

**2003 SUMMARY REPORT
of
ISLAND LAKE**

Lake County, Illinois

Prepared by the

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
LAKE IDENTIFICATION AND LOCATION	5
BRIEF HISTORY OF ISLAND LAKE	5
SUMMARY OF CURRENT AND HISTORICAL LAKE USES	5
LIMNOLOGICAL DATA	
Water Quality	9
Aquatic Plant Assessment	17
Shoreline Assessment	19
Wildlife Assessment	22
EXISTING LAKE QUALITY PROBLEMS	25
POTENTIAL OBJECTIVES FOR THE ISLAND LAKE MANAGEMENT PLAN	27
OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES	
Objective I: Eliminate or Control Invasive Species	28
Objective II: Enhance Wildlife Habitat Conditions	32
Objective III: Control Shoreline Erosion	38
Objective IV: Controlling Excessive Numbers of Carp	42
Objective V: Canada Geese Management	46

TABLES AND FIGURES

Figure 2. Approximate watershed of Island Lake, based on topographic data.	6
Figure 3. Approximate land use in the watershed of Island lake, based on 2000 land use data.	7
Figure 4. 1939 aerial photograph of Island Lake.	8
Figure 5. 2003 water quality sampling site and access locations on Island Lake from 1993 aerial photograph.	11
Figure 6. Epilimnetic TP vs. TSS concentrations for Island Lake, May-September 2003.	13
Figure 7. Epilimnetic TSS concentrations vs. Secchi depth measurements for Island Lake, May-September 2003.	14
Figure 8. Historical VLMP average Secchi depth measurements for Island Lake (1986-2003).	15
Table 4. Aquatic and shoreline plants on Island Lake, May-September 2003.	18
Figure 9. 2003 shoreline types on Island Lake (combination of 1993 and 2000 aerial).	20
Figure 10. 2003 shoreline erosion on Island Lake (combination of 1993 and 2000 aerial).	21
Table 6. Wildlife species observed at Island Lake, May-September 2003.	24

APPENDIX A. DATA TABLES FOR ISLAND LAKE.

Figure 1 & 1a. Bathymetric maps of Island Lake, including morphometric data.	
Table 1. Land use totals for the watershed of Island Lake, based on 2000 land use data.	
Table 2. 2003 and 1998 water quality data for Island Lake (epilimnetic and hypolimnetic).	
Table 3. Lake County average TSI phosphorus ranking 1999-2003.	
Table 5. Aquatic vegetation sampling results for Island Lake, May-September 2003.	
Table 7. Common native emergent, floating, and submersed plants available from selected nurseries.	
Table 8. List of local vendors specializing in the sale of submersed and emergent aquatic plants.	

APPENDIX B. METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES.

APPENDIX C. 2003 MULTIPARAMETER DATA FOR ISLAND LAKE.

EXECUTIVE SUMMARY

Island Lake is located in the Village of Island Lake, partially in Lake County and partially in McHenry County. The lake originated as a gravel pit and was dammed in the early 1930's. It has a surface area of 83.8 acres and mean and maximum depths of 5.3 feet and 9.8 feet, respectively. Island Lake is managed by the Village of Island Lake. It is used by residents for swimming, boating and fishing. There are a number of beaches, parks and boat launches on the lake.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature and water clarity were measured and the plant community was assessed each month from May-September 2003. Island Lake did not stratify in 2003. Phosphorus levels were nearly double the Lake County median and fluctuated with water levels. Total suspended solids (TSS) concentrations were also high, and were closely related to total phosphorus (TP) concentrations. A large source of TP and TSS appears to be Lake Napa Suwe, which flows into Island Lake and has very poor water quality. Secchi depths (water clarity) were also low throughout the summer, and did correspond with increases and decreases in TSS concentrations. Historically, average Secchi depths have not changed significantly. Average 2003 conductivities had increased 23% since sampling in 1998, but were not much higher than the county median throughout the summer. Conductivity changes can occur seasonally and even with depth, but over the long term, increased conductivity levels can be a good indicator of potential watershed or lake problems or an increase in pollutants entering the lake if the trend is noted over a period of years.

Virtually no plants are present in Island Lake. Very small amounts of curly leaf pondweed, water stargrass, Eurasian watermilfoil, small pondweed and sago pondweed existed, but were very localized in small beds in the same areas of the lake all summer. A large carp population is likely maintaining the high turbidity, that prevents plant growth, and results in easily resuspended sediment. It would be very difficult to break this cycle without removing the carp population and replanting native aquatic vegetation in shallow, undisturbed areas of the lake.

Although very little erosion was occurring around Island Lake, buckthorn, honeysuckle, purple loosestrife and reed canary grass were present along 6% of the shoreline. These are exotic plant species that out-compete native vegetation and provide poor habitat for wildlife. A relatively large number of waterfowl and bird species were observed during the summer, despite the dominance of residential shoreline.

LAKE IDENTIFICATION AND LOCATION

Island Lake is located in the Village of Island Lake, partially in Lake County and partially in McHenry County, just north of IL Route 176 (T 44N, R 9E, S 20, 21). Island Lake has a surface area of 83.8 acres, mean and maximum depths of 5.3 feet and 9.8 feet, respectively, and a volume of 443.3 acre-feet (Figures 1 & 1a, Appendix A). The watershed of Island Lake encompasses approximately 6132.3 acres, draining all of the Mutton Creek watershed. This includes Drummond Lake, Lake Napa Suwe, Monahan Lake, Golden Oaks Farm Lake, Lake Betty and Woodland Lake. The watershed to lake surface area ratio of 73:1 is extremely large and is more comparable to ratios associated with large reservoirs (Figure 2). Because their drainage basins areas are usually much larger, reservoirs typically lose volume rapidly to siltation. Additionally, nutrient and sediment loads are much higher for reservoirs.

Based on the most recent land use survey of the Island Lake watershed, conducted in 2000, agricultural areas dominate the watershed, making up over one third of the area (Figure 3). Private and public open space and wetlands together make up approximately 26% of the watershed. Other land uses are listed in Table 1, Appendix A. The large amount of agricultural and other disturbed land uses does not bode well for the reduction of sediment and soils entering the lake, or for the improvement of water quality in Island Lake. Water exits Island Lake over a spillway on the southwest end and flows through a large marsh area before entering the Fox River. The lake is located in the Mutton Creek sub basin, within the Fox River watershed.

BRIEF HISTORY OF ISLAND LAKE

Island Lake originated as a gravel pit and was dammed in the early 1930's to create the lake as it is today. The original owner of the quarry is not known, but very soon after the lake was created, land was sold for the establishment of residential homes. This can be seen in a 1939 aerial photograph, where roads have already been laid out along the north and south ends of the lake (Figure 4). A lake association was formed in 1938 and management activities on the lake began in the 1960's. The Village of Island Lake has designated a Lake Management Committee to make decisions on management activities.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Island Lake has been treated with herbicides and algaecides since 1987 for EWM and filamentous algae. The numerous bays were the target treatment areas. From 1987-1988, Aquazine and 2,4-D were used. In 1989, copper sulfate, 2,4-D were used in the lake and Rodeo® and Diquat were used on the shoreline to treat cattails and other shoreline plants. During the 1990's, copper sulfate was used to treat shorelines and beach areas. Chelated copper products were tried in 1998 and 1999, but did not produce better results, and the switch was made back to copper sulfate (less expensive). In the spring of 1997, spot

treatments of Sonar™ SRP were applied to treat CLPW in the area where Mutton Creek enters the lake, as well as in Eastway Bay and in Little Island Bay. Treatments were made in April and May. FasTest results show that concentrations ranged from less than 1.0 ppb to just over 5.0 ppb, increasing from May-August as the pellets released more chemical with time. No Sonar™ treatment has been conducted since 1997. Currently (since 2000), copper sulfate is applied several times per summer along the shoreline at beaches and boat slips on an as needed basis.

In 1988 and 1989, dry bottom dredging was carried out in all bays of the lake and in 1999, the small island bay was dredged. An ¾ horsepower aeration unit runs from May-October in the north bay to prevent the area from becoming stagnant. Four diffusers are located in seven feet of water. The approximate cost of running the aerator is \$600 per year. Access to Island Lake is available through ten sites, all of which are owned by the Village of Island Lake (Figure 5). The lake's main uses are swimming, boating and fishing. The Lake Management Commission of the Village of Island Lake, the primary lake manager, meets once per month from January-December and has an operating budget of approximately \$20,000 per year. Currently, the biggest management concern is sedimentation of the lake from watershed inputs.

Every two weeks (from May to September) we sampled the three licensed beaches on Island Lake (South Shore Beach, Brier Court Beach and Park Drive Beach) to test for the presence of high *E. coli*. *E. coli* bacteria is found virtually everywhere, but is present in very high numbers in the feces of animals and humans. The bacteria may indicate the presence of other pathogens such as *Giardia*, which can cause serious illness in humans. In 2003, South Shore Beach was closed on May 14th, Brier Court Beach was closed on July 8th and Park Drive Beach was closed on August 19th due to *E. coli* concentrations that exceeded 235 MPN/100 mL. High counts can be caused by a number of things, including a large number of waterfowl, stormwater inflow, and high wind and wave events. The presence of a large number of waterfowl in the vicinity of the beach area could cause problems because their wastes contain *E. coli*. Rain events can increase *E. coli* because as rain runs over the land, it can pick up high numbers of *E. coli*, which are then washed into the lake. Additionally, if a storm sewer discharges near the beach, the discharge can increase counts. From May 7-14, 1.8 inches of rainfall fell in Wauconda. Additionally, from July 1-8, over 2.5 inches of rain fell in the same area. This likely explains the high counts at South Shore Beach in May and at Brier Court Beach in July. Rainfall prior to the Park Drive Beach closure was minimal. This closure was most likely the result of a high goose population at the beach. Despite the swim bans on these three dates throughout the summer, *E. coli* contamination does not appear to be a serious problem on Island Lake beaches.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Island Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected at the 3 foot and the 5-6 foot depths (depending on site water depth) from the deep hole location in the

lake (Figure 5). Island Lake did not thermally stratify in 2003. 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. Island Lake remained mixed as a result of its shallow morphometry and the effects of wind and wave action across the lake. Therefore, only data from the epilimnetic samples will be discussed. The surface waters of Island Lake were well oxygenated during the summer, and dissolved oxygen (DO) concentrations did not fall below 5.0 mg/l (a level below which some aquatic organisms become stressed) at any time during the study period.

Phosphorus (P) is a nutrient that can enter lakes through runoff or be released from lake sediment, and high levels of phosphorus typically trigger algal blooms or produce high plant density. The average surface total phosphorus (TP) concentration in Island Lake was 0.099 mg/l, nearly double most of the lakes in the county studied since 1999 (county median = 0.059 mg/l). TP increased significantly in August and September (up 89% over the July TP concentration) (Table 2, Appendix A). This increase appears to correspond with lower rainfall amounts and decreased water levels in August and September. Prior to August, water was flowing over the spillway; however, water level decreased by 1.65 feet between July and September. This decrease in lake volume may have caused an increase in TP, as nutrients continued to be released from bottom sediments, but were consolidated into a smaller volume of water. The same trend was observed in 1998, when TP doubled between June and July. Although 1998 rain data is not available, a decrease in water level was likely the cause of the increase in TP during that year. TP levels could also be related to rainfall with regard to the quantity and quality of water entering Island Lake from upstream lakes such as Golden Oaks Farm Lake and Lake Napa Suwe, as well as Mutton Creek, during wet months. The average TP concentration in Lake Napa Suwe, which flows into Island Lake, was 0.203 mg/l in 2002. This is an extremely high phosphorus concentration and Lake Napa Suwe could be a significant source of phosphorus to Island Lake when water levels are high.

The average epilimnetic TP concentration (0.099 mg/l) has decreased by 15% since the 1998 study conducted on Island Lake, when the average TP concentration was 0.116 mg/l. This relatively small decrease does not necessarily indicate any trends in water quality, and may only be the result of different weather and/or rainfall conditions between years.

Total suspended solids (TSS) is a measure of the amount of suspended material, such as algae or sediment, in the water column. High TSS values are typically correlated with poor water clarity and can be detrimental to many aspects of the lake ecosystem such as the plant and fish communities. A large amount of material in the water column can inhibit successful predation by sight-feeding fish, such as bass and pike, or settle out and smother fish eggs. High turbidity caused by sediment or algae can shade out native aquatic plants, resulting in their reduction or disappearance from the littoral zone. This eliminates the benefits provided by plants, such as habitat for many fish species and stabilization of the lake bottom. The average epilimnetic TSS concentration (14.9 mg/l)

in Island Lake was almost twice as high as the county median (7.5 mg/l). As a result of the increase in TP in August and September, planktonic algae blooms were observed beginning in mid-July. These blooms lead to an increase in TSS, which was closely related to TP (Figure 6). Typically, if high TSS concentrations are the result of dense planktonic algae, TSS and total volatile solids (TVS) (a measure of organic solids such as algae) will be correlated as well. This was not the case in Island Lake. Additionally, 68% of TSS was made up of non-volatile suspended solids (NVSS) (a measure of non-organic solids, such as sediment and soil particles). This is a strong indication that suspended sediment is the dominant component of TSS. As with TP, the source of this sediment may also be a combination of internal sediment resuspension and loading from Golden Oaks Farm Lake, Mutton Creek and Lake Napa Suwe, which had an average TSS concentration of 43.4 mg/l in 2002. The average 1998 epilimnetic TSS concentration in Island Lake (17.4 mg/l) was approximately 15% higher than the current average TSS concentration (Table 2, Appendix A). This difference could be the result of numerous things, including differences in rainfall amounts and/or differences in sediment in the water column between the two years.

Secchi depth (water clarity) in Island Lake was relatively low throughout the summer, ranging from 4.95 feet in June to 1.28 feet in September. Decreases in Secchi depth somewhat coincided with increases in TSS (and algae density) as the summer progressed (Figure 7). An excellent volunteer lake monitoring program (VLMP) has been in place on Island Lake since 1996 (VLMP samples were also taken in 1986). This Illinois Environmental Protection Agency (IEPA) program, organized and run by the Northeastern Illinois Planning Commission (NIPC), involves the collection of water quality data by a volunteer in the same sampling location and along the same time frame each year. Although the amount of data collected is often limited, it can provide valuable historical information on water clarity and, therefore, water quality on many Illinois lakes. Average Secchi depth has not greatly fluctuated in Island Lake since 1996 and is actually increasing overall, ranging between 1.5 and 2.0 feet (Figure 8). This is positive in that it indicates that water quality is not degrading with time. However, average Secchi depth on Island lake is below the median Secchi depth value for Lake County lakes (3.41 feet) and the Illinois Department of Public Health suggested Secchi depth value for safe swimming (4.0 feet).

Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Conductivity has been shown to be highly correlated (in urban areas) with chloride ions found in road salt mixtures. Water bodies most subject to the impacts of road salts are streams, wetlands or lakes draining major roadways. Average 2003 epilimnetic conductivity (0.8376 mS/cm) in Island Lake was not substantially higher than the county median (0.7503 mS/cm), but has increased 23% since sampling in 1998 (0.6490 mS/cm) (Table 2, Appendix A). Conductivity changes can occur seasonally and even with depth, but over the long term, increased conductivity can be a good indicator of potential watershed or lake problems or an increase in pollutants entering the lake if the trend is noted over a period of years.

High conductivity levels (which often indicate an increase in sodium or potassium chloride) can eventually change the plant community, as more salt tolerant plants take over. Sodium, potassium and chloride ions can bind substances in the sediment, preventing their uptake by plants and reducing native plant densities. Additionally, juvenile aquatic organisms may be more susceptible to high chloride concentrations. The general increase in conductivity levels observed in Island Lake in the past five years may be the cumulative result of years of salt laid down on roads within the lake's large watershed. Typically, when road salt is the cause of an increase in conductivity, levels will be very high in May and June, when spring runoff brings a large amount of salt-laden water into the lake, and then decreases throughout the summer. This was the trend in Island Lake, whose conductivity was highest in June and lowest in September. Other sources could also include materials leached from soil, a change in land use within the watershed, algae treatments of copper sulfate, groundwater sources or bacterial activity in the lake. Although the increasing conductivity levels are cause for concern, there may not be much that can be done about it. Non-point runoff, such as that which picks up road salt and enters the lake during rain events, is very difficult to control. However, the Village of Island Lake Public Works Department is fully aware of the environmental impacts that salt can have on natural water bodies and try to limit the amount of salt laid down on roads in the village.

Typically, lakes are either phosphorus (P) or nitrogen (N) limited. This means that one of these nutrients is in short supply relative to the other and that any addition of phosphorus or nitrogen to the lake might result in an increase of plant or algal growth. Other resources necessary for plant and algae growth include light or carbon, but these are typically not limiting. Most lakes in Lake County are phosphorus limited, but to compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than or equal to 10:1 indicate nitrogen is limiting. Ratios greater than or equal to 15:1 indicate that phosphorus is limiting. Ratios greater than 10:1, but less than 15:1 indicate that there are enough of both nutrients to facilitate excess algal or plant growth. Island Lake had an average TN:TP ratio of 39:1. Due to a higher concentration of nitrate nitrogen, this is much higher than the 1998 TN:TP ratio of 24:1. Regardless, the lake is phosphorus limited during both years. Typically, this means that an increase in the phosphorus concentration could result in more planktonic algae in the future. However, in highly nutrient-enriched lakes such as Island Lake, phosphorus levels have often reached the point where either very large increases or very large decreases in phosphorus would be necessary to trigger changes in algae density. What this means is two things: that water quality could be continually degrading, yet there would be minimal visual indication of this, or that a high amount of money and time could be invested into reducing phosphorus concentrations and, in the end, lakeshore homeowners may not be able to see a noticeable difference in algae density or water clarity.

Phosphorus concentrations can also be used to indicate the trophic state (productivity level) of a lake. The Trophic State Index (TSI) uses phosphorus, chlorophyll *a* (algae biomass) and Secchi depth to classify and compare lake trophic states using just one value. The TSI is set up so that an increase in phosphorus concentration is related to an

increase in algal biomass and a corresponding decrease in Secchi depth. A moderate TSI value (TSI=40-49) indicates mesotrophic conditions, typically characterized by relatively low nutrient concentrations, low algae biomass, adequate DO concentrations and relatively good water clarity. High TSI values indicate eutrophic (TSI=50-69) to hypereutrophic (TSI \geq 70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO levels, a rough fish population, and low water clarity. Island Lake had an average phosphorus TSI (TSIp) value of 70, indicating slightly hypereutrophic conditions and highly degraded water quality. When compared to other lakes in the county, Island Lake ranks 90th out of 130 lakes studied, with regard to total phosphorus concentration (Table 3, Appendix A). However, Lake Napa Suwe, which flows into Island Lake has a much higher TP and TSS concentrations, and ranked 123rd out of 130 lakes. So, it appears that some beneficial decreases in both TP and TSS are occurring before or within Island Lake. This is uncommon, as water will typically pick up more TS and TSS as it moves down a creek bed, but bodes well for the water quality of Island Lake.

Most of the water quality parameters just discussed can be used to analyze the water quality of Island Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Island Lake provides *Full* support of aquatic life and *Partial* support of swimming and recreation because of its low Secchi depth and moderately high levels of sediment in the water column. The lake has *Partial* overall use.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See Appendix B for methodology). Shoreline plants of interest were also recorded. However, no quantitative surveys were made of these shoreline plant species and these data are purely observational. Although it was sparse, sago pondweed and EWM dominated the plant community in 2003. Small amounts of spatterdock, curly leaf pondweed, and water stargrass were also observed at very low densities (Tables 4 & 5). During the study, light level was measured at one-foot intervals from the water surface to the lake bottom. When the light intensity falls below 1% of the level at the water surface, plants are no longer able to grow. Using this information, it can be determined how much of the lake has the potential to support aquatic plant growth. Based on 1% light level, Island Lake could have supported plants in 36%-90% of the lake area, depending on the month. Plants did not grow over this surface area and were very sparse, occurring in very defined, small beds, and in the same places every month. The inability of aquatic plants to grow in all areas as determined by percent light level may be explained by the presence of inadequate substrate in many parts of the lake, the historical use of herbicides and the possible depletion of the native plant seed bank.

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

FQI (Floristic Quality Index) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). Each floating or submersed aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of plant species found in the lake. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2003 Lake County lakes is 14.4. Island Lake has an FQI of 14.7, which is right at the county average. However, this number can be deceiving, as it only indicates the quality of the plants found and does not take into account plant density. The plants found in Island Lake were at very low densities and were present as very small, distinctive beds in only a handful of places in the lake. This is not reflected in the FQI number, and the plant community is below average when plant density is considered. The lake ranks 56th out of 118 lakes studied since 2000.

Table 4. Aquatic and shoreline plants on Island Lake, May-September 2003.

Aquatic Plants

Water Stargrass

Duckweed

Eurasian Watermilfoil[^]

Spatterdock

Curlyleaf Pondweed[^]

Small Pondweed

Sago Pondweed

Watermeal

Heteranthera dubia

Lemna minor

Myriophyllum spicatum

Nuphar variegata

Potamogeton crispus

Potamogeton pusillus

Potamogeton pectinatus

Wolffia columbiana

Shoreline Plants

Purple Loosestrife[^]

Reed Canary Grass[^]

Swamp Smartweed

Common Arrowhead

Wild Grape

Lythrum salicaria

Phalaris arundinacea

Polygonum coccineum

Sagittaria latifolia

Vitis sp.

Trees/Shrubs

Box Elder

Silver Maple

Ash

Honeysuckle[^]

Acer negundo

Acer saccharinum

Fraxinus sp.

Lonicera sp.

Table 4. Aquatic and shoreline plants on Island Lake, May-September 2003 (cont'd).

<u>Trees/Shrubs</u>	
Red Mulberry	<i>Morus rubra</i>
Cottonwood	<i>Populus deltoides</i>
Black Cherry	<i>Prunus serotina</i>
Bur Oak	<i>Quercus macrocarpa</i>
Common Buckthorn [^]	<i>Rhamnus cathartica</i>
Weeping Willow	<i>Salix alba tristis</i>
Basswood	<i>Tilia americana</i>
Elm	<i>Ulmus sp.</i>

[^]Exotic plant or tree species

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Island Lake in September 2003. The shoreline was assessed for a variety of criteria (See Appendix B for methods), and based on these assessments, several important generalizations could be made. Approximately 99.6% of Island Lake’s shoreline is developed. The majority of the developed shoreline is comprised of seawall (59.5%) and rip rap (29.3%) (Figure 9). The remainder consists of beach (4.6%), manicured lawn (3.3%), buffer (1.8%), woodland (1.6%) and shrub (0.4%). Although rip rap and seawalls are not ideal shoreline types with regard to wildlife habitat, they do, typically, help to prevent shoreline erosion. As a result of the dominance of these two shoreline types around Island Lake, 97.3% of the shoreline exhibited no erosion (Figure 10). However, certain types of shoreline exhibited a significant amount of erosion. The types of shoreline exhibiting the majority of the erosion were woodland (71.6%), shrub (70.7%) and manicured lawn (28.7%). Other shoreline types with erosion included buffer and riprap. Although the deep roots of shrubs and trees can hold soil in place and filter some nutrients, if improperly maintained, shrub and woodland shorelines, especially those with buckthorn infestations, will typically exhibit erosion. The same is true for buffered shorelines, although typically to a lesser extent. Manicured lawn is considered undesirable because it provides a poor shoreline-water interface due to the short root structure of turf grasses. These grasses are incapable of stabilizing the shoreline and typically lead to erosion on most lakes. Although rip rap is intended specifically to prevent or stop erosion, if improperly installed, this shoreline can exhibit erosion. Often, the rip rap consists of very small rocks without filter fabric installed underneath that simply end up sloughing into the lake as a result of wave action. If they are not replaced, erosion will occur on the exposed soil. Erosion along all areas of the lake should be addressed.

Very few homeowners have installed buffer strips of emergent vegetation along their shorelines. Buffers are excellent features for providing erosion control and wildlife habitat and for reducing sediment and nutrient load to the lake. It is recommended that these emergent types of buffer strips, as well as upland buffer strips, be installed along as many shorelines as possible. Upland buffers can even be installed above rip rap or seawalled shorelines to help filter non-point runoff before it enters the lake. Although relatively little erosion was occurring around Island Lake, invasive plant species, including reed canary grass, purple loosestrife, honeysuckle and buckthorn were present along 5.7% of the shoreline. The areas of invasion were scattered along various shoreline types. These plants are extremely invasive and exclude native plants from the areas they inhabit. Buckthorn and honeysuckle provide very poor shoreline stabilization. Reed canary grass and purple loosestrife inhabit mostly wet areas and can easily outcompete native plants. Additionally, it does not provide the quality wildlife habitat or shoreline stabilization that native plants provide. Since the relative density of the invasive species found around Island Lake is not high, steps to eliminate these plants should be carried out before they become a nuisance.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Records indicate that since 1966, fish surveys have been performed on Island Lake by the Illinois Department of Natural Resources (IDNR). Subsequent year surveys include 1967, 1969, 1970, 1971, 1973, 1985, 1991, 1995 and 2003. A rotenone (fish poison) treatment was carried out in 1967, which improved water clarity (three feet in 1968 and 1969). However, the carp population appeared to have recovered quickly, as water clarity decreased in 1970 and 1971, when Secchi depth was only eight inches. In 1985, 17 fish species were documented during an electro fishing survey, including northern pike, largemouth bass, bluegill, walleye, yellow bass, green sunfish, orange-spotted sunfish, warmouth, black and white crappie, yellow perch, black bullhead, bowfin, brook silversides, goldfish, golden shiners and common carp. A complete rehabilitation was recommended, as the fishery was dominated by undersized bluegill. In 1992, the fish survey yielded only 12 fish species and bluegill were still dominant, representing 61% of the total catch. Carp represented 23% of the total fish collected. Complete rehabilitation was recommended again. Fish population diversity decreased again in 1995, when only 10 species were collected. At that time, it was noted that northern watermilfoil dominated the plant community, but that only 1% of the lake was vegetated. There was a partial fish kill of the crappie population in 1997 and 1998 due to a species-specific fungal infection. In 2001, 17 fish cribs were placed around the lake (concentrated at the southern end near the dam) to provide additional structure and spawning habitat for the fish community. Possibly as a result of the installation of the fish cribs and the partial fish kill in the late 1990's, more fish of larger size were collected during the 2003 fish survey than in 1995. The fish survey in 2003 yielded 15 species of fish. Fifty largemouth bass were collected and the panfish population looked good, with large sized bluegill and black crappie. Northern pike seem to be reproducing naturally. Unfortunately, carp were still abundant as carp can enter the lake via Mutton Creek. Currently, the lake association holds a carp derby every summer, with \$10,000 going to

the person who catches the correctly tagged carp. This is a great practice and helps to educate fishermen and homeowners about the benefits of removing carp from the lake, but Island Lake will probably always have a carp problem, regardless of how many are removed through carp derbies.

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See Appendix B for methodology). Although wildlife habitat in the form of woodland, shrub and buffer areas was not abundant around Island Lake, several species of waterfowl, as well as a good mix of songbirds were observed (Table 6). A study done by researchers at the University of Michigan and the Wisconsin Department of Natural Resources showed that birds that eat insects and birds that nest on the ground were less common around developed lakes, while birds that eat seeds and berries were more prevalent. When assessing bird communities using more traditional methods, the researchers found no differences in bird numbers and species around developed and undeveloped lakes. However, the more detailed analysis used in their study suggests that lakeside homeowners' habits of clearing brush, planting lawns, and stocking bird feeders contribute to the differences in bird guilds (ecological groups) and result in the high number of seed and berry eating species. It is also possible that the prevalence of domestic cats and raccoons in more developed areas may threaten ground nesting birds and their eggs. While an abundance of seed-eating birds is not a problem, the loss of insect-eating birds could be. Without birds to keep them in check, insect larvae such as gypsy moths and tent caterpillars could cause damage to plants and trees. The researchers recommend that shoreline homeowners keep their lawns small, encourage native vegetation, and keep pets away from areas where birds may be nesting or feeding. Island Lake appears to have a mix of both seed and insect eaters among the songbirds observed. However, it is important that the current buffer, woodland and shrub areas around Island Lake should be maintained and that additional buffered areas are encouraged to provide the appropriate habitat for a continued high diversity of bird species into the future.

A large number of geese were observed along the shoreline at Eastway Park. While they were not congregated near the beach, their presence poses the threat of beach closures due to high *E. coli* density in their feces. Additionally, goose feces contain a tremendous amount of phosphorus, and they could be a source of phosphorus to the lake in that particular location.

Table 6. Wildlife species observed at Island Lake, May-September 2003.

Birds

Double-crested Cormorant	<i>Phalacrocorax auritus</i>
Canada Goose	<i>Branta canadensis</i>
Mallard	<i>Anas platyrhynchos</i>
Great Blue Heron	<i>Ardea herodias</i>
Green Heron	<i>Butorides striatus</i>
Solitary Sandpiper	<i>Tringa solitaria</i>
Turkey Vulture	<i>Cathartes aura</i>
Mourning Dove	<i>Falco sparverius</i>
Common Flicker	<i>Colaptes auratus</i>
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>
Purple Martin	<i>Progne subis</i>
Barn Swallow	<i>Hirundo rustica</i>
Tree Swallow	<i>Iridoprocne bicolor</i>
Chimney Swift	<i>Chaetura pelagica</i>
American Crow	<i>Corvus brachyrhynchos</i>
Blue Jay	<i>Cyanocitta cristata</i>
Black-capped Chickadee	<i>Parus atricapillus</i>
House Wren	<i>Troglodytes aedon</i>
Catbird	<i>Dumetella carolinensis</i>
American Robin	<i>Turdus migratorius</i>
Cedar Waxwing	<i>Bombycilla cedrorum</i>
Red-eyed Vireo	<i>Vireo olivaceus</i>
Common Grackle	<i>Quiscalus quiscula</i>
Starling	<i>Sturnus vulgaris</i>
Northern Oriole	<i>Icterus galbula</i>
House Sparrow	<i>Passer domesticus</i>
Northern Cardinal	<i>Cardinalis cardinalis</i>
American Goldfinch	<i>Carduelis tristis</i>
Song Sparrow	<i>Melospiza melodia</i>

Mammals

Eastern Chipmunk	<i>Tamias striatus</i>
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Amphibians

Green Frog	<i>Rana clamitans melanota</i>
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EXISTING LAKE QUALITY PROBLEMS

- *Lack of Aquatic Vegetation*

One key to a healthy lake is a healthy plant community. Island Lake had virtually no aquatic vegetation present in much of the lake. It is not known if substantial plant beds have ever existed in Island Lake, but high turbidity is currently preventing adequate growth of plants. A large carp population is likely maintaining the high turbidity, that prevents plant growth and results in easily resuspended sediment. It would be very difficult to break this cycle without completely removing the carp population and replanting native aquatic vegetation in shallow, undisturbed areas of the lake.

- *Invasive Shoreline Plant Species*

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. The outcome is a loss of plant and animal diversity. Reed canary grass and purple loosestrife are exotic plants found in wetland habitat. They spread very quickly and are not well utilized by wildlife. Buckthorn and honeysuckle are aggressive shrub species that grow along lake shorelines as well as most upland habitats. They shade out other plants and are quick to become established on disturbed soils. Reed canary grass, purple loosestrife, honeysuckle and buckthorn are present along 5.7% of the shoreline of Island Lake, and attempts should be made to control their spread before they become a larger problem.

- *Limited Wildlife Habitat and Shoreline Erosion*

Nearly 100% of Island Lake's shoreline is dominated by residential homes, which do not always encourage a diverse bird and animal community. While a few residents have buffer strips along their shore, many of the residents have rip rap, seawalls and manicured lawn. It is recommended that those residents that already have buffer consider widening their strips and do their best to encourage neighboring properties to establish buffers. It is also recommended that those residents that do not have a buffer strip or are experiencing erosion consider planting at least a 10-20 foot wide strip of native plants along their shoreline. This could increase wildlife habitat, reduce the amount of nutrients and soil particles entering the lake, deter geese and decrease shoreline erosion. Pathways through these buffers could accommodate lake access for homeowners without reducing the integrity of the buffer. Slight to severe erosion is occurring along 2.7% of the shoreline, especially along areas dominated by shrub, woodland and manicured lawn.

- *Excessive Numbers of Common Carp*

Island Lake has had excessive numbers of common carp since fish surveys began in the 1960's. Even after a rotenone treatment was carried out in 1967 to reduce the number of carp and stunted panfish, carp continued to dominate the fish community and are still one of the top three fish species in Island Lake (with regard to number of individuals). It is impossible to remove all carp during a rotenone treatment, and, typically, the lake can be repopulated within a few years. This time frame is probably accelerated in Island Lake because it receives water directly from Mutton Creek and Lake Napa Suwe, both of which are heavily populated with common carp. Due to the fact that Island Lake receives water from several other water bodies through Lake Napa Suwe, it is unlikely that the lake will ever be free of a large carp population.

- *Excessive Numbers of Canada Geese*

A large flock of Canada geese was observed at Eastway Park during each month of sampling. Geese can provide large amounts of nutrients, especially phosphorus, to the lake through their feces. This is especially of concern at this location, which is relatively near Briar Court Beach. Goose feces contain high amounts of the bacteria *E.coli*, which is also found with illness-causing bacteria and viruses.

POTENTIAL OBJECTIVES FOR THE ISLAND LAKE MANAGEMENT PLAN

- I. Eliminate or Control Invasive Species
- II. Enhance Wildlife Habitat Conditions
- III. Control Shoreline Erosion
- IV. Controlling Excessive Numbers of Carp
- V. Canada Geese Management
- VI. Continue VLMP Program

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

Objective I: Eliminate or Control Invasive Species

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

Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Reed canary grass is an aggressive plant that if left unchecked will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of purple loosestrife, buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Alliaria officinalis*) or honeysuckle (*Lonicera* spp.) as well as some aggressive native species, such as box elder (*Acer negundo*).

Presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself. However, problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. A monitoring program should be established, problem areas identified, and control measures taken when appropriate. Although exotic species were found along about 6% of the shoreline of Island Lake, the density of the plant species in these areas was not extremely high. Therefore, control measures should be carried while these exotics would still be relatively easy to control.

Option 1: No Action

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

Pros

There are few advantages with this option. Some of the reasons exotics were brought into this country are no longer used or have limited use. However, in some cases having an exotic species growing along a shoreline may actually be

preferable if the alternative plant is commercial turfgrass. Since turfgrass has shallow roots and is prone to erosion along shorelines, exotics like reed canary grass or common reed (*Phragmites australis*) will control erosion more effectively. Native plants should take precedent over exotics when possible. Table 10, Appendix A lists several native plants that can be planted along shorelines.

Cons

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

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

Costs

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

Option 2: Control by Hand

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

Pros

Removal of exotics by hand eliminates the need for chemical treatments. Costs are low if stands of plants are not too large already. Once removed, control is simple with yearly maintenance. Control or elimination of exotics preserves the

ecosystem's biodiversity. This will have positive impacts on plant and wildlife presence as well as some recreational activities.

Cons

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

Costs

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

Option 3: Herbicide Treatment

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

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

Pros

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

Cons

Since most herbicides are non-selective, they are not suitable for broadcast application. Thus, chemical treatment of large stands of exotic species may not be practical unless it is a monocrop of a specific plant species. 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™, Eagle™, 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 II: Enhance Wildlife Habitat Conditions

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

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

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

Option 1: No Action

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

Pros

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

Cons

If environmental conditions change or substantial land use actions occur (i.e., development) wildlife use of the area may change. For example, if a new housing

development with manicured lawns and roads is built next to an undeveloped property, there will probably be a change in wildlife present.

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

Costs

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

Option 2: Increase Habitat Cover

This option can be incorporated with Option 3 (see below). One of the best ways to increase habitat cover is to leave a minimum 25-foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes (see Table 7 & 8, Appendix A for costs and seeding rates). This will provide cover from predators and provide nesting structure for many wildlife species and their prey. It is important to control or eliminate non-native plants such as buckthorn, purple loosestrife, garlic mustard, and reed canary grass, since these species outcompete native plants and provide little value for wildlife.

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

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

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

Increasing habitat cover should not be limited to the terrestrial environment. Native aquatic vegetation, particularly along the shoreline, can provide cover for fish and other wildlife. Because of the turbidity in Island Lake, it would be best to start with planting of emergent species and most toward submersed species as water clarity improves.

Pros

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

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

Cons

There are few disadvantages to this option. However, if vegetation is allowed to grow, lake access and visibility may be limited. If this occurs, a small path can be made to the shoreline or lower growing species (1.5-2.0 feet tall) can be planted). Composition and density of aquatic and shoreline vegetation are important. If vegetation consists of non-native species such as or Eurasian water milfoil or purple loosestrife, or in excess amounts, undesirable conditions may result. A shoreline with excess exotic plant growth may result in a poor fishery (exhibited by stunted fish) and poor recreation opportunities (i.e., boating, swimming, or wildlife viewing).

Costs

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

Option 3: Increase Natural Food Supply

This can be accomplished in conjunction with Option 2. Habitats with a diversity of native plants will provide an ample food supply for wildlife. Food comes in a variety of forms, from seeds to leaves or roots to invertebrates that live on or are attracted to the plants. Plants found in Table 7, Appendix A should be planted or allowed to grow. In addition, encourage native aquatic vegetation, such as water lily (*Nuphar* spp. and *Nymphaea tuberosa*), sago pondweed (*Stuckenia pectinatus*), largeleaf pondweed (*Potamogeton amplifolius*), and wild celery (*Vallisneria americana*) to grow. Aquatic plants such as these are particularly important to waterfowl in the spring and fall, as they replenish energy reserves lost during migration.

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

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

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

Pros

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

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

Cons

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

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

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

Costs

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

Option 4: Increase Nest Availability

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

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

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

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

Pros

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

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

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

Cons

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

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

Costs

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

Objective III: Control Shoreline Erosion

Erosion is a potentially serious problem to lake shorelines and occurs as a result of wind, wave, or ice action or from overland rainwater runoff. While some erosion to shorelines is natural, human alteration of the environment can accelerate and exacerbate the problem. Erosion not only results in loss of shoreline, but negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. This effect is felt throughout the food chain since poor water quality negatively affects everything from microbial life to sight feeding fish and birds to people who want to use the lake for recreational purposes. The resulting increased amount of sediment will over time begin to fill in the lake, decreasing overall lake depth and volume and potentially impairing various recreational uses. Island Lake has slight to severe erosion along 2.7% of its shoreline, concentrated along shrub, woodland and manicured lawn. The Village of Island Lake should address those small areas that are eroded or could become eroded in the future.

Option 1: No Action

Pros

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

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

Cons

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

Costs

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

Option 2: Create a Buffer Strip

Another effective method of controlling shoreline erosion is to create a buffer strip with existing or native vegetation. Native plants have deeper root systems than turfgrass and thus hold soil more effectively. Native plants also provide positive aesthetics and good wildlife habitat. Cost of creating a buffer strip is quite variable, depending on the current state of the vegetation and shoreline and whether vegetation is allowed to become established naturally or if the area needs to be graded and replanted. Allowing vegetation to naturally propagate the shoreline would be the most cost effective, depending on the severity of erosion and the composition of the current vegetation. Non-native plants or noxious weedy species may be present and should be controlled or eliminated.

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

Buffer strips can be constructed in a variety of ways with various plant species. Generally, buffer strip vegetation consists of native terrestrial (land) species and emergent (at the land and water interface) species. Terrestrial vegetation such as native grasses and wildflowers can be used to create a buffer strip along lake shorelines. Table 7, 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.

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 7, Appendix A should be considered for native plantings.

Pros

Buffer strips can be one of the least expensive means to stabilize shorelines. If no permits or heavy equipment are needed (i.e., no significant earthmoving or filling is planned), the property owner can complete the work without the need of professional contractors. Once established (typically within 3 years), a buffer strip of native vegetation will require little maintenance and may actually reduce the overall maintenance of the property, since the buffer strip will not have to be

continuously mowed, watered, or fertilized. Occasional high mowing (1-2 times per year) for specific plants or physically removing other weedy species may be needed.

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

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

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

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

Cons

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

Costs

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

Objective IV: Controlling Excessive Numbers of Carp

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

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

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

Option 1: No Action

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

Pros

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

Cons

There are many negative aspects to a no action management plan for carp management. The feeding habits of carp cause most of the associated problems. As carp feed they root around in the lake sediment. This causes resuspension of

sediment and nutrients. Increased nutrient levels can lead to increased algal blooms, which, combined with resuspended sediment, lead to increased turbidity (reduced clarity). As a result there is a decrease in light penetration, negatively impacting aquatic plants. Additionally, the rooting action of the carp causes the direct disruption of aquatic plants. Loss of aquatic plants can further aggravate sediment and nutrient loads in the water column due to loss of sediment stabilization provided by the plants. Additionally, the fishery of the lake may decline and/or become stunted due to predation issues related to decreased water clarity and loss of habitat. Other wildlife, such as waterfowl, which commonly forage on aquatic plants and fish, would also be negatively impacted by the decrease in vegetation.

The loss of aquatic plants and an increase in algae will drastically impair recreational use of the lake. Swimming could be adversely affected due to the increased likelihood of algal blooms. Swimmers may become entangled in large mats of filamentous algae, and blooms of planktonic species, such as blue-green algae, can produce harmful toxins and noxious odors. Fishing would also be negatively affected due to the decreased health of the lake's fishery. The overall appearance of the lake would also suffer from an increase in unsightly algal blooms, having an unwanted effect on property values.

Costs

There is no cost associated with the no action option.

Option 2: Rotenone

Rotenone is a piscicide that is naturally derived from the stems and roots of several tropical plants. Rotenone is approved for use as a piscicide by the USEPA and has been used in the U.S. since the 1930's. It is biodegradable (breaks down into CO₂ and H₂O) and there is no bioaccumulation. Because rotenone kills fish by chemically inhibiting the use of oxygen in biochemical pathways, adult fish are much more susceptible than fish eggs (carp eggs are 50 times more resistant). Other aquatic organisms are less sensitive to rotenone. However, some organisms are effected enough to reduce populations for several months. In the aquatic environment, fish come into contact with the rotenone by a different method than other organisms. With fish, the rotenone comes into direct contact with the exposed respiratory surfaces (gills), which is the route of entry. In other organisms this type of contact is minimal. More sensitive nonfish species include frogs and mollusks but these organisms typically recover to pretreatment levels within a few months. Rotenone has low mammalian and avian toxicity. For example, if a human consumed fish treated with normal concentrations of rotenone, approximately 8,816 lbs. of fish would need to be eaten at one sitting in order to produce toxic effects. Furthermore, due to its unstable nature, it is unlikely that the rotenone would still be active at the time of consumption. Additionally, warm-blooded mammals have natural enzymes that would break down the toxin before it had any effects.

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

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

Pros

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

Cons

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

Costs

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

(Lake volume in Acre Feet)(2.022 gallons) = Gallons needed to treat lake
(443.3 acres feet)(2.022 gallons) = 896.4 gallons

(Gallons needed)(Cost/gallon*) = Total cost (no drawdown)
(896.4 gallons) (\$50) = \$44,818
(896.4 gallons) (\$75) = \$67,230

*Cost/gallon = \$50-75 range

In waters with high turbidity and/or planktonic algae blooms, the ppm may have to be higher. A IDNR fisheries biologist will be able to determine if higher concentrations will be needed.

Objective V: Canada Geese Management

Canada geese (*Branta canadensis*) 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.

Option 1: No Action

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 which 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

A 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/repellent 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™. Rental costs for a pair of wing-clipped swans is approximately \$2,500 per pair for a season (March-October). Rental costs for using dogs varies greatly depending on the size of the water body, but can range from \$500-\$6,000 per month.

Option 4: Exclusion

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 owners 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. A table 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 of the area that is in 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 \$10 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. If aerators are not run for several months, there will be a reduction in electrical costs.

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 accustomed 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. A sign designed by the Lake County Health Department can be purchased for approximately \$35.

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.