIFICATION AND LOCATION

Cedar Lake is a 302-acre glacial lake in northwestern Lake County (T46 R10 S32, 33), with a maximum depth of 44 feet. The lake has an average depth of 8.3 feet, with a volume of 2,482 acre-feet, or 809 million gallons (see Appendix E). The length of shoreline is 4.38 miles. Most of the lake shoreline lies within the municipal boundaries of the Village of Lake Villa. The majority of the northwest lobe of the lake and a small portion of the north shoreline are unincorporated Lake County. Cedar Lake is the headwaters of the Sequoit Creek watershed, and drains to a small creek that reaches Deep Lake, which eventually flows to the Fox River/Chain O'Lakes.

BRIEF HISTORY OF CEDAR LAKE

Beginning in the late 1800's, the Lake Villa area was popular for its fishing, hunting and resort opportunities. In 1900, the Village of Lake Villa became incorporated, and most of the lake now lies within the village municipal boundaries. In 1894, the Allendale Farm for Boys (now Allendale School) was established on the west shore. Lehmann Park, on the southeast shore, was created in 1921. Cedar Lake was dammed in the late 1920's with the installation of a spillway on the southeast shore. Two beaches that are no longer in operation, Sherwood Park (est. 1924) and Cedar Lake Park (est. 1949) were open to the public until 1991 and 2000, respectively. Cedar Lake Park also offered non-motorized boat rentals.

For the most part, few lake management practices have been implemented in Cedar Lake. Periodic aquatic herbicide treatments have been conducted on 1.35 acres of the property formerly known as Fowler's Subdivision, now called Cedar Lake Park. In 2003, 270 pounds of Navigate® were applied in this area to control Eurasian water milfoil (EWM) and spatterdock. No single organization has acted as lake guardian in the past and complete lake management records do not exist.

In addition to 2003, the we have collected water quality data in 1990, 1992, 1993 and 1998. Except for 1986, a volunteer working through the Illinois Environmental Protection Agency's (IEPA) Volunteer Lake Monitoring Program has taken Secchi disk readings since 1985. We created a bathymetric map of the lake in 1990 (Appendix E).

Cedar Lake is home to several Illinois State threatened and endangered species. Four are aquatic plants: water marigold (*Bidens beckii*), white-stemmed pondweed (*Potamogeton praelongus*), grass-leaved pondweed (*Potamogeton gramineus*), and fernleaf pondweed (*Potamogeton robbinsii*). In the past century, the water marigold has been located in three lakes in Illinois, all in Lake County. In 2003 we found healthy populations scattered around Cedar Lake, and a small population was located in Deep Lake. Gray's Lake harbored this rare plant until shortly after 1969, when the location where it was growing was buried with sand in an effort to create Jones Island Beach. State threatened fish that were found in Cedar Lake are the banded killifish (*Fundulus diaphanous*) and the blackchin shiner (*Notropis heterodon*). State endangered fish in Cedar Lake are the Iowa darter (*Etheostoma exile*) and the blacknose shiner (*Notropis heterolepis*). In 1978, the Illinois Department of Natural Resources (IDNR) captured a lake

sturgeon (*Acipenser fulvescens*), another state endangered fish. Three other lake sturgeon sightings, the latest in 1995, have since occurred, although they were not verified by the IDNR. The IDNR assessed the fishery in 1977, 1992, 1996 and 2001.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Cedar Lake is used for boating, swimming, fishing, and aesthetics. Lehmann Park, operated by the Village of Lake Villa, offers a playground, picnic area, boat launch (limited to 10 horsepower) and a beach. We have conducted bacteria testing for this beach since 1988. To date, the beach has been closed due to high bacteria on only two occasions, once in 2002 and once in 1996. Lehmann Park is open only to residents of Lake Villa. The Belmoral Park subdivision has a park and beach for their association members with a playground and boat launch for small non-motorized boats. Cedar Lake Park, historically called Fowler's Subdivision Park, offers a beach and playground for their association members. Sherwood Park Beach operated from 1924 until 1991, and Cedar Lake Park (located on the south shore) operated from 1949 until 2000. Both were open to the general public.

Area residents wish to keep the lake in its present state, since it is a high quality ecosystem. Possible impacts of concern are stormwater runoff, an increased Canada goose population, encroaching EWM, aquatic herbicide use in the lake, and an increasing number of large size motorboats on the lake. Although the launch at Lehmann Park is limited to boats with 10 HP, some residents living on the north shore have boats with engines much larger, up to 50 HP, which is ***illegal*** on Cedar Lake. According to Lake Villa ordinance, "No motorboat propelled by an internal combustion engine, which has a manufacturer's rating in excess of ten (10) horsepower, shall be operated on any portion of Cedar Lake or any other body of water, excluding Deep Lake, within the jurisdiction of the Village." (Ord. 2003-06-02, 6-11-2003). Even though portions of the lake bottom are privately owned, 2000 Illinois Compiled Statutes states that "The corporate authorities in all municipalities have jurisdiction over all waters within or bordering upon the municipality, to the extent of 3 miles beyond the corporate limits, but not beyond the limits of the State." (5/7-4-4. Jurisdiction over waters)

LIMNOLOGICAL DATA – WATER QUALITY

Water samples were collected each month, from May through September 2003, at the deepest location (Figure 1). Samples were collected at three feet to represent water from the oxygenated zone (epilimnion) and 38-40 feet to represent water from the anoxic zone (hypolimnion). All samples were analyzed for a variety of parameters. The 2003 and 1998 water quality data can be found in Table 1, Appendix A. The 1993, 1992 and 1990 water quality data can be found in Table 2, Appendix A.

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. This is typical of nutrient-enriched deep lakes like

INSERT FIGURE 1

Cedar Lake. This phenomenon is a natural occurrence and is not necessarily a bad thing if enough of the lake volume remains well oxygenated. This is the case for Cedar Lake, in which at least 80% of the lake volume had a minimum of 5.0 milligrams per liter (mg/L) of dissolved oxygen (DO) during each year this parameter was measured. A 5.0 mg/L concentration of DO is considered adequate to support aquatic life, since some aquatic life, such as fish, suffer from oxygen stress below this amount.

When stratification occurred in Cedar Lake, oxygen was depleted in the hypolimnion, triggering chemical reactions at the sediment surface. These reactions, which commonly occur in most stratified lakes, result in the release of nutrients such as phosphorus and nitrogen from the sediment interface into the water column, and are known as internal loading. Typically, the hypolimnion is thermally isolated from the epilimnion during the summer, and nutrients build up in the bottom waters, reaching the sunlit surface waters of the epilimnion during fall turnover.

Total phosphorus (TP) is a key nutrient for algal growth, and in lakes across Lake County, the median TP concentration for epilimnetic samples is 0.059 mg/L. During 2003, Cedar Lake had an average TP concentration of 0.021 mg/L in the epilimnion. TP averages in Cedar Lake fluctuated from a low of 0.015 mg/L (1998) to a high of 0.027 (1993). These concentrations are very low, which is exceptional and unusual for a lake in Lake County to maintain its TP levels over this 11 year time period. This is a testimony to the high water quality in Cedar Lake. Sources of TP may be a result of internal loading from the sediment and external sources such as the watershed. Some residents did have concerns about the inputs from the construction of soccer fields during the fall of 2002 and spring of 2003 just south of Cedar Lake. A small inlet flows intermittently from this property, owned by the American Aid Society of German Descendants. The phosphorus and sediment loading from the construction site to Cedar Lake is unknown. The fields have since been seeded and are now covered with grass. If this area had been a significant source of TP, concentrations in the epilimnion would have been notably higher, which was not the case in 2003. To prevent this location and other residential areas from becoming a phosphorus source to the lake, the fields and lawns should be cared for in an environmentally friendly way, such as determining the actual need (if any) for fertilizer through soil testing, and using a no or low phosphorus formulation of fertilizer once the turfgrass is established. TP averages also fluctuated in the hypolimnion, ranging from a low of 0.039 mg/L in 1998 to a high of 0.070 mg/L in 2003. Although this is over two times lower than the Lake County median of 0.186 mg/L for hypolimnetic samples, this is the highest seasonal average for Cedar Lake.

The other nutrient critical for algae growth is nitrogen. Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen, and is typically bound up in algal cells. In Cedar Lake's epilimnion, TKN concentrations increased from an average of 0.66 mg/L in 1992 to 1.17 mg/L in 2003. In the hypolimnion, the average TKN concentration increased from 0.63 mg/L in 1992 to 2.28 mg/L in 2003. The Lake County TKN medians were 1.22 mg/L in epilimnetic samples and 2.25 mg/L in hypolimnetic samples. Although the 2003 seasonal averages are close to Lake County medians, TKN increased by 77% in the epilimnion and by 262% in the hypolimnion within this eleven year time frame. Sources of TKN are numerous, and include rain, fertilizer, the atmosphere and other non-point sources, and can be difficult to pinpoint, and virtually impossible to control.

The ratio of total nitrogen (TN), to total phosphorus (TP) in the epilimnion indicates if the lake is in shorter supply of nitrogen or phosphorus. Lakes with TN:TP ratios greater than 15:1 are limited by phosphorus. Those with ratios less than 10:1 are limited by nitrogen. In 2003, the TN:TP ratio of Cedar Lake was 56:1, which means it is limited by phosphorus. Most lakes throughout Lake County are phosphorus limited. TP also plays a role in determining the trophic state index (TSI), which classifies lakes according to the overall level of nutrient enrichment. Using the TP concentration in the epilimnion, the TSI score can be calculated. The TSI score falls within the range of one of four categories: hypereutrophic, eutrophic, mesotrophic and oligotrophic. Hypereutrophic lakes are those that have excessive nutrients, with nuisance algae growth reminiscent of "pea soup" and have a TSI score greater than 70. Lakes with a TSI score of 50 or greater are classified as eutrophic or nutrient rich, and are productive lakes in terms of aquatic plants and/or algae and fish. Mesotrophic and oligotrophic lakes are those with lower nutrient levels. These are very clear lakes, with little algae growth. Most lakes in Lake County are eutrophic. The trophic state of Cedar Lake in terms of its phosphorus concentration during 2003 was mesotrophic, with a score of 48. During each year except for 1993, Cedar Lake was categorized as a mesotrophic lake. However, low TP concentrations can also be attributed to high plant densities. In 1993, the average TP concentration was a little higher, resulting in a eutrophic TSI rank. In 2003, Cedar Lake ranked #11 out of 130 Lake County lakes based on average total phosphorus concentrations (Table 3, Appendix A). Lakes with relatively low nutrients, such as Cedar Lake, can be more sensitive to small increases of TP, resulting in noticeable algae blooms.

Nuisance algal blooms typically flourish in July and August, causing lower water clarity. In Cedar Lake, we did notice lower water clarity at the sampling point and isolated algal blooms bordered by plants in August 2003. The area had received very little rain between the July and August sampling dates, and the water elevation decreased, which didn't allow much water movement through the plant beds to disperse the blooms. Although there was a definite decrease in clarity during August, these isolated pockets within the plant beds and near the Lehman Park launch might have appeared less dramatic if they had been dispersed. If the algae population had indeed increased throughout the lake over the years, the TP concentrations in the epilimnion would have also increased, and the August TP concentration would have most likely been higher than in the other months during 2003. In fact, not only have the TP averages remained stable in Cedar Lake, the concentration in August 2003 was actually lower than in July and September of 2003.

Water clarity is usually the first thing people notice about a lake, and typifies the overall lake quality. The Illinois Department of Public Health suggests that a lake has clarity readings of at least 4 feet deep for swimming safety in order to see submerged objects. The Lake County median clarity for 130 lakes is 3.41 feet deep. The readings in Cedar Lake far surpass this, with a seasonal average of 12.15 feet deep for the 2003 season. Although planktonic algae was not a problem throughout 2003, the August algal bloom did cause the Secchi disk reading to drop from 8.69 feet in July to 5.74 feet. The water clarity rebounded in September when the reading was 11.94 feet. Seasonal clarity averages throughout the years have fluctuated, but has produced a weak increasing overall trend. Water clarity has also been measured by a volunteer participating in the Illinois Environmental Protection Agency's Volunteer Lake Monitoring Program (VLMP)

in 1985 and from 1987-2003. Figure 2 shows this data using Volunteer Lake Monitoring Program (VLMP) information, and the Lakes Management Unit (LMU) information. The excellent water clarity in Cedar Lake is a result of very low total suspended solids (TSS). TSS are composed of nonvolatile suspended solids (NVSS), non-organic materials such as clay or sediment particles, and volatile suspended solids (VSS), algae and other organic matter.

INSERT FIGURE 2. SECCHI TIMETABLE

An increase in TSS normally results in a decrease in water clarity. Since 1990, TSS seasonal averages in Cedar Lake changed very little, ranging from 1.3 mg/L in 1992 to 3.1 mg/L in 1998. This higher TSS concentration resulted in the lowest historical Secchi disk average of only 8.5 feet. We noticed that after Eurasian water milfoil beds died back after June of 1998, the water clarity decreased for the remainder of the season. Because fewer plants were present to stabilize the sediment, more sediment particles were swept into the water column through wind, wave and carp action. In 2003, the average TSS was 2.2 mg/L, more than 3 times lower than the Lake County median of 7.5 mg/L. The calculated NVSS concentrations averaged 1.4 mg/L during 2003, which constitutes 64% of the TSS. This suggests that sediment, not algae, is the major component of the suspended solids in Cedar Lake.

The IEPA has assessment indices to classify Illinois lakes for their ability to support aquatic life, swimming, or recreational uses. The guidelines consider several aspects, such as water clarity, phosphorus concentrations (for the trophic state index) and aquatic plant coverage. Cedar Lake fully supports aquatic life and swimming uses according to these guidelines. However, the lake is slightly impaired for recreational uses because of the plant coverage in the lake, which is estimated at 82% of the lake bottom. Cedar Lake has full overall use support.

Conductivity is a measurement of water's ability to conduct electricity via total dissolved solids (TDS) made up of minerals and salts in the water column. Lakes with residential and/or urban land uses in their watersheds often have higher conductivity readings and higher TSS concentrations than lakes that are not surrounded by development because of the use of road salts. Stormwater runoff from impervious surfaces such as roads and parking lots can deliver high concentrations of these salts to nearby lakes and ponds. In Cedar Lake, conductivity was measured only in 1998 and 2003. The average conductivity reading in the epilimnion is 0.7909 milliSiemens/cm for Lake County lakes. During both years, the conductivity readings in Cedar Lake were low, averaging 0.5932 milliSiemens per centimeter (mS/cm) in the epilimnion in 2003 and 0.5816 mS/cm in 1998. TDS concentrations in Cedar Lake were also lower than the Lake County median of 451 mg/L during 2003 and 1998 (344 mg/L and 318 mg/L, respectively). However, TDS has increased by 8% in the past five years, indicating that road salt may be impacting Cedar Lake. Unfortunately, there may not be much that can be done about increasing levels of TDS. Non-point runoff, such as that which picks up road salt and enters the lake during rain events, is very difficult to control.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

We randomly sampled locations in Cedar Lake each month for aquatic plants, and identified 28 species. We also identified one macroalgae, (*Chara*) and recorded shoreline plants. Table 4 lists the plants that were identified by their common and scientific names.

Table 5 in Appendix A lists the aquatic plant species and the frequency that they were found. The three aquatic plants found most frequently overall were Eurasian water milfoil (EWM) in 66% of all samples, sago pondweed (44% of all samples) and largeleaf pondweed (31% of all samples). Depending on their life cycles, some plants were more prevalent in some months than others. For example, in August and September, largeleaf pondweed was replaced by eelgrass in

the top three plants found in the lake. Cedar Lake harbors four Illinois state endangered plants including the water marigold (*Bidens beckii*), grass-leaved pondweed (*Potamogeton gramineus*), fernleaf pondweed (*Potamogeton robbinsii*), white-stemmed pondweed (*Potamogeton praelongus*), and Illinois state threatened grass-leaved pondweed (*Potamogeton gramineus*). We did not find grass-leaved pondweed in 2003. However, College of Lake County botanist Linda Curtis did identify this plant in 2002. She did not see this species in 2003, either. The state endangered plants are found in several locations throughout the lake (Figure 3), at times sharing space with EWM. Of concern is that the EWM may crowd out the beneficial native plants including these endangered species. It was noted, however, that for the most part the EWM-dominated plant beds were generally in water between 6 and 12 feet deep. Often, the beneficial, native plant beds, including the endangered species, were growing in about 4 feet of water or less, and were not dominated by EWM.

EWM has been periodically controlled by the milfoil weevil, *Euhrychiopsis lecontei*. *E. lecontei* is a native weevil, which feeds exclusively on milfoil species. It was originally discovered while investigating declines of EWM in a Vermont lake in the early 1990s. It was discovered in northeastern Illinois lakes, including Cedar Lake, in 1995. During 1995 and 1998, the weevils caused a noticeable decrease in the size of the milfoil beds. In 2003, the weevils were present, but we did not see a noticeable decrease in the milfoil beds. Best results of milfoil control by the weevils are achieved in lakes that have milfoil infestations in shallow depths undisturbed by recreational and management activities. Research has shown that approximately 1-2 weevils per stem are needed in order to see significant damage and decline of an EWM bed. The recent increase in boats with large motor sizes may disturb weevil populations. Milfoil beds that reached the water's surface covered about 29 acres, which is less than 10% of the water surface area. Native plant beds covered about 22 acres. Total plant coverage, which includes plants that did not reach the surface was approximately 82% of the lake bottom.

Aquatic plants will not photosynthesize at water depths receiving less than 1% of the available surface sunlight. Water clarity and depth are the major limiting factors in determining the maximum depth at which aquatic plants will grow in a specific lake. Because of the excellent water clarity in 2003, the 1% light level reached at least 12.2 feet deep from May through September in Cedar Lake. The maximum depth to which plants were found was 16.7 feet. The unwritten "hands off" policy for aquatic plant management for the entire lake has been beneficial in preserving the abundant locations of Illinois endangered and threatened plants and the variety of native plants.

Residents have expressed concern about the use of boats with engines larger than 10 horsepower on Cedar Lake, because of the possible impacts to the endangered plants. Although the launch at Lehmann Park is limited to boats with 10 HP, some residents living on the north shore have boats with engines much larger, up to 50 HP, which is ***illegal*** on Cedar Lake. According to Lake Villa ordinance, "No motorboat propelled by an internal combustion engine, which has a manufacturer's rating in excess of ten (10) horsepower, shall be operated on any portion of Cedar Lake or any other body of water, excluding Deep Lake, within the jurisdiction of the Village." (Ord. 2003-06-02, 6-11-2003). Even though portions of the lake bottom are privately owned, 2000 Illinois Compiled Statutes states that "The corporate authorities in all municipalities have jurisdiction over all waters within or bordering upon the municipality, to the extent of 3 miles

beyond the corporate limits, but not beyond the limits of the State." (5/7-4-4. Jurisdiction over waters)

Some residents were concerned about the use of aquatic herbicides in front of the Cedar Lake Park homeowner's association beach. During 2003, a certified applicator applied 270 pounds of Navigate®, a granular 2,4-D product, to 1.35 acres owned by the association to control EWM and spatterdock. In 2002, glyphosate was applied to spatterdock plants in the same area with little resulting control. Although residents nearby this association property are concerned with the use of any aquatic herbicides, the owner of a lake bottom parcel can apply these products to their property if they choose to. However, any drift from the herbicide that kills plants on neighboring property would warrant a pesticide misuse complaint with the Illinois Department of Agriculture. The Cedar Lake Park association, in order to improve their relationship with their neighbors, could alter their aquatic plant management plan by using manual techniques to remove unwanted plants since it is a small area.

Floristic quality index is a measurement designed to evaluate the closeness of the flora (plants species) of an area to that with 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. Each floating and submersed aquatic plant in a lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). These numbers are then used to calculate the floristic quality index (FQI). A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake, and better plant diversity. Nonnative species are included in the FQI calculations for Lake County lakes. The FQI scores of 86 lakes measured from 2000 through 2003 ranges from 0 to 37.2, with an average of 14.7. Cedar Lake has an excellent floristic quality of 35.6, which is second place out of 118 lakes measured for FQI since 2000.

Insert FIGURE 3 PLANT LOCATIONS

Table 4. Aquatic and shoreline plants on Cedar Lake, May – September, 2003.

Aquatic Plants	
Water marigold*	*Bidens beckii*
Coontail	*Ceratophyllum demersum*
Chara	*Chara spp.*
Elodea	*Elodea canadensis*
Water Stargrass	*Heteranthera dubia*
Northern Water Milfoil	*Myriophyllum sibiricum*
Eurasian Water Milfoil^	*Myriophyllum spicatum*
Slender Naiad	*Najas flexilis*
Southern Naiad	*Najas guadalupensis*
Spiny Naiad	*Najas marina*
Spatterdock	*Nuphar variegata*
White Water Lily	*Nymphaea tuberosa*
Largeleaf Pondweed	*Potamogeton amplifolius*
Curlyleaf Pondweed	*Potamogeton crispus*
Threadleaf Pondweed	*Potamogeton diversifolius*
Illinois Pondweed	*Potamogeton illinoensis*
Floating-leaf Pondweed	*Potamogeton natans*
Whitestem Pondweed*	*Potamogeton praelongus*
Small Pondweed	*Potamogeton pusillus*
Claspingleaf Pondweed	*Potamogeton richardsonii*
Fernleaf Pondweed*	*Potamogeton robbinsii*
Flatstem Pondweed	*Potamogeton zosteriformis*
White Water Crowfoot	*Ranunculus longirostris*
Giant Duckweed	*Spirodela polyrhiza*
Sago Pondweed	*Stuckinia pectinatus*
Common Bladderwort	*Utricularia vulgaris*
Eel Grass	*Vallisneria americana*
Watermeal	*Wolffia spp.*
Shoreline Plants	
Yarrow^	*Achillea millefolium*
Jewelweed	*Cirsium arvense*
Swamp Loosestrife	*Decodon verticillatus*
Blue-flag Iris	*Iris versicolor L.*
Purple Loosestrife^	*Lythrum salicaria*
White Sweet Clover^	*Melilotus alba*
Reed Canary Grass^	*Phalaris arundinacea*
Common Reed^	*Phragmites australis*
Pickerelweed	*Pontederia cordata L.*

Table 4. Aquatic and shoreline plants on Cedar Lake, May – September, 2003, cont'd.

Hardstem Bulrush	*Scirpus acutus*
Softstem bulrush	*Scirpus validus*
Cattail	*Typha spp.*
Wild grape	*Vitis sp.*
<u>*Trees/Shrubs*</u>	
Box Elder	*Acer negundo L.*
Silver Maple	*Acer saccharinum*
Green Ash	*Fraxinus pennsylvanica*
Locust	*Gelditsia sp.*
Black Walnut	*Juglans nigra L.*
Honeysuckle^	*Lonicera sp.*
Red Mulberry	*Morus rubra L.*
Cottonwood	*Populus deltoides*
Oak	*Quercus spp.*
Bur Oak	*Quercus macrocarpa*
Buckthorn^	*Rhamnus sp.*
Staghorn Sumac	*Rhus typhina*
Willow	*Salix spp.*
Common Elderberry	*Sambucus canadensis*
Basswood	*Tilia americana*

*Endangered in Illinois
^Exotic plant or trees species

LIMNOLOGICAL DATA - SHORELINE ASSESSMENT

In August 2003, LCHD staff assessed the shoreline of Cedar Lake. Approximately 58% (13,363 feet) of the shoreline is classified as developed. Figure 4 shows the three most common shoreline types around Cedar Lake: buffer (34%), wetland (25%) and woodland (14%). Approximately 97% of the shoreline classified as buffer was on developed property where the owners had allowed plants other than turfgrass to meet the shoreline. Because turfgrass has a shallow root system of about 2-3 inches, it does not stabilize the shoreline against erosion. Native deep-rooted plants such as those noted around the Cedar Lake stabilize the shoreline better, as well as adding good wildlife habitat. In addition, the milfoil weevil, which has played a role in decreasing the size of the Eurasian water milfoil beds, needs proper overwintering habitat such as leaf litter and mud, which are typically found on naturalized shorelines or shores with good buffer strips. Only 487 feet of the shoreline is mowed lawn to the water's edge. The majority of the shoreline slope is flat, which is one reason that Cedar Lake has only 4.7 % of the shoreline eroding (Figure 5). Other reasons include the small length of shoreline with mowed lawn to the edge and the relatively low boat traffic. The south side of the island has had a

noticeable shoreline loss since 1990. This area should be protected since it does offer good wildlife habitat and will only add sediment to the water column if it continues to erode. Approximately 55% of the eroding Cedar Lake shoreline is woodland and 25% is lawn, both of which are only slightly eroding. The moderately and severely eroding shorelines are buffer, and are located on the island and along shoreline owned by Allendale School. Although buffer strips are usually touted as being able to withstand erosion, they can erode if they are not properly maintained.

During 2003, we measured water elevation of the lake each month. The largest change in elevation was a 4.68-inch decrease occurring between August and September. Over the season, the change between elevation readings was greatest between July through September, with a loss in elevation each month, totaling 6.96 inches. These elevation changes are typical for lakes in Lake County and did not fluctuate greatly. Large water elevation fluctuations over time can lead to shoreline erosion.

The watershed feeding Cedar Lake is small, consisting of 853.5 acres, 300 acres of which is Cedar Lake itself (Figure 6). The watershed was delineated using ARCView, a geographic information software, and new two-foot topography maps from Lake County Stormwater Management Commission. A small watershed generally transports less pollutant loading to lakes than a larger watershed. However, the quality of the stormwater entering a lake depends on the land uses within the watershed. Developed land can deliver more pollutants such as sediment and nutrients than undeveloped areas such as prairies or forests. Figure 7 shows the land uses within the Cedar Lake watershed. This map is based on 2000 data updated by Lake County Planning and Zoning. The largest percent of land that drains into Cedar Lake is categorized as forest and grassland, which comprises approximately 16% of the total watershed (Table 6, Appendix A). Residential land use follows, with approximately 14% of the total watershed. Public and private open space, the third largest land use, encompasses about 9% of the watershed. Residents expressed concern about the runoff that Cedar Lake receives from the construction of soccer fields during the fall of 2002 and spring of 2003 just south of Cedar Lake. A small inlet flows from this property, owned by the American Aid Society of German Descendants. The phosphorus and sediment loading from the construction site to Cedar Lake is unknown. To date, the property has been seeded and is no longer exposed soil, but turfgrass. Care for the fields should be carried out in a "lake friendly" manner, with the use of low or no phosphorus fertilizers if the soils from this property require any fertilizer to be used at all after turfgrass has been established. According to the land use map, the soccer fields comprise about 3.3 acres, which is 0.38 % of the total watershed. Another concern residents had was the impacts from the construction of a new senior living center on the east side of the lake. A detention basin collects stormwater from this property before flowing into a depressional wetland on the east side of the Wisconsin Central railroad. Before the water enters Cedar Lake from this wetland, the area needs to flood and reach the high water mark. It is unknown how often the water elevation reaches this level on a yearly basis. At this time, there is not continual flow from this area into Cedar Lake. The parcel, which includes the building, lawn and some forest, encompasses approximately 8.7 acres, which is 1% of the total watershed. Most of what will drain to the detention pond is now the parking lot, which can still add sediment with attached phosphorus or nitrogen and road salt. Some of the surrounding lawn will also drain to the pond. Depending on how the lawn is cared for, nutrients from fertilizers can eventually enter the

detention pond also. The phosphorus and sediment loading to Cedar Lake from the site during construction is unknown. The combined area of this and the soccer fields in question is about 12 acres, or 1.38% of the total watershed and should not impact the high water quality of Cedar Lake.

We also noticed the presence of aggressive exotic shoreline plant species, most notably along the east shoreline, the main island, the two small islands in the northwest corner, and along the southwest shoreline (Figure 8). The exotic species are listed in Table 4 and include buckthorn and honeysuckle shrubs, reed canary grass, common reed, and purple loosestrife. These species are especially detrimental, as they can crowd out native, beneficial plants used by wildlife. Their removal is recommended.

Insert figure 4, shoreline type

INSERT FIGURE 5, SHORELINE EROSION

INSERT FIGURE 6, WATERSHED MAP

INSERT FIG. 7 LAND USE

INSERT FIGURE 8, EXOTIC SPECIES

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Table 7 lists the wildlife species observed at Cedar Lake. Both Cedar Lake and the adjacent IDNR Nature Preserve at the northwest lobe of the lake are designated as an Illinois State Natural Area. Mature trees, and the relatively large amount of shoreline classified as buffer, woodland and wetland offers good habitat for a variety of wildlife. The ospreys, listed as Illinois endangered species, were observed late in the season and were considered to be migrating through the area. Another interesting life form we found in Cedar Lake was a freshwater sponge. An invertebrate called a bryozoan (species name, *Cristatella mucedo*) was identified in 1990 by staff of Wright State University of Dayton Ohio. Until 1990, this bryozoan was only known in Illinois from two historic records dating 1890 and 1894. This species of bryozoan is known to be sensitive to pollutants and may still be present in Cedar Lake. Of concern was the discovery of zebra mussel shells along the Lehmann Park beach. The Village of Lake Villa has installed a sign at the launch warning people that zebra mussels exist in Cedar Lake. It is believed that these mussels spread to this country in the mid 1980's by cargo ships from Europe that discharged their ballast water into the Great Lakes. The mussels spread throughout the Great Lakes and by 1991 had made their way into the Illinois and Mississippi Rivers. In 1999, the first sighting of the mussel in Lake County (besides Lake Michigan and the Chain of Lakes) occurred. Currently, 18 inland lakes in the County are known to be infested with the zebra mussel, but this number could be much higher, since the mussel has probably gone unnoticed in many lakes. Due to their quick life cycle and explosive growth rate, zebra mussels can quickly edge out native mussel species. Negative impacts on native bivalve populations include interferences with feeding, habitat, growth, movement and reproduction. The impact that the mussels have on fish populations is not fully understood. However, zebra mussels feed on algae, a major food source for planktivorous fish, such as bluegills, which are food for bass and pike. Zebra mussels have also caused economic problems for large power plants, public water supplies, and industrial facilities, where they clog water intake pipes. Recent studies on the transport of the zebra mussel have shown that they can be found in any area of a boat that holds water, including the engine cooling system, bilge water, and bait buckets used in fishing. The researchers also found that many of the mussel larvae were being transported via aquatic plants that were taken from one lake to another on boats or boat trailers. The larvae did not appear to be transported by attaching to the sides of the boats themselves. At this time, there are no methods for control for lake infestations that are selective for zebra mussels.

It is recommended that residents (1) educate themselves on what the species looks like and how it can be spread; (2) remain diligent about removing plants and emptying all sources of water from boats being transferred from Cedar Lake or to any lake; and (3) post an additional sign at the Lehman Park launch educating boaters about the zebra mussel (and Eurasian watermilfoil), the negative impacts it can have on a lake and ways to prevent the spread of the organism. These signs can be purchased for approximately $15.00 from the Indiana-Illinois Sea Grant College Program web site at http://www.iisgcp.org. Once on the home page, go to Outreach, Biological Resources, Publications, Exotic Species Advisory Sign.

Table 7. Wildlife species observed on Cedar Lake, May – September 2003.

Birds	
Mute Swan	*Cygnus olor*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Wood Duck	*Aix sponsa*
Ring-billed Gull	*Larus delawarensis*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Osprey*	*Pandion haliaetus*
Belted Kingfisher	*Megaceryle alcyon*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Pewee	*Contopus virens*
Barn Swallow	*Hirundo rustica*
Tree Swallow	*Iridoprocne bicolor*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Catbird	*Dumetella carolinensis*
American Robin	*Turdus migratorius*
Yellow Warbler	*Dendroica petechia*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Northern Oriole	*Icterus galbula*
Northern Cardinal	*Cardinalis cardinalis*
American Goldfinch	*Carduelis tristis*
White-breasted nuthatch	*Sitta carolinensis*
Mammals	
*Eastern Chipmunk	*Tamias striatus*
*Gray Squirrel	*Sciurus carolinensis*
Reptiles	
Painted Turtle	*Chrysemys picta*
Insects	
Cicadas	*Cicadidae*
Dragonfly	*Anisoptera*
Damselfly	*Zygoptera*
Water Strider	*Gerridae*
Invertebrates	
Freshwater sponge	
Bryozoan	

Table 7. Wildlife species observed on Cedar Lake, May – September 2003

Fish	
Blacknose Shiner*	*Notropis heterolepis*
Bluntnose Minnow	*Pimephales notatus*
Lake Chubsucker	*Erimyzon sucetta*
Mimic Shiner	*Notropis volucellus*
Grass Pickerel	*Esox americanus*
Pumpkinseed	*Lepomis gibbosus*
Warmouth	*Chaenobryttus gulosis*
Bluegill	*Lepomis macrochirus*
Redear Sunfish	*Lepomis megalotis*
Large-mouthed Bass	*Micropterus salmoides*
Mussels	
Giant Floater	*Pyganodon grandis*
Zebra Mussel^	*Dreissena polymorpha*

* Endangered in Illinois
+Threatened in Illinois
^ Exotic species

On July 17, 2003, staff from Southern Illinois University seined Cedar Lake, which resulted in the collection of the Illinois State endangered blacknose shiner. Staff indicated that these fish were present in large numbers. Only high quality lakes such as Cedar Lake are able to sustain populations of threatened and endangered aquatic plants and fish. The Illinois Department of Natural Resources surveyed Cedar Lake in 1992, 1996 and 2001. Eighteen species of fish were collected in 2001, which is slightly lower than in 1992 during which 23 species were collected. In terms of threatened and endangered species two of the six T & E species known to occur in the lake were sampled in IDNR's 2001 survey; blacknose shiners and banded killifish. Iowa darters were not collected with the seine this time. The blackchin shiner, starhead topminnow and lake sturgeon (only one fish was previously recorded in 1978) were not collected. The 2001 fisheries survey reports that the fishery in Cedar Lake continues to be relatively diverse.

EXISTING LAKE QUALITY PROBLEMS

- *Invasive Aquatic Plants*

Thick beds of Eurasian water milfoil, an invasive, exotic plant species dominated approximately 29 acres (about 10% of the surface area) of Cedar Lake. Although this lake hosts an excellent variety of native aquatic plants, the Eurasian water milfoil can pose a problem to these species.

- *Invasive Shoreline Plant Species*

Invasive shoreline plants are scattered around Cedar Lake, and not in large populations at this time. However, they can cause problems in large numbers. Their removal now would curtail their expansion.

- *Shoreline Erosion*

Although only 4.7% of the total shoreline around Cedar Lake is eroding, these shorelines will continue to erode if protective measures are not taken. The areas in most need of protection are the southern shore and west end of the island, and an area owned by Allendale School.

- *Zebra Mussels*

Zebra mussels were identified for the first time in Cedar Lake in 2003. Their presence may have significant impacts on water quality and the food chain in the lake in the future. Signage has been posted at Lehmann Park to inform lake users of the zebra mussel presence and to prevent the spread of this exotic species to other inland lakes.

- *Canada Geese*

Some residents voiced concern over the number of Canada geese frequenting Cedar Lake. Canada geese can add nutrients (especially phosphorus), and bacteria to a lake through their feces. We did not see excessive numbers of Canada geese during the 2003 sample visits.

- *Lack of Enforcement of 10 Horsepower Engine Limit*

Although the launch at Lehmann Park is limited to boats with 10 HP, some residents living on the north shore have boats with engines much larger, up to 50 HP, which is ***illegal*** on Cedar Lake. According to Lake Villa ordinance, "No motorboat propelled by an internal combustion engine, which has a manufacturer's rating in excess of ten (10) horsepower, shall be operated on any portion of Cedar Lake or any other body of water, excluding Deep Lake, within the jurisdiction of the Village." (Ord. 2003-06-02, 6-11-2003). Even though portions of the lake bottom are privately owned, 2000 Illinois Compiled Statutes states that "The corporate authorities in all municipalities have jurisdiction over all waters within or bordering upon the municipality, to the extent of 3 miles beyond the corporate limits, but not beyond the limits of the State." (5/7-4-4. Jurisdiction over waters)

POTENTIAL OBJECTIVES FOR CEDAR LAKE MANAGEMENT PLAN

I. Enhance Aquatic Plant Management Plan
II. Eliminate or Control Exotic Species
III. Shoreline Erosion Control
IV. Zebra Mussels
V. Canada Geese Control
VI. Enforcement of Engine Limit Ordinance

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

Objective I: Enhance Aquatic Plant Management Plan

All aquatic plant management techniques have both positive and negative characteristics. If used properly, they can all be beneficial to a lake's well being. If misused or abused, they all share similar outcomes - negative impacts to the lake. Putting together a good aquatic plant management plan should not be rushed. Plans should consist of a realistic set of goals well thought out before implementation. The plan should be based on the management goals of the lake and involve usage issues, habitat maintenance/restoration, and limitations of the lake. For an aquatic plant management plan to achieve long term success, follow up is critical. A good aquatic plant management plan considers both the short and long-term needs of the lake. The management of the lake's vegetation does not end once the nuisance vegetation has been reduced/eliminated. It is critical to continually monitor problematic areas for regrowth and remove as necessary. An association or property owner should not always expect immediate results. A quick fix of the vegetation problems may not always be in the best interest of the lake. Sometimes the best solutions take several seasons to properly solve the problem. The management options covered below are commonly used techniques that are coming into wider acceptance and have been used in Lake County. There are other plant management options that are not covered below as they not are very effective, unreliable, or are too experimental to be widely used. Eurasian water milfoil has been a threat in Cedar Lake, and covers 29 acres of the lake's surface. In some years, the water milfoil weevils have helped control some of the milfoil beds. Best results of milfoil control by the weevils are achieved in lakes that have shallow milfoil infestations in shallow depths where it is undisturbed by recreational and management activities.

It is imperative to preserve the large variety of beneficial native aquatic plants and endangered/threatened plants in Cedar Lake. Few lakes in Lake County, or for that matter, in Illinois have the species variety that Cedar Lake has. With these points in mind, the use of a large-scale aquatic herbicide treatment should be avoided at all costs.

Option 1: No Action

If the lake is dominated by *native*, *non-invasive* species, the no action option could be ideal. Under these circumstances native plant populations could flourish and keep nuisance plants from becoming problematic. However, if a no action aquatic plant management plan in a lake with non-native, invasive species, nothing would be done to control the aquatic plant population of the lake regardless of the type and extent of the vegetation. Nuisance vegetation could continue to grow until epidemic proportions are reached. Growth limitations of the plant and the characteristics of the lake itself (light penetration, lake morphology, substrate type, etc.) will dictate the extent of infestation. Rooted plants, such as curly leaf pondweed (*Potamogeton crispus*) and elodea (*Elodea canadensis*), will be bound by physical factors such as substrate type and light availability. Because of the impressive variety of native, beneficial plants and Illinois state threatened and endangered species that are found scattered around Cedar Lake, this option is recommended. Some control of the Eurasian water milfoil has occurred by the action of the water milfoil weevil, which is present in the lake.

Pros

There are positive aspects associated with the no action option for plant management. The first, and most obvious, is that there is no cost. However, if an active management plan for vegetation control were eventually needed, the cost would be substantially higher than if the no action plan had been implemented. Another benefit of this option would be the lack of environmental manipulation. Under the no action option, no chemicals, mechanical alteration, or introduction of any organisms would take place. This is important since studies have shown that nuisance plants are more likely to invade disrupted areas. If the lake contains native, non-invasive plant species, expansion of the native plant population would increase the overall biodiversity and health of the lake. Habitat, breeding areas, and food source availability would greatly improve. Use of the lake would continue as normal and in some cases might improve (fishing) if native plants keep "weedy" plants under control.

An additional benefit of the no action option is the possible improvement in water quality. Turbidity could decrease and clarity should increase due to sediment stabilization by the plant's roots. Algal blooms could be reduced due to decreased resource availability and sediment stabilization. However, the occurrence of filamentous algae may increase/remain stable due to their surface growth habitat. The lake's fishery could improve due to habitat availability, which in turn would have numerous positive effects on the rest of the lake's ecosystem.

Cons

Under the no action option, if nuisance vegetation is dominant in the lake and were uninhibited and able to reach epidemic proportions, there will be many negative impacts on the lake. By their weedy nature, the nuisance plants would out-compete the more desirable native plants. This could eventually, drastically reduce or even eliminate the native plant population of the lake and reduce the lake's biodiversity. The fishery of the lake may become stunted due the to lack of quality forage fish habitat and reduced predation. Predation will decrease due to the difficulty of finding prey in the dense stands of vegetation. This may cause an explosion in the small fish population and with food resources not increasing, growth of fish will be reduced. This situation does not exist in Cedar Lake, however. According to the IDNR fisheries reports, the populations are not stunted. Decreased dissolved oxygen levels, due to high biological oxygen demand from the excessive vegetation, will also have negative impacts on the aquatic life. Wildlife populations may also be negatively impacted by these dense stands of vegetation. Birds and waterfowl will have difficulty finding quality plants for food or in locating prey within the dense plant stands.

Water quality could also be negatively impacted with the implementation of the no action option. Deposition of large amounts of organic matter and release of nutrients upon the death of the massive stands of vegetation is a probable outcome of the no action option. These dead plants will contribute to the sediment load of the lake and could accelerate its filling in. The large nutrient release when the plants die back in the fall could lead to lake-wide algae blooms and an overall increase of the internal nutrient load.

In addition to the ecological impacts, many physical uses of the lake will be negatively impacted. Boating could be nearly impossible without becoming entangled in thick stands of plants. Swimming could also become increasingly difficult due to thick vegetation that would develop at beaches. Fishing could become more and more exasperating due in part to the thick vegetation and also because of the stunted fish population. In addition, the aesthetics of the lake will also decline due to large areas of the lake covered by tangled mats of vegetation and the odors that will develop when they decay. The combination of the above events could cause property values on the lake to suffer. Property values on lakes with weedy plant/algae problems have been shown to decrease by as much as 15-20%.

Costs

No cost will be incurred by implementing the no action management option. However, if in the future a management plan was initiated, costs might be significantly higher since a no action plan was originally followed.

Option 2: Aquatic Herbicides

Aquatic herbicides are the most common method to control nuisance vegetation/algae. When used properly, they can provide selective and reliable control. Products cannot be licensed for use in aquatic situations unless there is less than a 1 in 1,000,000 chance of any negative effects on human health, wildlife, and the environment. Aquatic herbicides are not allowed to be environmentally persistent, bioaccumulate, or have any bioavailability. Prior to herbicide application, licensed applicators should evaluate the lake's vegetation and, along with the lake's management plan, choose the appropriate herbicide and treatment areas, and apply the herbicides during appropriate conditions (i.e., low wind speed, D.O. concentration, temperature).

There are two groups of herbicides: contact and systemic. Contact herbicides, like their name indicates, kill on contact. These herbicides affect only the above ground portion of the plant that they come into contact with and therefore do not kill the root system. An example of a contact herbicide is diquat. Systemic herbicides are taken up by the plant and disrupt cellular processes, which in turn cause plant death. These herbicides kill both the above ground portions of the plant as well as the root system. An example of a systemic herbicide is fluridone. Both types of herbicides are available in liquid or granular forms. Liquid forms are concentrated and need to be mixed into water to obtain the desired concentration. The solution is then sprayed on the water's surface or injected into the water in the treatment areas. Granular herbicides are broadcast in a known rate over the treatment area where they sink to the bottom. Some granular products slowly release the herbicide, which is then taken up by the plant. These are referred to as SRP formulations (Slow Release Pellet). Other granular herbicides come in crystal form and dissolve as they come in contact with water. This is typical of herbicides such as copper sulfate. Many herbicides come in both liquid and granular forms to fit the management needs of the lake. Herbicide applications can either be done as whole lake treatments or as more selective spot treatments. Multiple herbicides are often mixed and applied together. This is called a tank mix. This is done to save time, energy, and cost.

Aquatic herbicides are best used on actively growing plants to ensure optimal herbicide uptake. For this reason, herbicides are normally applied mid to late spring when water temperatures are above 60^0F. This is the time of year when the plants are most actively growing and before seed/vegetative propagule formation. Follow up applications should be done as needed. When choosing an aquatic herbicide it is important to know what plants are present, which ones are problematic, which plants are beneficial, and how a particular herbicide will act upon these plants. The herbicide label is very important and should always be read before use. There may be more than one herbicide for a given plant. As with other management options, proper usage is the key to their effectiveness, benefits, and disadvantages.

It is imperative to preserve the large variety of beneficial native aquatic plants and endangered/threatened plants in Cedar Lake. These include the water marigold (*Bidens beckii*), grass-leaved pondweed (*Potamogeton gramineus*), fernleaf pondweed (*Potamogeton robbinsii*), white-stemmed pondweed (*Potamogeton praelongus*), and Illinois state threatened grass-leaved pondweed (*Potamogeton gramineus*). Few lakes in Lake County, or for that matter, in Illinois have the species variety that Cedar Lake has. With these points in mind, the use of a large-scale aquatic herbicide treatment should be avoided. During 2002 and 2003, an area encompassing 1.35 acres owned by the Cedar Lake Park homeowner's association was treated with 270 pounds of Navigate®, a granular 2,4-D product to control spatterdock and Eurasian water milfoil. This is the proper application rate of this aquatic herbicide for the control of spatterdock according to the product label. At times, their treatment of the area has caused strained relationships with adjacent neighbors, but the Cedar Lake Park association can legally use aquatic herbicides on the parcel that they own. In order to improve their relationship with their neighbors, the Cedar Lake Park association could alter their aquatic plant management plan by using manual techniques for plant removal since it is a small area. Because the plant beds may differ in size in different years, the association may still decide to apply aquatic herbicides if the plant beds are particularly dense. The use of a granular product such as what was used in 2003 is better than a liquid, since there is less potential for herbicide drift.

Pros

When used properly, aquatic herbicides can be a powerful tool in management of excessive vegetation. Often, aquatic herbicide treatments can be more cost effective in the long run compared to other management techniques. A properly implemented plan can often provide season long control with minimal applications. Ecologically, herbicides can be a better management option than using mechanical harvesting or grass carp. When properly applied, aquatic herbicides may be selective for nuisance plants such as Eurasian water milfoil but allow desirable plants such as American pondweed (*Potamogeton nodosus*) to remain. This removes the problematic vegetation and allows native and more desirable plants to remain and flourish with minimal manipulation.

The fisheries and waterfowl populations of the lake would benefit greatly due to an increase in quality habitat and food supply. Dense stands of plants would be thinned out and improve spawning habitat and food source availability for fish. Waterfowl population would greatly benefit from increases in quality food sources, such as large-leaf pondweed (*Potamogeton amplifolius*). Another environmental benefit of using aquatic herbicides over other management options is that they are organism specific. The

metabolic pathways by which herbicides kill plants are plant specific. Humans and other organisms do not possess these same pathways. Organisms such as fish, birds, mussels, and zooplankton are generally unaffected.

By implementing a good management plan with aquatic herbicides, usage opportunities of the lake would increase. Activities such as boating and swimming would improve due to the removal of dense stands of vegetation. The quality of fishing may improve because of improved habitat. In addition to increased usage opportunities, the overall aesthetics of the lake would improve, potentially increasing property values on the lake.

Cons

The most obvious drawback of using aquatic herbicides is the input of chemicals into the lake. Even though the United States Environmental Protection Agency (USEPA) approved these chemicals for use, human error can make them unsafe and bring about undesired outcomes. If not properly used, aquatic herbicides can remove too much vegetation from the lake. This could drastically alter biodiversity and ecological. Total or over-removal of plants can cause a variety of problems lake-wide. The fishery of the lake may decline and/or become stunted due to predation issues related to decreased water clarity. Other wildlife, such as waterfowl, which commonly forage on aquatic plants, would also be negatively impacted by the decrease in food supply.

Another problem associated with removing too much vegetation is the loss of sediment stabilization by plants, which can lead to increased turbidity and resuspension of nutrients. The increase in turbidity can cause a decrease in light penetration, which can further aggravate the aquatic plant community. The resuspension of nutrients will contribute to the overall nutrient load of the lake, which can lead to an increased frequency of noxious algal blooms. Furthermore, the removal of aquatic vegetation, which competes with algae for resources, can directly contribute to an increase in blooms.

After the initial removal, there is a possibility for regrowth of vegetation. Upon regrowth, weedy plants such as Eurasian water milfoil and coontail quickly reestablish, form dense stands, and prevent the growth of desirable species. This causes a decrease in plant biodiversity. Additionally, these dense stands of nuisance vegetation can lead to an overpopulation of stunted fish due to a decrease in predation of forage species by predatory fish. This disruption in the fisheries can have negative impacts throughout the ecosystem from zooplankton to higher organisms such as waterfowl and other wildlife. Additionally, some herbicides have use restrictions regarding their use in relation to fish, swimming, irrigation, etc.

Over-removal, and possible regrowth of nuisance vegetation that may follow will drastically impair recreational use of the lake. Swimming could be adversely affected due to the likelihood of increased algal blooms. Swimmers may become entangled in large mats of filamentous algae. Blooms of planktonic species, such as blue-green algae, can produce harmful toxins as well produce noxious odors. If regrowth of nuisance vegetation were to occur, motors could become entangled making boating difficult.

Fishing would also be negatively impacted due to the decreased health of the lake's fishery. The overall appearance of the lake would also suffer due to an increase in unsightly algal blooms and massive stands of vegetation. This in turn could have an unwanted effect on property values. Studies have shown that problematic algal blooms can decrease property values by 15-20%.

Costs

The area owned by the Cedar Lake Park homeowner's association is 1.35 acres. The application rate for the granular formulation of 2,4-D to control spatterdock that was used in 2003 is 200 pounds per surface acre. This formulation costs about $350-425 per surface acre, which for this area would be about $472-573 at the rate used to control spatterdock.

Option 3: Mechanical Harvesting

Mechanical harvesting involves the cutting and removal of nuisance aquatic vegetation by large specialized boats with underwater cutting bars. Plants are cut below the water at a level that will restore use of the lake. Typically, problematic areas are harvested and other areas are left alone. However, some management plans call for more widespread harvesting, especially when nuisance plants such as Eurasian water milfoil become dominant. The total removal or over removal (neither of which should never be the plan of any management entity) of plants by mechanical harvesting should never be attempted. To avoid complete or over removal, the management entity should have a harvesting plan that determines where and how much vegetation is to be removed. This option should not be used for several reasons. This would disturb habitat for the water milfoil weevil, which has controlled the milfoil beds in some years. Their populations should be left undisturbed in order to allow them to keep sustainable numbers, which can control the milfoil in years to come. Another reason to avoid this method is to preserve the rare plants in the lake, some of which are in close proximity to the milfoil beds, and could be uprooted and cut.

Option 4: Hand Removal

Hand removal of excessive aquatic vegetation is a commonly used management technique. Hand removal is normally used in small ponds/lakes and limited areas for selective vegetation removal. Areas surrounding piers and beaches are commonly targeted areas. Typically tools such as rakes and cutting bars are used to remove vegetation. These are easily obtainable through many outdoor supply catalogs or over the internet. Some rakes are equipped with tines as well as cutting edges. Tools can also be hand made by drilling a hole in the handle of a heavy-duty garden rake and tying it to a length of rope. Weights may be needed in order to provide forceful contact with the plants. In many instances, homeowners on lakes with near shore vegetation problems simply cut swaths through the weeds to create pathways to open water. Due to the limited amount of biomass removed, harvested plant material is often used as fertilizer and compost in gardens. In the 1.35 acres owned by the Cedar Lake Park homeowner's association, this method could be used depending on the density of the plants in a particular year. If they are sparse, the plants could be left alone, or if they are in small beds, hand removal could be fast and inexpensive. It would not be necessary to clear the entire area of plants, but enough for use by swimmers.

Pros

Hand removal is a quick, inexpensive, and selective way to remove nuisance vegetation. Hand removal is an activity in which all lake residents could participate. The work involved in removing plants can provide a rewarding sense of accomplishment. By removing excess vegetation, use of beaches and piers would be improved. Many of the improved water quality benefits of a well-executed herbicide program or harvesting program are also shared by hand removal. Wildlife habitat, such as fish spawning beds, could be greatly improved. This in turn would benefit other portions of the lake's ecosystem.

Cons

There are few negative attributes to hand removal. One negative implication is labor. Depending on the extent of infestation, removal of large amount, of vegetation can be quite tiresome. Another drawback can be disposal. Finding a site for numerous residents to dispose of large quantities of harvested vegetation can sometimes be problematic. However, individual homeowners would be removing limited quantities of plant material so there would not be much to dispose of. Another drawback is possible nonselective removal by hand harvesting. By throwing a rake blindly into the depths, it is impossible to determine what plants are removed and which ones are not until the rake is pulled up. Even in shallow depths, untrained persons might mistakenly remove desirable vegetation and/or disrupt valuable habitat (fish spawning beds). Over removal could also be a problem but is not normally a concern with hand removal.

Costs

Plant removal rakes can range in price from $50-150 and cutting tools commonly range in price from $50-200. Both are available from numerous catalogs and from the Internet. A homemade rake (heavy duty garden rake, rope, and weight) would cost about $20-40.

Option 5: Water Milfoil Weevil

Euhrychiopsis lecontei (*E. lecontei*) is a biological control organism used to control Eurasian water milfoil (EWM). *E. lecontei* is a native weevil, which feeds exclusively on milfoil species. It was originally discovered while investigating declines of EWM in a Vermont lake in the early 1990s. It was discovered in northeastern Illinois lakes including Cedar Lake by 1995. Another weevil, *Phytobius leucogaster*, also feeds on EWM but does not cause as much damage as *E. lecontei*. Therefore, *E. lecontei* is stocked as a biocontrol and is commonly referred to as the Eurasian water milfoil weevil. Currently, the LCHD-Lakes Management Unit has documented weevils (*E. lecontei* and/or *P. leucogaster*) in 31 Lake County lakes. Many of these lakes have seen declines in EWM densities in recent years. Milfoil bed densities declined in Cedar Lake during 1995 and 1998. It is highly likely that *E. lecontei* and/or *P. leucogaster* occurs in all lakes in Lake County that have excessive EWM growth.

Weevils are stocked in known quantities to achieve a density of 1-4 weevils per stem. As weevil populations expand, EWM populations may decline. After EWM declines, weevil populations decline and do not feed on any other aquatic plants. When EWM starts to grow again in the

spring, the weevil populations respond by keeping the increasing milfoil under control before it becomes a problem. Once the weevil is established, EWM should no longer reach nuisance proportions and should begin to become sparse. Best results are achieved in lakes that have shallow EWM infestations in areas where it is undisturbed by recreational and management actives. The recent increase in boats with large motor sizes on Cedar Lake may disturb weevil populations. Weevils need proper overwintering habitat such as leaf litter and mud, which are typically found on naturalized shorelines or shores with good buffer strips. The Cedar Lake shoreline does have this habitat. Additionally, water temperatures need to be 68-70^{o}F for maximum weevil activity. For this reason, weevils are typically stocked in late spring/early summer. Currently only one company, EnviroScience Inc., has a stocking program (called the MiddFoil® process). The program includes evaluation of EWM densities, of current weevil populations (if any), stocking, monitoring, and restocking as needed. Because weevils are already present in Cedar Lake, stocking additional weevils is not recommended at this time.

Pros

The milfoil weevil can provide long-term control of EWM. Typically, by the end of June EWM stands are starting to decline due to weevil damage. In many situations, EWM beds might not reach the surface before weevil damage causes declines. *E. lecontei* is also a selective means to control EWM. Studies have shown that *E. lecontei* has a strong preference for EWM and the only other plant it possibly will feed on is northern water milfoil. Since milfoil weevils are found to naturally occur in several lakes in Lake County, weevil stocking would be an augmentation rather than an introduction, making it a more natural control option.

If control with milfoil weevils were successful, the quality of the lake would be improved. Native plants could then start to recolonize. Fisheries of the lake would improve due to more balanced predation and higher quality habitat. Waterfowl would benefit due to increased food sources and availability of prey. Recreational activities such as fishing, swimming, and boating would be easier and more enjoyable with the removal of inhibiting stands of EWM.

Cons

Use of milfoil weevils does have some drawbacks. Control using the weevil has been inconsistent in many cases. EWM has been reduced one year, only to be unaffected the next. Reasons for these inconsistencies are under investigation. One possible explanation is lack of suitable overwintering habitat. The highly developed, manicured shorelines of many lakes in the County are not suitable habitat for weevil overwintering. Another possible explanation is cooler than normal summer water temperatures. Studies have shown that cooler water temperatures reduce weevil feeding and egg production.

Milfoil control using weevils may not work well on plants in deep water. Plants are able to compensate for weevil damage on upper portions of the plant by increasing growth on lower portions where weevil does not feed. Furthermore, weevils do not work well in areas where plants are continuously disturbed by activities such as powerboats and swimming, harvesting or herbicide use. In areas where weevils are to be stocked, activity

should be reduced as much as possible. This may either limit the extent to which the weevils can be used or limit recreational use of the lake.

One of the most prohibitive aspects to weevil use is price. Typically weevils are stocked to achieve a density of 1-4 weevils per stem. This translates to 500-3000 weevils per acre. At a cost of $1 per weevil plus labor, a EWM management program using weevils can be expensive. Additionally, there is no guarantee that weevils will provide long term control or even produce any results at all.

Costs

EnviroScience, Inc.
3781 Darrow Road
Stow, Ohio 44224
1(800) 940-4025

Weevils are sold in units of 1000 bugs/unit and stocking rates must be at least 1 unit/stocked area. Normally there is a minimum purchase of 5-10 units. The cost of the weevils does not include the labor involved in initial surveys, stocking, and monitoring, which typically run an additionally $3,500-$4,500.

Option 6: Grass Carp

Triploid grass carp (*Ctenopharyngodon idella*) are biological control agents that are used to in some situations to control nuisance aquatic vegetation.

Grass carp can only be stocked in man-made bodies of water with controlled outlets and inlets. They cannot be stocked in glacial lakes, slough potholes, bottomlands, backwaters, streams, rivers, if state threatened or endangered plant or animal species are present, or in any state inventory natural area or nature preserve.

This option is ILLEGAL in Cedar Lake since it is of glacial origin and the lake hosts state threatened and endangered species. Cedar Lake is also an Illinois State Natural Area.

Objective II: 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, its roots exude a chemical that discourages other plant growth, and it is quick to become established on disturbed soils. Reed canary grass is an aggressive plant species that was introduced as a shoreline stabilizer. It is found on lakeshores, stream banks, marshes and exposed moist ground. Although it does serve to stabilize shorelines to some extent, it has low food value and does not provide winter habitat for wildlife. It is very successful in taking over disturbed areas and, 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*).

The 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, but its removal early on is best. 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.

At Cedar Lake, we noticed the presence of aggressive exotic shoreline plant species, most notably along the east shoreline, the main island, the two small islands in the northwest corner and along the southwest shoreline. The exotic species are listed in Table 4 and include buckthorn and honeysuckle shrubs, reed canary grass, common reed, and purple loosestrife. These species are especially detrimental, as they can crowd out native, beneficial plants used by wildlife. Their removal is recommended.

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 whenever possible. Table 8 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 affected.

Costs

Costs with this option are zeroing 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: Biological Control

Biological control (bio-control) is a means of using natural relationships already in place to limit, stop, or reverse an exotic species' expansion. In most cases, insects that prey upon the exotic plants in its native ecosystem are imported. Since there is a danger of bringing another exotic species into the ecosystem, state and federal agencies require testing before any bio-control species are released or made available for purchase.

Recently two leaf beetles (*Galerucella pusilla* and *G. calmariensis*) and two weevils, one a root-feeder (*Hylobius transversovittatus*) and one a flower-feeder (*Nanophyes marmoratus*) have offered some hope to control purple loosestrife by natural means. These insects feed on the leaves, roots, or flowers of purple loosestrife, eventually weakening and killing the plant or, in the case of the flower-feeder, prevent seeding. In large stands of loosestrife, the beetles and

weevils naturally reproduce and in many locations, significantly reduce plant densities. The insects are host specific, meaning that they will attack no other plant but purple loosestrife. Currently, the beetles have proven to be most effective and are available for purchase. There are no designated stocking rate recommendations, since using bio-control insects are seen as an inoculation and it may take 3-5 years for beetle populations to increase to levels that will cause significant damage. Depending on the size of the infested area, it may take 1,000 or more adult beetles per acre to cause significant damage.

Pros

Control of exotics by a natural mechanism is preferable to chemical treatments. Insects, being part of the same ecological system as the exotic plant (i.e., the beetles and weevils and the purple loosestrife) are more likely to provide long-term control. Chemical treatments are usually non-selective while bio-control measures target specific plant species. This technique is beneficial to the ecosystem since it preserves, even promotes, biodiversity. As the exotic plant dies back, native vegetation can reestablish the area.

Cons

Few exotics can be controlled using biological means. Currently, there are no bio-control techniques for plants such as buckthorn, reed canary grass, or a host of other exotics. One of the major disadvantages of using bio-control is the costs and labor associated with it.

Use of biological mechanisms to control plants such as purple loosestrife is still under debate. Similar to purple loosestrife, the beetles and weevils that control it are not native to North America. Due to the poor historical record of introducing non-native species, even to control other non-native species, this technique has its critics.

Costs

The New York Department of Natural Resources at Cornell University (email: bb22@cornell.edu, 607-255-5314, or visit the website: www.invasiveplants.net) sells overwintering adult leaf beetles (which will lay eggs the year of release) for $1 per beetle and new generation leaf beetles (which will lay eggs beginning the following year) at $0.25 per beetle. The root beetles are sold for $5 per beetle. Some beetles may be available for free by contacting the Illinois Natural History Survey (INHS; 217-333-6846). The INHS also conducts a workshop each spring at Volo Bog for individuals and groups interested in learning how to rear their own beetles.

Option 3: 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 since regrowth is common. 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 4: 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 impractical (i.e., large expanses of a wetland or woodland), chemical treatments may not be an option because in order to chemically treat the area, a broadcast application would be needed. Because many of the herbicides 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 an herbicide-soaked device. Trees are normally treated by cutting off a ring of bark around the trunk (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®, Round-up™, Eagre™, or AquaPro™), are sold in 2.5 gallon jugs, and cost approximately $200 and $350, 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. A girdling tool costs about $150.

Objective III: Shoreline Erosion Control

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 also 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.

In the case of Cedar Lake, only 4.7% of the shoreline is eroding. Although this may not seem significant, these shores still warrant protection. The south side of the island has had a noticeable shoreline loss since 1990. This area should be protected since it does offer good wildlife habitat and will only add sediment to the water column if it continues to erode.

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: Install a Seawall

Seawalls are designed to prevent shoreline erosion on lakes in a similar manner they are used along coastlines to prevent beach erosion or harbor siltation. Today, seawalls are generally constructed of steel, although in the past seawalls were made of concrete or wood (frequently old

railroad ties). Concrete seawalls cracked or were undercut by wave action requiring routine maintenance. Wooden seawalls made of old railroad ties are not used anymore since the chemicals that made the ties rot-resistant could be harmful to aquatic organisms. A new type of construction material being used is vinyl or PVC. Vinyl seawalls are constructed of a lighter, more flexible material as compared to steel. Also, vinyl seawalls will not rust over time as steel will. In Cedar Lake, because the moderately and severely eroding shorelines are areas within a buffer zone, seawalls would take away the integrity of this natural shoreline. Methods using native plants are recommended over the installation of a seawall.

Option 3: Install Rock Rip-Rap

Rip-rap is the term for using rocks to stabilize shorelines. Size of the rock depends on the severity of the erosion, distance to rock source, and aesthetic preferences. Generally, four to eight inch diameter rocks are used. Rip-rap can be incorporated with other erosion control techniques such as plant buffer strips. If any plants will be growing on top of the rip-rap or gabions, fill will probably be needed to cover the rocks and provide an acceptable medium for plants to grow on. Prior to the initiation of work, permits and/or surveys from the appropriate government agencies need to be obtained (see costs below). Riprap can be further enhanced by the addition of deep-rooted native vegetation upland of the rocks. Because the moderately and severely eroding shorelines are areas within a buffer zone, would take away the integrity of a natural shoreline. Methods using native plants are recommended over the installation of rip-rap. Rip-rap would also be difficult to install, since heavy equipment and all materials would need to be transported to the island.

Pros

Rip-rap can provide good shoreline erosion control. Rocks can absorb some of the wave energy while providing a more aesthetically pleasing appearance than seawalls. If installed properly, rip-rap will last for many years. Maintenance is relatively low, however, undercutting of the bank can cause sloughing of the rip-rap and subsequent shoreline. Areas with severe erosion problems may benefit from using rip-rap or gabions. In all cases, a filter fabric should be installed under the rocks to maximize its effectiveness.

Fish and wildlife habitat can be provided if large boulders are used. Crevices and spaces between the rocks can be used by a variety of animals and their prey. Small mammals, like shrews can inhabit these spaces in the rock above water and prey upon many invertebrate species, including many harmful garden and lawn pests. Also, small fish may utilize the structure underwater created by large boulders for foraging and hiding from predators.

Cons

A major disadvantage of rip-rap is the initial expense of installation and associated permits. Installation is expensive since a licensed contractor and heavy equipment are generally needed to conduct the work. Permits are required if replacing existing or installing new rip-rap and must be acquired prior to work beginning. If any fill material is placed in the floodplain along the shoreline, compensatory storage may also be needed.

Compensatory storage is the process of excavating in a portion of a property or floodplain to compensate for the filling in of another portion of the floodplain.

While rip-rap and gabions absorb wave energy more effectively than seawalls, there is still some wave deflection that may cause resuspension of sediment and nutrients into the water column.

Small rock rip-rap is poor habitat for many fish and wildlife species, since it provides limited structure for fish and cover for wildlife. As noted earlier, some small fish and other animals will inhabit the rocks if boulders are used. Smaller rip-rap is more likely to wash away due to rising water levels or wave action. On the other hand, larger boulders are more expensive to haul in and install.

Rip-rap may be a concern in areas of high public usage since it is difficult and possibly dangerous to walk on due to the jagged and uneven rock edges. This may be a liability concern to property owners.

Costs

Cost and type of rip-rap used depend on several factors, but average cost for installation (rocks and filter fabric) is approximately $35-50 per linear foot. The steeper the slope and severity of erosion, the larger the boulders that will need to be used and thus, higher installation costs. In addition, costs will increase with poor shoreline accessibility (such as on the island) and increased distance to rock source. The moderately eroding shoreline by the Allendale property is approximately 162 feet, which would cost about $5670-8100 for rip-rap. Costs for permits and surveys can be $1,500-2,000 for installation of rip-rap or gabions, depending on the circumstances. Additional costs will be incurred if compensatory storage is needed. Contact the Army Corps of Engineers, local municipalities, and the Lake County Planning and Development Department.

Option 4: 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 8 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 Table 8 in Appendix A should be considered for native plantings. This could be the best option for the moderately and severely eroding shorelines on Cedar Lake in order to maintain the shoreline while offering wildlife habitat. The installation of buffer strips can also be done behind existing riprap or seawall on private properties, and taller emergent plants can be added in front, in the water. If people are concerned about being unable to approach the lake on their property, a narrow, mowed path to the shoreline will allow access and not interrupt the integrity of the buffer strip. The newly planted vegetation will need protection from grazing wildlife until it is established.

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*). Both species are present in Cedar Lake. 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. This habitat can be found already in place around Cedar Lake. 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 $15 per linear foot, plus labor. Cost of installing willow posts is approximately $20-25 per linear foot. Along Cedar Lake, approximately1095 feet of private shoreline is eroding. The cost for a buffer strip would be about $150 per 100 feet of shoreline. Willow posts would cost about $200-250 per 100 feet of shoreline. The moderately eroding shoreline by the Allendale property is approximately 162 feet, which would cost about $2430 for a buffer strip, and $3240-4050 for the installation of willow posts. 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 $1,500-2,000 depending on the types of permits needed.

Option 5: Install A-Jacks®

A-Jacks® are made of two pieces of pre-cast concrete when fitted together resemble a child's playing jacks. These structures are installed along the shoreline and covered with soil and/or an erosion control product. Native vegetation is then planted on the backfilled area. They can be used in areas where severe erosion does not justify a buffer strip alone. This option would be difficult for use on the island because they would need to be transported across the water. However, they could be used on the Allendale Property that is eroding.

Pros

The advantage to A-Jacks® is that they are quite strong and require low maintenance once installed. In addition, once native vegetation becomes established the A-Jacks® can not be seen. They provide many of the advantages that both rip-rap and buffer strips have. Specifically, they absorb some of the wave energy and protect the existing shoreline from additional erosion. The added benefit of a buffer strip gives the A-Jacks® a more natural appearance, which may provide wildlife habitat and help filter run-off nutrients, sediment, and pollutants. Less run-off entering a lake may have a positive effect on water quality.

Cons

The disadvantage is that installation cost can be high since labor is intensive and requires some heavy equipment. A-Jacks® need to be pre-made and hauled in from the manufacturing site. These assemblies are not as common as rip-rap, thus only a limited number of contractors may be willing to do the installation.

Costs

The cost of installation is approximately $50-75 per linear foot, but does not include permits and surveys, which can cost $1,500-2,000 and must be obtained prior to any work implementation. Additional costs will be incurred if compensatory storage is needed. The moderately eroding shoreline owned by Allendale School is approximately 162 feet, and would cost $8,100-12,150.

Option 6: 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 $40 to $45 per linear foot of shoreline, including plantings. This does not include the necessary permits and surveys, which may cost $1,500 – 2,000 depending on the type of earthmoving that is being done. Additional costs may be incurred if compensatory storage is needed. Along Cedar Lake, approximately 1,095 feet of private shoreline is eroding. Installation of a biolog, fiber roll or straw blanket with plantings would cost about $400-450 per 100 feet of shoreline. The moderately eroding shoreline by the Allendale property is approximately 162 feet, which would cost about $6480-7290 for the installation of a biolog.

Option 7: Establish a "No Wake" Zone or No Motor Area

Establishing a "no wake" zone or no motor area will not solve erosion problems by itself. However, since shoreline erosion is generally not caused by one specific factor, these techniques can be effective if used in combination with one or more of the techniques described above.

A "no wake" zone is generally established in a defined area from the shoreline out to a certain point in a lake and is usually marked by buoys. This area should be sufficiently wide enough to allow wave action from boats to attenuate before reaching the shoreline. The size of the zone will depend on many factors including size and depth of the lake, the amount of shallow (<10 feet deep) areas, and the type of motors and boats used on the lake. No motor areas may be warranted

on small shallow lakes or in areas of a lake that are particularly susceptible to erosion or otherwise need protection.

Pros

These techniques may reduce wave activity along shorelines susceptible to erosion. Limiting boat activity, particularly near shorelines or in shallow areas, may also have an additional benefit by improving water quality since less sediment may be disturbed and resuspended in the water column. Disturbed sediment contributes to poor water clarity, which can negatively effect sight feeding fish and wildlife and limit the available light needed for plant growth. Nuisance algae also benefit from disturbed sediment since this action makes available nutrients in the sediment that otherwise would stay settled on the bottom. This also may minimize plants being cut by boat props if the no wake buoys are outside plant beds.

Less motorboat disturbance will benefit wildlife and may encourage many species to use the lake both during spring and fall migration and for summer residence. This may add to the lake's aesthetics and increasing recreational opportunities for some lake users.

Cons

Enforcement and public education are the primary obstacles with these techniques. Public resistance to any regulation change may be strong, particularly if the lake is open to the public and has had no similar regulations in the past. Depending on the regulations implemented, there may be some loss of recreational use for some users, particularly power boating. However, if the lake is large enough, certain parts of the lake (i.e., the middle or deepest) may be used for this activity without negatively influencing other uses.

Costs

Costs include the purchase and placement of signs, buoys, and enforcement, as well as maintenance of signs and buoys. No wake buoys cost approximately $35-150 each. Signs may cost $15-30 each.

Objective IV. Zebra Mussels

The Village of Lake Villa was alerted to the finding of the zebra mussels in 2003 and has installed signage at the launch area informing lake users of the mussel's presence in the lake to prevent its spread to other inland lakes. An Exotic Species Advisory signs are available for $13.50 each to homeowner associations from the Illinois-Indiana Sea Grant Program at their internet site http://www.iisgcp.org/outrch/br/sign.htm or by calling 1-800-345-6087.

Zebra mussels get their name from the alternating black and white stripped pattern on their shells. They have spread extensively in the Great Lakes region in the past decade. They attach themselves to any solid underwater object such as boat hulls, piers, intake pipes, plants, other bivalves (mussels), and even other zebra mussels. Zebra mussels originated from Eastern Europe, specifically the Black and Caspian Seas. By the mid 18th and 19th centuries they had spread to most of Europe. The mussels were believed to have been spread to this country in the mid 1980s by cargo ships that discharged their ballast water into the Great Lakes. They were first discovered in Lake St. Clair (the body of water that connects lakes Erie and Huron) in June of 1988. The mussels then spread to the rest of the Great Lakes. The first sighting in Lake Michigan was in June 1989. By 1990, zebra mussels had been found in all of the Great Lakes. By 1991 zebra mussels had made their way into the adjacent waters of the Great Lakes such as the Illinois River, which eventually led to their spread into the Mississippi River and all the way down to the Gulf of Mexico. Other states in the Midwest have also experienced zebra mussel infestations of their inland lakes. Southeastern Wisconsin has about a dozen lakes infested with zebra mussels. The state of Michigan has about 100 infested lakes. Even though they are a fresh water mussel they have also been found in brackish (slightly saline) water and they can even live out of the water for up to 10 days at high humidity and cool temperatures. At average summer temperatures, zebra mussels can survive out of water for an average of five days.

The zebra mussel=s reproductive cycle allows for rapid expansion of the population. A mature female can produce up to 40,000 eggs in a cycle and up to one million in a season. Eggs hatch within a few days and young larvae (called veligers) are free floating for up to 33 days, carried along on water currents. This allows for the distribution of larvae to uninfected areas, which accelerates their spread. The larvae attach themselves by a filamentous organ (called a byssus) near their foot. Once attached to a solid surface, larvae develop into a double shelled adult within three weeks and are capable of reproduction in a year. Zebra mussels can live as long as five years and have an average life span of about 3.5 years. The adults are typically about the size of a thumb nail but can grow as large as 2 inches in diameter. Colonies can reach densities of 30,000 - 70,000 mussels per square meter.

Due to their quick life cycle and explosive growth rate, zebra mussels can quickly edge out native mussel species. Negative impacts on native bivalve populations include interference with feeding, habitat, growth, movement, and reproduction. Some native species of bivalves have been found with 10,000 zebra mussels attached to them. Many of these native, rare, threatened and endangered bivalve species may not be able to survive if zebra mussels populations continue to expand. The impact that the mussels have on fish populations is not fully understood. However, zebra mussels feed on phytoplankton (algae), which is also a major food source for planktivorous fish, such as bluegills. These fish, in turn, are a food source for piscivorus fish

(fish eating fish), such as largemouth bass and northern pike. Concern has also arisen over the concentration of pollutants found in zebra mussels. Since mussels are filter feeders, that take up water and sediment containing pollutants, which then build to high concentrations in their tissue (bioaccumulation). Due to the large number of mussels that are consumed by fish that feed on the mussels, concentrations of pollutants are even higher in the fish (biomagnification), which are potentially consumed by humans.

In addition to the ecological impacts, there are also may economical concerns. Zebra mussels have caused major problems for industrial complexes located on the Great Lakes and associated bodies of water. Mussels can clog water intakes of power plants, public water supplies, and other industrial facilities. This can reduce water flow (by as much as two-thirds) to heat exchangers, condensers, fire fighting equipment, and air conditioning systems. Zebra mussels can infest inboard motor intakes and can actually grow inside the motor, causing considerable damage. Navigational buoys have sunk due to the weight of attached mussels. Corrosion of concrete and steel, which can lead to loss of structural integrity, can occur from long-term mussel attachment. A Michigan-based paper company recently reported that it had spent 1.4 million dollars in removing only 400 cubic yards of zebra mussels. It has been estimated that billions of dollars have been incurred in removal efforts and in damage to factories, water supply companies, power plants, ships, and the fishing industry. There are several methods of control, which include both removal and eradication. Many are site specific, so control methods are often dictated by the situation. These control methods include chemical molluscicides, manual removal, thermal irritation, acoustical vibration, toxic and non-toxic coatings, CO_2 injection, and ultraviolet light. Additionally, several biological controls are being investigated. However, there is currently no widespread/whole lake control practice that would be effective without harming other wildlife.

Surprisingly, some positive impacts have been observed from zebra mussel infestations. Zebra mussels are capable of filtering one liter of water per day. This water often contains sediment and phytoplankton, which contribute to turbidity. As a result, large infestations of zebra mussels have brought about significant improvements in water clarity in some lakes. Due to severe mussel infestations, Lake Erie water clarity has increased four to six times what it was before zebra mussels invaded the lake (in addition to improvements as a result of pollution control measures). This has resulted in deeper penetration of light and an expansion of aquatic plant populations, something that has not been seen for decades. In turn, the increased plant growth is providing better fish habitat and better fishing. Unfortunately, the negative ecological and economical impacts associated with zebra mussels far outweigh any positive benefits.

Here are some tips from the Great Lakes Sea Grant Network that can help prevent the spread of zebra mussels.

-Flush clean water (tap) through the cooling system of your motor to rinse out any larvae.

-Drain all bilge water, live wells, bait buckets, and engine compartments. Make sure water is not trapped in your trailer.

-Always inspect your boat and boat trailer carefully before transporting.

-In their earlier stages, attached zebra mussels may not be easily seen. Pass your hand across the boat=s bottom - if it feels grainy, it=s probably covered with mussels. Don=t take a chance; clean them off by scraping or blasting.

-Full grown zebra mussels can be easily seen but cling stubbornly to surfaces. Carefully scrape the hull (or trailer), or use a high pressure spray (250 psi) to dislodge them. Or leave your boat out of the water for at least 10-14 days, preferably two weeks. The mussels will die and drop off.

-Dispose of the mussels in a trash barrel or other garbage container. Don=t leave them on the shore where they could be swept back into the lake or foul the area.

-Before you leave the boat launch site, remove from the boat trailer any plant debris where tiny zebra mussels may be entangled.

-Always use extra caution when transporting bait fish from one lake to another. You could be carrying microscopic veligers. To be safe, do not take water from one lake to another.

-Certain polymer waxes discourage zebra mussels from attaching. But check your hull periodically because the mussels cling to drain holes and speedometer brackets.

Objective V: Canada Geese Control (*Branta canadensis*)

Canada geese are migratory waterfowl common throughout North America. Geese in urban areas can be undesirable primarily due to the large amount of feces they leave behind. Recreational activities on lawns and parks are impeded due to goose feces. Large amounts of feces may end up in the water, either directly from geese on the water or rainwater runoff from lawns where feces have accumulated. Goose feces are high in organic phosphorus. High nutrient levels, particularly phosphorus, can contribute to excessive algae growth in lakes. This may inhibit other recreational activities such as boating or swimming, as well as create poor habitat for fish and wildlife, and possibly bad odors when the algae decays.

Geese become problematic for many reasons. They seek locations that have open water, adequate food supplies, and safety from predators. If these factors are present, geese may not migrate. Since geese exhibit a high level of site fidelity, they return to (or stay at) the same area each year. Thus, adults will likely come back to the same area year after year to nest. If conditions remain optimal, one pair of geese can quickly multiply causing additional problems. Increased development in Lake County has inadvertently created ideal habitat for goose populations. Manicured lawns mowed to the edge of lakes and detention ponds provide geese with open areas with ample food and security. Other conditions that encourage goose residency include open water during winter (primarily the result of aerators in lakes and ponds), mild winters, and people feeding birds with bread or similar human food.

Large populations of geese pose a potential disease threat both to resident and wild populations of waterfowl. This problem may be more serious in residential populations since these birds stay in one area for long periods of time are more likely to transmit any disease to neighboring groups of geese. There is no threat of disease transmission to humans or domestic dogs and cats since most of the diseases are specific to birds.

Some residents voiced concern over the number of Canada geese frequenting Cedar Lake. Canada geese can add nutrients (especially phosphorus), and bacteria to a lake through their feces. We did not see excessive numbers of Canada geese during the 2003 sample visits.

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

Pros

This option has no costs, however, increasing numbers of geese will most likely exacerbate existing problems and probably create new ones, which in the future may cost more than if the problems are addressed immediately.

Cons

If current conditions continue and no action is taken, numbers of Canada Geese and problems associated with them will likely increase. An increase of goose feces washed into a lake will increase the lake's nutrient load and eventually may have a detrimental impact on water quality through excessive algae growth. One study (Manny et al. 1975) documented that each goose excretes 0.072 lbs of feces per day. This may not seem like a significant amount, but if 100 geese are present (many lakes in the county can

experience 1,000 or more at a time) that equates to over 7 lbs of feces per day! Algae blooms may negatively impact recreational uses such as swimming, boating, and fishing. In addition, when algae dies, odor problems and depleted oxygen levels in the water occur. Increased numbers of geese may also result in overgrazed areas of grass.

Costs

There are a few short-term financial costs with this option. Costs of cleaning feces off lawns or piers are probably more psychological or physical than financial. Long-term costs may be more indirect, including increased nutrient deposition into lakes that may promote excessive algae and plants. Costs incurred may include money needed to control algae with algaecides.

Option 2: Removal

Since Canada Geese are considered migratory waterfowl, both state and federal laws restrict taking or harassing geese. Under the federal Migratory Bird Treaty Act, it is illegal to kill or capture geese outside a legal hunting season or to harass their nests without a permit. If removal of problematic geese is warranted or if nest and egg destruction is an option, permits need to be obtained from the Illinois Department of Natural Resources (217- 782-6384) and the U.S. Fish and Wildlife Service (217-241-6700).

Hunting is one of the most effective techniques used in goose management. However, since many municipalities have ordinances prohibiting the discharge of firearms, reduction of goose numbers by hunting in urban areas (i.e., lakes, ponds, and parks) may not be an option. Hunting does occur on many lakes in the county, but certain regulations apply (e.g., 100 yard minimum distance from any residential property). Contact the Illinois Department of Natural Resources for dates and regulations regarding the waterfowl hunting seasons. Also, contact local and county law enforcement agencies regarding any ordinances concerning hunting within municipal boundaries.

Egg addling, or destroying the egg by shaking, piercing, or freezing, can be used to reduce or eliminate a successful clutch. Eggs should be returned to the nest so the hen goose does not re-lay another clutch. However, if no eggs hatch, she may still lay another clutch. Leaving one or two eggs unaltered and allowing them to hatch may prevent another clutch from being laid and reduces the total year's reproduction. Egg addling requires a state and federal permit.

The capture and relocation of geese is no longer a desirable option. First, relocated geese may return to the same location where they were captured. Second, there is a concern over potential disease transmission from relocated geese to other goose populations. Finally, since goose numbers in Illinois are already high there is no need to supplement other populations in the area.

Pros

Removing a significant portion of a problem goose population can have a positive effect on the overall health of a lake. Reduction of feces on lawns and parks is beneficial to recreation users of all types. Less feces in the water means less phosphorus available for nuisance plant and algae growth. Thus, the overall water quality of the lake may be improved by this reduction in phosphorus.

Cons

If the habitat conditions still exist, more geese will likely replace any that were removed. Thus, money and time used removing geese may not be well spent unless there is a change in habitat conditions.

Costs

An Illinois residential waterfowl hunting license (including state and federal waterfowl stamps) is $39.00 for the 2002-2003 hunting season. For depredation permits, there is a $25 fee for the federal permit. Once the federal permit is issued the state permit can be obtained at no charge.

Option 3: Dispersal/Repellent Techniques

Several techniques and products are on the market that claim to disperse or deter geese from using an area. These techniques can be divided into two categories: harassment and chemical. With both types of techniques it is important to implement any action early in the season, before geese establish territories and begin nesting. Once established, the dispersal/repellant techniques may be less effective and geese more difficult to coerce into leaving.

The goal with harassment techniques is to frighten geese from an area using sounds or objects. Various products are available that simulate natural predators (i.e., plastic hawks and owls) or otherwise make geese nervous (i.e., balloons, shiny tape, and flags). Other products emit noises, such as propane cannons, which can be set on a timer to go off at programmed intervals (e.g., every 20-30 seconds), or recorded goose distress calls which can be played back over a loudspeaker or tape player. Over time these techniques may be ineffective, since geese become acclimated to these devices. Most of these products are more effective when used in combination with other techniques.

Another technique that has become popular is using dogs or swans to harass geese. Dogs can be used primarily in the spring and fall to keep birds from using an area by herding or chasing geese away from a particular area. Any dogs used for this purpose should be well trained and under the owners control at all times. Professional trainers can be contracted to use their dogs for this purpose. Dogs should not be used during the summer when geese are unable to fly due to molting. Swans are used because they are naturally aggressive in defending their territory, including chasing other waterfowl away from their nesting area. Since wild swans cannot be used for this technique, non-native mute swans are used. However, mute swans are not as aggressive and in some case are permissive of geese. Again, using a combination of techniques would be most effective.

Chemical repellents can be used with some effectiveness. New products are continually coming out that claim to rid an area of nuisance geese. Several products (ReJeX-iT® and GooseChase™) are made from methyl-anthranilate, a natural occurring compound, and can be sprayed on areas where geese are feeding. The spray makes the grass distasteful and forces geese to move elsewhere to feed. Another product, Flight Control™, works similarly, but has the additional benefit of absorbing ultra violet light making the grass appear as if it was not a food source. The

sprays need to be reapplied every 14-30 days, depending upon weather conditions and mowing frequency.

Pros

With persistence, harassment and/or use of repellants can result in reduced or minimal usage of an area by geese. Fewer geese may mean less feces and cleaner yards and parks, which may increase recreational uses along shorelines. If large numbers of geese were once present, the reduction of fecal deposits into the lake may help minimize the amount of phosphorus entering the water. Less phosphorus in the water means less "food" available for plant and algae growth, which may have a positive effect of water quality. Finally, any areas overgrazed by geese may have a chance to recover.

Cons

The effectiveness of harassment techniques is reduced over time since geese will adapt to the devices. However, their effectiveness can be extended if the devices are moved to different locations periodically, or used in conjunction with other techniques.

Use of dogs can be time consuming, since the dog must be trained and taken care of. Dogs must also be used frequently in the beginning of the season to be effective at deterring geese. This requires time of the dog owner as well. Dogs (frequently herding dogs, like border collies) that are effective at harassing or herding geese are typically may not be the best pets for the average homeowner. They are bred as working dogs and consequently have high levels of energy that requires the owner's attention.

Repelling or chasing away geese from an area only solves the goose problem for that area and most likely moves the geese (and the problem) to another area. As long as there is suitable habitat nearby, the geese will not wander very far.

Costs

Costs for the propane cannons are approximately $660 ($360 for the cannon, $300 for a timer), not including the propane tank. The cost of ReJeX-iT® is $80/gallon, GooseChase™ is $95/gallon, and Flight Control™ costs $200/gallon. One gallon covers one acre of turf using ReJeX-iT® and, GooseChase™, and two acres using Flight Control™.

<u>Option 4: Exclusion</u>

Erecting a barrier to exclude geese is another option. In addition to a traditional wood or wire fence, an effective exclusion control is to suspend netting over the area where geese are unwanted. Geese are reluctant to fly or walk into the area. A similar deterrent that is often used is a single string or wire suspended a foot or so above the ground along the length of the shoreline.

Pros

Depending on the type of barrier used, areas of exclusion will have less fecal mess and may have higher recreational uses. Vegetation that was overgrazed by geese may also be able to recover.

Cons

This technique will not be effective if the geese are using a large area. Also, use of the area by people is severely limited if netting is installed. Fences can also limit recreational uses. The single string or wire method may be effective at first, but geese often learn to go around, over, or under the string after a short period of time. Finally, excluding geese from one area will force them to another area on a different part of the same lake or another nearby lake. While this solves one property owner's problem, it creates one (or makes one worse) for another. Also, problems associated with excess feces entering the lake (i.e., increased phosphorus levels) will continue.

Costs

The costs of these techniques are minimal, unless a wood or wire fence is constructed. String, wire, or netting can be purchased or made from materials at local stores.

Option 5: Habitat Alteration

One of the best methods to deter geese from using an area is through habitat alteration. Habitats that consist of mowed turfgrass to the edge of the shoreline are ideal for geese. Low vegetation near the water allows geese to feed and provides a wide view with which to see potential predators. In general, geese do not favor habitats with tall vegetation. To achieve this, create a buffer strip (approximately 10-20 feet wide) between the shoreline and any mowed lawn. Planting natural shoreline vegetation (i.e., bulrushes, cattails, rushes, grasses, shrubs, and trees, etc.) or allowing the vegetation to establish naturally can create buffer strips. Table 8 in Appendix A has a list of native plants, seeding rates, and approximate costs that can be used when creating buffer strips.

Geese prefer ponds and lakes that have shorelines with gentle slopes to ones with steep slopes. While this alone will not prevent geese from using an area, steeper slopes used along with other techniques will be more effective. This option may not be practical for existing lake shorelines since any grading and/or filling would require permits and surveys, which would drive up the costs of redoing the shoreline considerably.

Aeration systems that run into the fall and winter prevent the lake from freezing, thus not forcing geese to migrate elsewhere. To alleviate this problem, turn aerators off during fall and early winter. Once the lake freezes over and the geese have left, wait a few weeks before turning the aerators on again if needed.

Pros

Altering the habitat in an area can not only make the habitat less desirable for geese, but may be more desirable for many other species of wildlife. A buffer strip has additional benefits by filtering run-off of nutrients, sediments, and pollutants and protecting the shoreline from erosion from wind, wave, or ice action. Finally, the more area that is natural vegetation, the less turfgrass that needs to be constantly manicured and maintained.

Cons

Converting a portion or all of an area to tall grass or shrub habitat may reduce the lake access or visibility. However, if this occurs, a small path can be made to the lake or shorter plants may be used at the access location in the buffer strip.

Costs

If minimal amount of site preparation is needed to create a buffer strip, costs can be approximately $15 per linear foot, plus labor. 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. Compensatory storage is the process of excavating in a portion of a property or floodplain to compensate for the filling in of another portion of the floodplain. The permitting process is costly, running as high as $1,000-2,000 depending on the types of permits needed.
Once established, a buffer strip of native plants needs little maintenance.

Option 6: Do Not Feed Waterfowl!

There are few "good things", if any, that come from feeding waterfowl. Birds become dependent on handouts, become semi-domesticated, and do not migrate. This causes populations to increase and concentrate, which may create additional problems such as diseases within waterfowl populations. The nutritional value in many of the "foods" (i.e., white bread) given to geese and other waterfowl are quite low. Since geese are physiologically adapted to eat a variety of foods, they can actually be harmed by filling-up on human food. Geese that are accustom to hand feeding may become aggressive toward other geese or even the people feeding the geese.

Costs

There are no costs to this option, except the public education that is needed to encourage people not to feed waterfowl. In some cases, signs could be posted to discourage waterfowl feeding.

Reference:

Manny, B. A., R. G. Wetzel, and W. C. Johnson. 1975. Annual contribution of carbon, nitrogen, and phosphorus by migrant Canada geese to a hardwater lake. Verh. Internat. Verein. Limnol. 19:949-951.

Objective VI: Enforcement of Engine Limit Ordinance

Although the launch at Lehmann Park is limited to boats with 10 HP, some residents living on the north shore have boats with engines much larger, up to 50 HP, which is ***illegal*** on Cedar Lake. According to Lake Villa ordinance, "No motorboat propelled by an internal combustion engine, which has a manufacturer's rating in excess of ten (10) horsepower, shall be operated on any portion of Cedar Lake or any other body of water, excluding Deep Lake, within the jurisdiction of the Village." (Ord. 2003-06-02, 6-11-2003). Even though portions of the lake bottom are privately owned, 2000 Illinois Compiled Statutes states that "The corporate authorities in all municipalities have jurisdiction over all waters within or bordering upon the municipality, to the extent of 3 miles beyond the corporate limits, but not beyond the limits of the State." (5/7-4-4. Jurisdiction over waters)

At this time, the police department serving Lake Villa does not have any watercraft to patrol Cedar Lake for these violations. They rely on residents to call in a complaint about the offender. The complainant needs to provide the police department with the Illinois boat registration number. Illinois law requires that boats are labeled with this number on each side.

In order to enforce this ordinance, the Village of Lake Villa could hire off-duty law enforcement officers to patrol Cedar Lake. Off-duty law enforcement officers usually charge $30/hour to enforce boating laws or local ordinances. Another option is to hire the Lake County Sheriff's marine unit to patrol the lake on a periodic basis. However, it may be more cost-effective for the Village to purchase their own boat for enforcement. Funding for the purchase of the boat and enforcement could be obtained by requiring boat owners using the lake to purchase village boat stickers each year. Owners of boats without these stickers could be issued a fine.