2004 SUMMARY REPORT
of
DEER LAKE MEADOWS LAKE

Lake County, Illinois

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT
ENVIRONMENTAL HEALTH SERVICES
LAKES MANAGEMENT UNIT
3010 Grand Avenue
Waukegan, Illinois 60085

Christina L. Sanders
Jennifer Wudi
Michael Adam
Mary Colwell
Mark Pfister

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EXECUTIVE SUMMARY

Deer Lake Meadows Lake is located in the Village of Deer Park. The lake was created in the early 1980's as a detention pond for approximately 20 homes in the subdivision that surrounds it. It has a surface area of 13.6 acres and an estimated mean and maximum depths of 1.9 feet and 3.7 feet, respectively. Deer Lake Meadows Lake is managed by 18 families who reside on the lake. It is used by residents and their guests for non-motorized boating and aesthetics.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature and water clarity were measured and the plant community was assessed each month from May-September 2004. Deer Lake Meadows Lake did not stratify in 2004. The average phosphorus concentration was 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. The main source of TP and TSS to the lake appears to be internal, and is likely a combination of resuspended sediment from common carp activities and dense algae concentrations. Secchi depths (water clarity) were low throughout the summer, and corresponded with increases and decreases in TSS concentrations. The conductivity in May was the highest of all the months, indicating that the road salt concentration in spring runoff was high. Conductivity decreased dramatically from May to June, but increased gradually from June through September and did not coincide with rainfall amounts. This indicates that the increase throughout the summer was the result of in-lake factors. 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.

Almost no plants are present in Deer Lake Meadows Lake. Very small amounts of curly-leaf pondweed, sago pondweed and water smartweed existed, but were very localized in small beds in the same areas of the lake all summer. The southeast bay had a large population of *Chara*, a macroalgae that forms a low-lying cover over the sediment. A large carp population is likely maintaining the high turbidity that prevents plant growth, and results in easily resuspended sediment. Additionally, much of the lake bottom is relatively hard and may not support plants as well as more flocculent substrate.

Although minimal erosion was occurring around Deer Lake Meadows Lake, buckthorn, honeysuckle, purple loosestrife, Dame's rocket, Canada thistle, multiflora rose, yellow sweet clover and reed canary grass were present along 11% of the shoreline. These are exotic plant species that out-compete native vegetation and provide poor habitat for wildlife. A moderate number of waterfowl and bird species were observed during the summer, despite the dominance of residential shoreline. However, the conversion of more of the shoreline to buffered areas will further encourage high quality wildlife to utilize Deer Lake Meadows Lake.

LAKE IDENTIFICATION AND LOCATION

Deer Lake Meadows Lake is located in the Village of Deer Park on Long Grove Rd, just east of Ela Rd. (T 43N, R 10E, S 32). It has a surface area of 13.6 acres, estimated mean and maximum depths of 1.9 feet and 3.7 feet, respectively, and an estimated volume of 24.5 acre-feet. The watershed of Deer Lake Meadows Lake encompasses approximately 37.9 acres, draining only the area immediately surrounding it (Figure 1). The watershed to lake surface area ratio of less than 3:1 is very small. This is positive in that it may help prevent serious water quality problems that often accompany a larger watershed to lake ratio. However, lakes with small ratios often experience more severe water level fluctuations throughout the summer as well as the accumulation of solids and nutrients because lake retention time (the time it takes all the water in the lake to be replaced) is high. It takes 1½ years for all of the water volume of Deer Lake Meadows Lake to flush out of the lake and be replenished by new water. This can mean extended periods of poor water quality of water already in the lake even if there are improvements to new water entering the lake. Water level fluctuations during the summer 2004 were not large on Deer Lake Meadows Lake, but it is recommended that in the future, a staff gauge be installed and readings be taken weekly or bi-weekly if possible. This will give lake managers a much better idea of lake level fluctuations relative to rainfall events and can aid in future decisions regarding lake level.

Based on the most recent land use survey of the Deer Lake Meadows Lake watershed, conducted in 2000, residential areas dominate the watershed, making up over half of the area (Figure 2). The lake itself makes up approximately 35% of the watershed and other land uses together make up less than 10% of the watershed (Table 1, Appendix A). The large amount of residential area that makes up the watershed can be good or bad, depending on the activities of homeowners that live around the lake. If homeowners are educated about how their daily activities affect the lake and take steps to prevent additional sediment and nutrients from entering the water, there could be some improvement in water quality over time. However, if residents go about their daily activities with no regard to how it may affect the lake, water quality could be degraded over time. Water exits Deer Lake Meadows Lake over a spillway on the south end and flows under Long Grove Rd. into a small detention pond before eventually entering Flint Creek and then the Fox River. The lake is located in the Flint Creek sub basin, within the Fox River watershed.

BRIEF HISTORY OF DEER LAKE MEADOWS LAKE

Deer Lake Meadows Lake was created in the early 1980's as a detention pond for approximately 20 homes in the subdivision that surrounds it. It is managed by 18 families who reside on the lake and use it for non-motorized boating and aesthetics. There is no formal lake management association at this time but the homeowners around the lake contribute to a lake budget each year (~$3,500.00) for algaecide treatments.

Figure 1

Figure 2

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Deer Lake Meadows Lake is checked once per week by Environmental Aquatics and treated with an algaecide when necessary. No other management techniques are or have been employed on the lake.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Deer Lake Meadows Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected approximately one foot below the surface from the deepest location in the lake (Figure 3). The surface waters of Deer Lake Meadows Lake were well oxygenated during the summer, and dissolved oxygen (DO) concentrations remained well above 5.0 mg/L (a level below which some aquatic organisms become stressed) at all times 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 Deer Lake Meadows Lake was 0.116 mg/L, nearly double most of the lakes in the county studied since 1999 (county median = 0.063 mg/L). TP increased significantly in August as a result of increased algae density and then decreased again in September (Table 2, Appendix A). Since the watershed of Deer Lake Meadows Lake is so small, it is likely that the dominant source of phosphorus to the water column is internal (a combination of lake sediment that has been stirred up by carp activity and decomposing algae). As mentioned above, retention time is high and decreased water levels can cause nutrient and solids concentrations to become elevated as lake water volume decreases and variables become more concentrated. The observed increase in TP appears to correspond with decreased water levels in August and September. Prior to August, water was flowing over the spillway. However, water level decreased by 0.34 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.

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

Figure 3

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 (23.2 mg/L) in Deer Lake Meadows Lake was almost three times the county median (7.9 mg/L) and was highly correlated with TP (Figure 4). As a result of the increase in TP in August and September, planktonic algae blooms were observed beginning in August. A water sample was taken on September 8, 2004 using a net tow to collect algae for identification. The sample was dominated by two filamentous blue-green algae species (*Microcystis* spp. and *Anabaena* spp.), which gave the water a very green color. The increase in TP and subsequent blooms lead to an increase in TSS. 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 Deer Lake Meadows Lake. Additionally, 75% 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 algae and sediment together make up the TSS measured in Deer Lake Meadows Lake.

As a result of the increases in TP and TSS concentrations at the end of the summer, Secchi depth (water clarity) on Deer Lake Meadows Lake was lower than the county median (3.08 feet) every month during the summer of 2004, and reached a minimum of 1.05 feet in September (Figure 5) (Table 2, Appendix A). The combination of high TSS and low Secchi depth resulted in a near absence of aquatic plants in Deer Lake Meadows Lake. A diverse community of aquatic plants is beneficial to a lake in many ways, including stabilizing sediment to prevent resuspension, causing soil particles entering the lake through non-point runoff to settle out more quickly, competing with planktonic algae for resources and providing habitat and a food base for a healthy fish community. Without adequate plant coverage, there were likely more sediment particles in the water column during the summer. As a result, Secchi depth and light levels in the lake were very low, and plants were unable to thrive, which resulted in more resuspension of sediment into the water column, and the cycle continued.

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 2004 conductivity in Deer Lake Meadows Lake (1.0120 mS/cm) was much higher than the county median of 0.7652 mS/cm. Conductivity was highest in May, decreased dramatically from May to June, and then increased gradually from June through September. That the highest levels were observed in May, during the greatest amount of rainfall, is an indication that road salt in runoff makes up a major component of the dissolved ions in the lake early in the summer. The gradual increase throughout the rest of the summer after the decrease in conductivity from May to June indicates that other factors are contributing to the conductivity in the lake after the initial pulse of road salt in the spring.

Figure 4

Figure 5

Other sources of chemical ions could 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.

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 (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.

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. Deer Lake Meadows Lake had an *average* TN:TP ratio of 19:1, indicating slight phosphorus limitation. 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 Deer Lake Meadows 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 ≥70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO concentrations, a rough fish population, and low water clarity. Deer Lake Meadows Lake had an average phosphorus TSI (TSIp) value of 73, indicating slightly hypereutrophic conditions and highly degraded water quality. When compared to other lakes in the county, Deer Lake Meadows Lake ranks

120th out of 161 lakes studied, with regard to total phosphorus concentration (Table 3, Appendix A).

Most of the water quality parameters just discussed can be used to analyze the water quality of Deer Lake Meadows Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Deer Lake Meadows 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. *Chara* sp. (a macroalgae) dominated the plant community in 2004, but was only found in the southeast lobe of the lake. Other plant species observed (sago pondweed, curlyleaf pondweed and smartweed) were extremely sparse and, besides where *Chara* was found, the lake was virtually devoid of plants (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. Although water clarity was not high, based on 1% light level, Deer Lake Meadows Lake could have supported plants in 100% of the lake area. 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, or the historical use of herbicides.

Of the 23 emergent plant and trees species observed along the shoreline of Deer Lake Meadows Lake, eight (reed canary grass, purple loosestrife, honeysuckle, multiflora rose, yellow sweet clover, dames rocket, Canada thistle and buckthorn) are invasive species that do not provide ideal wildlife habitat and outcompete native plants.

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 2000-2004 Lake County lakes is 14.3. Deer Lake Meadows Lake has an FQI of 5.2,

which is far below the county average. The lake ranks 136th out of 150 lakes studied since 2000.

Table 4. Aquatic and shoreline plants on Deer Lake Meadows Lake, May-September 2004.

Aquatic Plants	
Chara	*Chara* sp.
Water Smartweed	*Polygonum amphibium*
Curlyleaf Pondweed^	*Potamogeton crispus*
Sago Pondweed	*Potamogeton pectinatus*
Shoreline Plants	
Swamp Milkweed	*Asclepias incarnata*
Nightshade	*Atropa belladonna*
Canada Thistle^	*Cirsium arvense*
Daisy Fleabane	*Erigeron annuus*
Dame's Rocket^	*Hesperis matronalis*
Jewelweed	*Impatiens pallida*
Blue Flag Iris	*Iris* sp.
Purple Loosestrife^	*Lythrum salicaria*
Yellow Sweet Clover^	*Melilotus officinalis*
Virginia Creeper	*Parthenocissus quinquefolia*
Reed Canary Grass^	*Phalaris arundinacea*
Canada Bluegrass	*Poa compressa*
Multiflora Rose^	*Rosa multiflora*
Common Arrowhead	*Sagittaria latifolia*
Goldenrod	*Solidago* sp.
Nannyberry	*Viburnum lentago*
Common Cattail	*Typha latifolia*
Wild Grape	*Vitis* sp.
Trees/Shrubs	
Silver Maple	*Acer saccharinum*
Serviceberry	*Amelanchier canadensis*
Honeysuckle^	*Lonicera* sp.
Common Buckthorn^	*Rhamnus cathartica*
Willow	*Salix* sp.

^Exotic species

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Deer Lake Meadows Lake in June 2004. 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 94% of Deer Lake Meadows Lake's shoreline is developed. The majority of the developed shoreline is comprised of manicured lawn (49.5%) and rip rap (31.2%) (Figure 6). The remainder consists of buffer (17.6%) and beach (1.8%). Although rip rap is not an ideal shoreline types with regard to wildlife habitat, it does typically help to prevent shoreline erosion. As a result of the dominance of this shoreline type around Deer Lake Meadows Lake, 82.9% of the shoreline exhibited no erosion (Figure 7). However, certain types of shoreline exhibited a significant amount of erosion. The type of shoreline exhibiting the majority of the erosion was manicured lawn (34.5). Buffer also exhibited some moderate erosion along 5% of the buffered shoreline. Although the deep roots of shrubs and trees can hold soil in place and filter some nutrients, if improperly maintained, buffered shorelines, especially those with buckthorn and honeysuckle infestations, will typically exhibit erosion. 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. 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 rapped shorelines to help filter non-point runoff before it enters the lake. Although relatively little erosion was occurring around Deer Lake Meadows Lake, invasive plant species, including reed canary grass, purple loosestrife, honeysuckle, multiflora rose and buckthorn were present along the shoreline. The areas of invasion were scattered along buffered shoreline types that had not been kept up. 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, they do not provide the quality wildlife habitat or shoreline stabilization that native plants provide. Since the relative density of the invasive species found around Deer Lake Meadows Lake is not high, steps to eliminate these plants should be carried out before they become a nuisance.

Figure 8

Figure 9

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

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 Deer Lake Meadows 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. Deer Lake Meadows Lake appears to have a mix of both seed and insect eaters among the songbirds observed. However, it is important that the current buffer areas around the lake should be rehabilitated and maintained, and that additional buffered areas are encouraged to provide the appropriate habitat for a continued high diversity of bird species into the future.

The homeowners around Deer Lake Meadows Lake rent a pair of mute swans each summer and provide a nesting platform in the northeast bay. This year the pair had three signets. However, according to a homeowner, several very large snapping turtles inhabit the lake (two were seen mating early in the summer) and two of the signets were eaten by the snappers. The homeowners are considering having the snappers trapped and relocated.

Table 6. Wildlife species observed at Deer Lake Meadows Lake, April-September 2004.

Birds	
Double crested Cormorant	*Phalacroxorax auritus*
Mute Swan	*Cygnus olor*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Great Egret	*Bubulcus ibis*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Belted Kingfisher	*Megaceryle alcyon*
Barn Swallow	*Hirundo rustica*
Blue Jay	*Cyanocitta cristata*
Ruby-crowned Kinglet	*Regulus calendula*
Catbird	*Dumetella carolinensis*
American Robin	*Turdus migratorius*
Cedar Waxwing	*Bombycilla cedrorum*
Yellow warbler	*Dendroica petechia*
Red-winged Blackbird	*Agelaius phoeniceus*
Starling	*Sturnus vulgaris*
Northern Cardinal	*Cardinalis cardinalis*
Amphibians	
Bull Frog	*Rana catesbeiana*
Green Frog	*Rana clamitans melanota*
Reptiles	
Painted Turtle	*Chrysemys picta*

EXISTING LAKE QUALITY PROBLEMS

- *Lack of a Quality Bathymetric Map*

A bathymetric (depth contour) map is an essential tool in effective lake management, especially if the long term lake management plan includes intensive treatments, such as fish stocking, dredging, chemical application or alum application. No bathymetric map currently exists for Deer Lake Meadows Lake. Morphometric data obtained in the creation of a bathymetric map is necessary for calculation of equations for correct application of many types of treatments. It is also necessary to determine the volume of water affected by low DO levels.

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

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

- *Lack of Aquatic Vegetation*

One key to a healthy lake is a healthy plant community. Deer Lake Meadows Lake had virtually no aquatic vegetation present in much of the lake. It is not known if substantial plant beds have ever existed in Deer Lake Meadows Lake, but high turbidity and poor sediment quality are currently preventing adequate growth of plants. A carp population is likely maintaining the high turbidity, which prevents plant growth and results in easily resuspended sediment.

- *Excessive Algae Blooms*

Blue-green algae blooms were present, especially in the southeast bay of Deer Lake Meadows Lake from July through September and lead to a decrease in water clarity and an increase in TSS. The blooms largely consisted of the blue-green algae species *Microcystis* spp. and *Anabaena* spp., and were caused by high phosphorus concentrations. It is thought that phosphorus was probably originating from suspended sediment in the water column and decaying algae cells. However, it is likely that some phosphorus is entering the lake via runoff from land surrounding the

lake (the watershed). Most of the watershed is comprised of residential land (Figure 2) and it is the responsibility of those people living in the watershed to ensure that they are having as little negative impact on the water quality as possible. Activities to reduce impact can include (1) using phosphorus-free fertilizer on well-established lawns (grass only needs phosphorus to form initial roots. After that, there is no need to fertilize with a product containing phosphorus, as it does not improve the health of your lawn), (2) cleaning up pet waste promptly, properly maintaining your septic system and washing cars on the lawn instead of the driveway. It is important that residents realize that everything they do in and around their homes can adversely impact Deer Lake Meadows Lake. Many educational tools exist to help residents fully understand the types of things they can personally do to protect and improve water quality in their lake, and we can help to provide these tools.

- *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, Canada thistle 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. Seven exotic shoreline plants species are present along the shoreline of Deer Lake Meadows 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 Deer Lake Meadows Lake's shoreline is dominated by residential homes, which do not always encourage a diverse bird and animal community. While some buffer strips exist along the shore, most of the residents have rip rap and manicured lawn. It is recommended that any 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 moderate erosion is occurring along 17% of the shoreline, especially along areas dominated by manicured lawn.

POTENTIAL OBJECTIVES FOR THE DEER LAKE MEADOWS LAKE MANAGEMENT PLAN

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

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

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

A bathymetric (depth contour) map is an essential tool in effective lake management since it provides information on the morphometric features of the lake, such as depth, surface area, volume, etc. The knowledge of this morphometric information would be necessary if lake management treatments such as fish stocking, dredging, alum application or aeration were part of the overall lake management plan. Deer Lake Meadows Lake does not currently have a bathymetric map. Maps can be created by the Lake County Health Department – Lake Management Unit or other agencies for costs that vary from $3,000-$10,000, depending on lake size.

Objective II: Participate in the Volunteer Lake Monitoring Program

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

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

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

For more information about the VLMP contact:

VLMP Regional Coordinator:
Holly Hudson
Northeastern Illinois Planning Commission
222 S. Riverside Plaza, Suite 1800
Chicago, IL 60606
(312) 454-0400

Objective III: Eliminate or Control Invasive Species

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

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 is an aggressive plant that if left unchecked will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of purple loosestrife, buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Allilaria officianalis*) or honeysuckle (*Lonicera* spp.) as well as some aggressive native species, such as box elder (*Acer negundo*).

Presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself. However, problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. A monitoring program should be established, problem areas identified, and control measures taken when appropriate. Although exotic species were found along about 11.7% of the shoreline of Deer Lake Meadows Lake, the density of the plant species in these areas was not extremely high. Therefore, control measures should be carried out 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. Tables 7 & 8, Appendix A lists several native plants that can be planted along shorelines.

Cons

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

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

Costs

Costs with this option are 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™, Eagre™, or AquaPro™), are sold in 2.5 gallon jugs, and cost approximately $200 and $350, respectively. Only Rodeo® is approved for water use. A Hydrohatchet®, a hatchet that injects herbicide through the bark, is about $300.00. Another injecting device, E-Z Ject® is $450.00. Hand-held and backpack sprayers costs from $25-$45 and $80-150, respectively. Wicking devices are $30-40. A girdling tool costs about $150.

Objective IV: Enhance Wildlife Habitat Conditions

The key to increasing wildlife species in and around a lake can be summed up in one word: habitat. Wildlife need the same four things all living creatures need: food, water, shelter, and a place to raise their young. Since each wildlife species has specific habitat requirements, which fulfill these four basic needs, providing a variety of habitats will increase the chance that wildlife species may use an area. Groups of wildlife are often associated with the types of habitats they use. For example, grassland habitats may attract wildlife such as northern harriers, bobolinks, meadowlarks, meadow voles, and leopard frogs. Marsh habitats may attract yellow-headed blackbirds and sora rails, while manicured residential lawns attract house sparrows and gray squirrels. Thus, in order to attract a variety of wildlife, a mix of habitats are needed. In most cases quality is more important than quantity (i.e., five 0.1-acre plots of different habitats may not attract as many wildlife species as 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 place at least 10 feet away from the shoreline to prevent any debris from washing into the lake.

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

Increasing habitat cover should not be limited to the terrestrial environment. Native aquatic vegetation, particularly along the shoreline, can provide cover for fish and other wildlife. Because of the turbidity in Deer Lake Meadows Lake, it would be best to start with planting of emergent species and move 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. 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 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 were wildlife can rear their young has many benefits. Watching wildlife raise their young can be an excellent educational tool for both young and old.

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

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

Cons

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

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

Costs

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

Objective V: Control Shoreline Erosion

Erosion is a potentially serious problem to lake shorelines and occurs as a result of wind, wave, or ice action or from overland rainwater runoff. While some erosion to shorelines is natural, human alteration of the environment can accelerate and exacerbate the problem. Erosion not only results in loss of shoreline, but negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. This effect is felt throughout the food chain since poor water quality negatively affects everything from microbial life to sight feeding fish and birds to people who want to use the lake for recreational purposes. The resulting increased amount of sediment will over time begin to fill in the lake, decreasing overall lake depth and volume and potentially impairing various recreational uses. Deer Lake Meadows Lake has slight to moderate erosion along 17% of its shoreline, concentrated along buffer and manicured lawn. The residents around the 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. Tables 7 & 8, 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.