2001 SUMMARY REPORT
of
NORTH TOWER LAKE

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

North Tower Lake is a 7.4 acre manmade lake in Cuba Township in the Village of Tower Lake. North Tower Lake was created in 1939 by the excavation and damming of a small creek. Since its construction, the Tower Lake Improvement Association has managed North Tower Lake and has been faced with many management problems. These problems have included low dissolved oxygen concentrations leading to fish kills, excessive aquatic vegetation, and nuisance algae blooms.

Overall, North Tower Lake has *below average* water quality as compared to other Lake County lakes. Dissolved oxygen concentrations were low despite the operation of an aeration system in the lake. The dissolved oxygen concentrations in May (5.2 mg/L) and July (5.4 mg/L) were just above the concentration needed to support aquatic life (5.0 mg/L). North Tower Lake has low dissolved oxygen concentrations because the amount of oxygen diffusion is unable to keep up with the oxygen demand from large amounts of decaying organic matter, which is partially the result of herbicide/algicide treatments. Additionally, data collected by the Lake Management Unit found that phosphorus concentrations were above average. In 2001, average phosphorus concentrations in North Tower Lake was 0.072 mg/L, which is well above the Lake County median concentration of 0.047 mg/L. Furthermore, phosphorus concentrations were nearly double the County median or greater during May, July, and August. These elevated concentrations of phosphorus are from decaying aquatic plants and algae that have been treated with herbicides and algicides, respectively. The 2001 study also found high concentrations of suspended organic matter (decaying plants and algae) that negatively impacted water clarity. Secchi disk depth decreased from a high of 9.32 feet (May) to a low of 3.25 feet (July) as a result of the decaying algae and plant matter due to algicide/herbicide treatments.

One key to a healthy lake is a healthy aquatic plant community. However, the herbicide treatments kept both aquatic plant *diversity* as well as *density* to a minimum in North Tower Lake. In May, three species of aquatic plants were found in North Tower Lake and coverage was approximately 75%. However, after May, the only “plant” species found was *Chara* which is a macroalga and is unaffected by herbicide and many algicide treatments. In order to allow aquatic vegetation to become established in North Tower Lake, herbicide treatments could be scaled back. Additionally, aquatic vegetation as well as the filamentous algae blooms, could be removed by as an alternative to herbicide/algicide use. This would reduce the amount of decomposing organic matter in the lake and would help to improve the low D.O. conditions and high phosphorus concentrations in the lake.

The shoreline of North Tower Lake is 100% developed. Most of the developed shoreline is made up of rock rip rap (53%) and manicured lawn (40%). Both of these shoreline types are considered undesirable because they provide little habitat and both can be prone to erosion if not installed/maintained properly. The Association, as well as individual property owners, should promote and implement the use of naturalized shoreline types, such as buffer strips of native vegetation, when replacing existing structures. Additionally, emergent shoreline vegetation should be planted in near shore areas.

LAKE IDENTIFICATION AND LOCATION

North Tower Lake is near the intersection of Route 59 and Roberts Road in Cuba Township in the Village of Tower Lake (T43N, R9E, Section 2). North Tower Lake is an oblong shaped 7.4 acre manmade lake with a current maximum depth of 9.4 feet and an average depth of 4.7 feet (Lake County Health Department – Lakes Management Unit [LMU] calculation) (Figure 1). Lake volume is approximately 34.8 acre-feet (LMU calculation). North Tower Lake is included in the Tower Lake Drainage basin, which is part of the Fox River watershed. North Tower Lake's watershed is small and is approximately 20 acres (LMU data). As with Tower Lake, watershed usage is entirely residential. The main flow into the lake is via a storm water culvert on the northeast side of the lake. Additionally, there is a drainage swale (an old creek bed) that drains into the lake, which drains the areas upland of North Tower Lake. A metal culvert on the northwest shore acts as an overflow, and controls flow into Rose's pond, a small pond just to the northwest of North Tower Lake. There is a spillway on the southeast side of the lake, which drains into Davlin's Pond, which then flows under Roberts Road and into Tower Lake (Figure 1).

BRIEF HISTORY OF NORTH TOWER LAKE

North Tower Lake was created in 1939 by damming a small tributary of the Timber Lake Drain. Residential housing started to appear on the lake by the early 1940s. Since its creation, the Tower Lakes Improvement Association (TLIA) has overseen the management of North Tower Lake. As with it's neighbor Tower Lake, North Tower Lake has experienced many management challenges over the past 62 years. These have included low dissolved oxygen (which has caused many fish kills), excessive aquatic vegetation, and nuisance algae blooms.

SUMMARY OF CURRENT AND HISTROICAL LAKE USES

Access to North Tower Lake is entirely private and TLIA owns 100% of the lake bottom. There are three TLIA access points on the lake that are open year-round to members of the TLIA (Figure 1). The launching of watercraft by non-association and non-approved personal is prohibited. Recreational opportunities on North Tower Lake have gone unchanged since its creation over 60 years ago and largely consist of boating (no motors of any kind allowed), swimming, and fishing. There is not a licensed Illinois Department of Public Health beach on North Tower Lake, but a few residents have beach areas on their property and there is a swimming platform in the middle of the lake.

LIMNOLOGICAL DATA - WATER QUALITY

Water samples collected at North Tower Lake were analyzed for a variety of water quality parameters. Samples were collected at three feet from the surface and three feet

off the bottom (6 feet deep) from the deep hole location in the lake (Figure 1). Due the shallow depth and the aeration system, North Tower Lake does not thermally stratify. This means the lake mixes and does not divide into a warm upper water layer (epilimnion) and cool lower water layer (hypolimnion) (see *Interpreting Your Lake's Water Quality* for further explanation). The constant mixing of North Tower Lake is reflected in the water quality data. Below is a discussion of highlights from the complete data set for Tower Lake (*Table 1, Appendix A*).

Overall, D.O. concentrations were uniform throughout the water column during the 2001 study. However, average D.O. concentrations in North Tower Lake are low. This is despite the fact that there is an aerator that is operated during the summer. Aquatic organisms need D.O. concentrations of $\geq$ 5.0 mg/L to survive. At concentrations below this level, fish become stressed and continual stress can lead to mortality. The average D.O. concentration in North Tower Lake during May and July was just above this threshold limit (5.2 mg/L and 5.4 mg/L, respectively) and the D.O. concentration in August was low (6.0 mg/L). Furthermore, D.O. concentrations fluctuate on a daily basis, with concentrations highest during the day because of photosynthesis (an oxygen producing process) and lowest at night/early morning due to respiration (an oxygen consuming process). This means that D.O. concentrations at night during May, July, and August might have been below 5.0 mg/L. Low D.O. problems are not a new phenomenon on North Tower Lake. Fishery surveys by the Illinois Department of Natural Resources (IDNR) report fish kills due to low D.O. concentrations occurring on North Tower Lake as far back as the 1950's with the most recent fish kill occurring in 1999. These low D.O. conditions are the result of the decomposition of organic matter, a biological process that consumes oxygen. The decaying organic matter is the byproduct of aquatic plant/algae death. Furthermore, the small volume of North Tower Lake also contributes to the low D.O. conditions. The concentration of D.O. that is soluble in water decreases with increasing water temperature. Since the volume of North Tower Lake is small, it warms and holds less oxygen. The aeration unit was originally installed to alleviate the low D.O. conditions. However, this unit might be undersized. A properly sized aeration unit for North Tower Lake should be at least ¾ horsepower and be able to operate at 5 pounds per square inch (psi). At the time of this report, no information had been provided as to the make, model or output of the current aeration system. In order to prevent further D.O. problems (and accompanying fish kills) the aeration unit on North Tower Lake should be upgraded if it is determined to be undersized. However, simply upgrading the compressor may not be enough to overcome the high biological oxygen demand from the decomposition of the dead plant/algae. Another possible option to help alleviate the low D.O. conditions would be to remove nuisance vegetation and filamentous algae by hand. This would reduce the amount of decaying organic matter in the lake and the resulting oxygen consumption. A few residents on North Tower Lake already rake out algae on a regular basis and this program could easily be expanded using volunteer labor with boats and rakes to include the rest of the lake or this is a task that the current consultant could carry out.

Secchi disk depth is a direct indicator of water clarity as well as overall water quality. In general, the greater the Secchi disk depth, the clearer the water and better the water quality. Based on the 2001 average Secchi depth, North Tower Lake has slightly above average water clarity compared to many other lakes in the County. The average Secchi depth on North Tower Lake in 2001 was 6.75[1] feet, which is 61% higher than the median County Secchi depth (4.2 feet). However, the Secchi disk readings in North Tower Lake fluctuated over the five-month study. In May, the Secchi disk depth was at its deepest and was to the bottom of the lake (9.32 feet) but by July, the Secchi depth had decreased to its shallowest depth of 3.25 feet. The fluctuations in Secchi depth can be directly attributed to suspended solids in the water column.

Total suspended solids (TSS) correlates with decreases in Secchi depth (Figure 2). As TSS concentrations increased, Secchi depth (clarity) decreased. However, the average TSS for North Tower Lake was low the entire study (2.8 mg/L). For comparison, the average TSS concentration in Tower Lake in 2001 was 15 mg/L. Similarly, total volatile solids (TVS) also followed this inverse trend with Secchi depth decreasing as TVS increased (Figure 3). TVS is a measurement of organic particles (algae, decomposing plants, etc.) suspended in the water column. These increasing concentrations of suspended organic matter can be attributed to herbicide/algaecide treatments of aquatic vegetation and filamentous algae. When these plants/algae decompose, organic matter spreads throughout the water column and reduces clarity. In May, the herbicide treatments on North Tower Lake had not yet started to kill the vegetation in the lake and as a result the clarity was good. After May, clarity decreased as herbicide treatments started to kill the aquatic plants and treatment of the algae mats increased. By September, the mats of algae were no longer being treated, which reduced the amount of suspended organic matter and as a result, clarity increased. Additionally, aquatic plants stabilize sediment, which reduces sediment resuspension and as vegetation is eliminated from the lake, resuspension increases. The calculated nonvolatile suspended solids (NVSS) concentration, which is the portion of the TSS measurement that is made up of inorganic particles, followed the same inverse trend as other solids measurements.

During the 2001 LMU study there were season long, filamentous algae blooms. Algae need light and nutrients, most importantly carbon, nitrogen (N) and phosphorus (P), to grow. Light and carbon are not normally in short supply (limiting). This means that nutrients (N&P) are the limiting factors in algal growth. To compare the availability of these nutrients, a ratio of total nitrogen to total phosphorus is used (TN: TP). Ratios <10:1 indicate nitrogen is limiting. Ratios of >15:1 indicate phosphorus is limiting. Ratios >10:1, <15:1 indicate that there is enough of both nutrients for excessive algal growth. Most lakes in the County are phosphorus limited and in these phosphorus-limited lakes even a small addition of P can trigger algae blooms. In 2001, North Tower Lake had an average TN: TP ratio of 14:1, which means that there are sufficient amounts of both nutrients to support the algae growth which was present during the entire 2001 study.

[1] This average includes Secchi measurements from May and September, when Secchi depth was inhibited by the bottom.

Overall, the average total nitrogen concentrations in 2001 were low. The average total Kjeldahl nitrogen (TKN) concentration of 0.983 mg/L was below the County median concentration of 1.120 mg/L. This below average concentration is the result of the filamentous algae blooms. TKN is all organic (algae) forms of nitrogen. Since these filamentous algae are not collected in water samples the TKN concentrations are lower. Nitrate nitrogen (NO_3-N) concentrations were lower than the laboratory detection limit of <0.05 mg/L for the entire five-month period. These low NO_3-N concentrations are uptake by the filamentous algae blooms.

Average seasonal total phosphorus concentration in North Tower Lake during the 2001 study was 0.072 mg/L, which was *above* the County median concentration of 0.047 mg/L. Total phosphorus concentrations were nearly double the County average or greater during May, July, and August. The TP concentrations drastically decreased in June and September. This decrease in the TP concentrations may be due to uptake by the filamentous algae blooms. Soluble reactive phosphorus (SRP) was detectable every month of the 2001 study. SRP is a form of phosphorus that is not normally found at detectable concentrations in the surface waters of lakes. These elevated concentrations of TP and SRP are from decaying aquatic plant and algae that have been treated with herbicides and algicides, respectively. The months with above average total phosphorus correspond with increases in TVS (Figure 4) and a decrease in Secchi depth (Figure 5) both of which were caused by an increase in suspended organic matter (dead algae and plant matter).

In lakes, phosphorus originates from two sources. One source is from within the lake (internal). These internal sources can include release from anoxic sediment, resuspension of sediment, and decomposition of organic matter. Based on the relationship between the monthly concentrations of volatile solids (organic matter), TP, and Secchi depth, it is more than likely that most of the TP in North Tower Lake is coming from decomposition of the treated aquatic plants and filamentous algae. The other main input of phosphorus is from sources outside of the lake (external). These external inputs consist of a variety of sources. They can include fertilizer runoff, failing septic systems and erosion. The TP concentrations in North Tower Lake did not correspond with rainfall data, which may indicate that a majority of North Tower Lake's TP may be coming from internal sources outlined above.

Another way to look at phosphorus concentrations and how they affect productivity of the lake is the use of a Trophic State Index (TSI). TSI can be based on phosphorus concentrations, chlorophyll *a* concentrations, and Secchi disk depth to classify and compare lake productivity levels (trophic state). The phosphorus TSI is setup so the higher the phosphorus concentration the greater amount of algal biomass and as a result, a higher trophic state. Based on a TSI phosphorus value of 65.8, North Tower Lake is classified as eutrophic ($\geq$50, <70 TSI). This means that North Tower Lake is a highly productive system that has above average nutrient concentrations and high algal biomass (growth). Field observations reinforce that North Tower Lake is highly eutrophic. Most lakes in the County are in a eutrophic state. Out of all the lakes in Lake Country studied by the LMU since 1988, North Tower Lake ranks 64 out of 102 lakes based on average phosphorus TSI (Table 2). For comparison, Tower Lake ranked slightly lower at 68.

TSI values along with other water quality parameters can be used to compare water quality standards as well as use impairment indexes established by the Illinois Environmental Protection Agency (IEPA). Based on above average phosphorus concentrations, North Tower Lake was listed as having a *Slight* violation of Illinois water quality standards. Other water quality standards (pH, low D.O., TDS, noxious plants, etc.) were listed as none. Based on IEPA Swimming Use Index, North Tower Lake is categorized as providing only *Partial* support. This is due to poor Secchi disk readings and high phosphorus concentrations, which lead to high algal biomass and decreased visibility. The Illinois Department of Public Health recommends at least 48” Secchi disk depth for safe swimming in 2001. North Tower Lake’s average Secchi disk was 64.4”, which is well above the state standard. Based on the Recreational Use Index, North Tower Lake was also categorized as providing *Partial* support. However, North Tower Lake provides *Full* support based on the Aquatic Life Use index. Based on the average of all the use impairment indices, North Tower Lake is listed as providing *Partial* support for Overall Use.

LIMNOLOGICAL DATA - AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (*Appendix A* for methodology). Shoreline plants of interest were also observed. However, no surveys were made of these shoreline species and all data is purely observational. A healthy aquatic plant population is critical to good lake health. Aquatic vegetation provides important wildlife habitat and food sources. Additionally, aquatic plants provid many water quality benefits such as sediment stabilization and competition with algae for available resources. Aquatic plant *diversity* on North Tower Lake is *extremely low* and only consisted of 3 species including the macro alga *Chara* (Table 3).

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

<u>*Aquatic Plants*</u>	
Chara	*Chara* sp.
Curly Leaf Pondweed	*Potamogeton crispus*
Small Pondweed	*Potamogeton pusillus*

The extent to which aquatic plants grow is largely dictated by light availability. Aquatic plants need at least 1% of surface light levels in order to survive. Based on light penetration measurements, aquatic plant coverage of North Tower Lake could have been as high as 100% of the surface area (bottom coverage). Plant *densities* were good every month of the study and total coverage by aquatic vegetation on North Tower Lake was about 45-75%. In May, coverage was approximately 75% and was made up of all three species. However, the only “plant” found in the lake after the herbicide treatment (June – September) was the macroalga *Chara,* which is unaffected by the herbicide used to treat North Tower Lake (fluridone) and is largely unaffected by most algicide treatments.

While *Chara* is a beneficial plant, it does not provide the quality habitat that higher aquatic plants (i.e., large leaf pondweed, American pondweed, eel grass) offer. In order to allow aquatic vegetation to become established in North Tower Lake, herbicide treatments could be scaled back as well as using supplemental plantings to increase species diversity. Additionally, aquatic vegetation, as well as filamentous algae mats, could be removed by hand as an alternative to herbicide/algicide use. This would reduce the amount of decomposing organic matter in the lake and would help improve the low D.O. conditions. The LMU staff did not find any Eurasian Water milfoil, which is an extremely aggressive exotic aquatic weed that can quickly take over shallow lakes and ponds. The TLIA should educate the residents of Tower Lakes to ensure that North Tower Lake remains milfoil free.

Floristic quality index (FQI) (Swink and Wilhelm 1994) is a rapid assessment metric designed to evaluate the closeness that the flora of an area is 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. Each submersed and floating aquatic plant species (emergent shoreline species were not counted) in the lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). Nonnative species were also counted in the FQI calculations for Lake County lakes. These numbers are then averaged and multiplied by the square root of the number of species present to calculate an FQI. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. A low FQI indicates that there are a low number of species and possibly lower quality species present in the lake. In 2001, North Tower Lake has a FQI of 4.9, which was the fourth lowest FQI that the LMU has calculated (64 lakes). The average FQI of lakes studied by the LMU in 2000-2001 was 14.0. This low FQI supports that North Tower Lake has *very poor* aquatic plant diversity compared to other lakes in Lake County.

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at North Tower Lake on August 29, 2001. Shorelines were assessed for a variety of criteria (*Appendix B* for methodology). Based on this assessment, several important generalizations can be made. All of North Tower Lake's shoreline is developed (100%). The majority of developed shoreline consists of rock rip rap (53%) and manicured lawn (40%) (Figure 6). Both of these shoreline types are considered *undesirable*. Rip rap can be prone to erosion if not installed properly. Several rock rip rapped areas on North Tower Lake were in disrepair and could be at risk to erosion in the future. Lawn at the land-water interface can create problems due to the poor root structure of turf grasses, which are unable to stabilize soils and may lead to erosion. Additionally, both rip rap and manicured lawns offer very poor wildlife habitat and offer low/no buffering of runoff into the lake. It is the recommendation of the LMU that the TLIA should promote the use of well-maintained, naturalized shoreline and to minimize the use of rip rap, seawalls, and manicured lawns to waters edge. Additionally, TLIA should promote the use of buffer strips containing deep-rooted native vegetation

around the entire lake regardless of shoreline type. This includes establishing buffer strips behind existing seawalls and rip rap and using buffers strips when replacing any failing erosion control structures. Additionally, it would be beneficial to extend these buffers into the lake by planting emergent vegetation (cattails, arrowhead, pickerel weed, etc) which will help to dissipate wave action and stabilize near shore sediments. Shorelines were also assessed for the presence of erosion. Based on the 2001 LMU assessment, there is no erosion on North Tower Lake. This is largely due to the overwhelming dominance of rip rap, which is typically immune to erosion if installed properly. Additionally, the slope leading up to the lake is very flat, which helps to reduce the chance of erosion. Low water level fluctuations also helped keep erosion to a minimum at North Tower Lake. The level of North Tower Lake only varied +/- 2.43 inches during the study, which help to minimize the negative impacts that large fluctuations in lake level can bring, such as erosion. However, LMU staff found that much of the rip rap is deteriorating and could be at risk from erosion in the future.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Past surveys by the IDNR have found the fishery of North Tower Lake in poor condition. This is due to reoccurring fish kills due to low D.O. concentrations. To prevent these low D.O. fish kills an aeration unit was installed in North Tower Lake. Unfortunately, fish kills still occur. These frequent fish kills are the direct result of low dissolved oxygen conditions due to the constant decomposition of decaying plants and algae. Even before herbicide/algicide treatments of North Tower Lake began, the lake was probably thick with growth due to its shallow nature and still at risk to low D.O. conditions. In 2001, North Tower Lake was stocked with 200 bass fingerlings as well as 100 breeder size bass to replenish the lake after the fish kill in 1999. However, until the low D.O. problems are rectified, these newly stocked fish will be at risk.

Wildlife observations were made on a monthly basis during water quality and plant sampling actives (Table 5). All observations were visual. Wildlife habitat on Tower Lake is below average. This is due to the dominance of the shoreline types such as rip rap and manicured lawn, which offer poor habitat, and the low occurrence of desirable types of shoreline such as shrub, woodland, and buffer areas. During the 2001 study several types of common waterfowl were observed during the course of the study including great blue and green herons. There is a nice habitat area at the northwest end of the lake (Rose’s Park).

Table 5. Wildlife species observed on North Tower Lake, May-September 2001.

Birds	
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Barn Swallow	*Hirundo rustica*
American Crow	*Corvus brachyrhynchos*
Amphibians	
Bull Frog	*Rana catesbeiana*
Reptiles	
Painted Turtle	*Chrysemys picta*

EXISTING LAKE QUALITY PROBLEMS

- *Low D.O. Problems*

  Despite having an aeration system, North Tower Lake has low D.O. concentrations for much of the summer. In May, July, and August, D.O. concentrations were just above 5.0 mg/L, which is the minimum concentration needed to support aquatic life. Furthermore, these D.O. measurements were taken during middle of the day when D.O. conditions are at their highest. The D.O. concentrations are probably below the threshold limit (5.0 mg/L) during the evening/early morning hours when oxygen is being consumed by respiration. Low D.O. conditions can cause fish stress and continual stress can lead to mortality. North Tower Lake experiences periodic fish kills due to low D.O. conditions even with the aeration system operating. Two main factors, decaying organic matter and small lake volume cause these low D.O. conditions. North Tower Lake experiences season long filamentous algae blooms. These blooms are continually treated with algicides. Bacterial decomposition consumes oxygen as these algae mats decay. Additionally, the aquatic vegetation in North Tower Lake is treated and also consumes oxygen as it decomposes. Furthermore, the small volume of North Tower Lake heats up quickly during the hot summer months and the water is unable to hold as much D.O.. To rectify this problem, the TLIA may need to upgrade the size of the compressor that runs the aeration system in North Tower Lake if it is found to be undersized. Based on the size of North Tower Lake, the compressor should be at least 3/4 horsepower operating at 5 psi. However, just upgrading the compressor may not fix the low D.O. problems since there is such high biological oxygen demand due to the amount of decomposition that is occurring in North Tower lake. Additionally, it may be beneficial to remove the filamentous algae blooms by hand instead of treating them with herbicides. This would reduce the amount of decaying organic matter in the lake.

- *Internal Phosphorus Loading*

  Phosphorus concentrations in North Tower Lake are higher other lakes in Lake County. The 2001 average TP concentration in North Tower Lake was 0.072 mg/L, which is 35% higher than the Lake County median of 0.047 mg/L. Additionally, with the exception of September, all monthly TP concentrations were above the County median (0.056 mg/L – 0.090 mg/L). These high TP concentrations are probably coming from internal (within the lake) sources. One of the main internal sources of TP is aquatic plant and algae decomposition. North Tower Lake is treated for excessive aquatic plant growth in the spring and for filamentous algae mats all summer long. Plants and algae need nutrients such as phosphorus to grow. After the phosphorus is taken up it is stored within the plants/algae. As a result, decaying plants/algae release stored phosphorus into the water. This is evident in the increases in TP after the lake was treated with herbicides in May and the summer long algicide treatments. Soluble reactive phosphorus, which is a biologically associated form of phosphorus is normally not found at detectable concentrations in the surface waters of lakes. However, SRP was found at detectable concentrations every month of the study in North Tower Lake because of the release from decomposing plants and algae.

- *Poor Shoreline Condition*

  Although the shoreline of North Tower Lake was assessed as having no erosion, the overall condition of this shoreline is poor. A majority of the North Tower Lake's shoreline was made up of rip rap (53%) and manicured lawn (40%), which are poor land-water interfaces. Many of the rock rip rapped shorelines on North Tower Lake were found to be in poorly maintained condition and may be at risk from erosion in the future. Manicured lawn is a poor shoreline/water interface due to the shallow root structure of turf grass, which are unable to properly stabilize the soil. These two shoreline types are not currently experiencing erosion due to the gentle to flat slope of the shoreline and low seasonal water fluctuations. Besides being at risk to future erosion, both of these dominant shoreline types offer little wildlife habitat. The TLIA, as well as individual property owners should promote and implement the use of more naturalized shoreline types (buffer strips) when replacing existing structures. This will benefit not only the water quality of North Tower Lake, but also improve the wildlife habitat surrounding the lake.

- *Unhealthy Aquatic Plant Community*

  One key to a healthy lake is a healthy aquatic plant population. North Tower Lake has *extremely poor* plant diversity. There are only three species of aquatic plants (including the macro alga *Chara*) in North Tower Lake. However, after the May 2001 herbicide treatment, only Chara was found in the lake. The negative impacts associated with the absence of a quality aquatic plant community are widespread and include those on water clarity/quality and fishery health. The TLIA conducts whole lake herbicide treatments to control nuisance aquatic plant growth. Aquatic plants stabilize bottom sediment and compete with algae for available resources. Secchi depth in May was at 9.32 feet (lake bottom) and had decreased to 3.25 feet by July. This decrease in clarity can be directly linked to the decomposition of aquatic plants and algae. Since North Tower Lake is used for recreational boating, aquatic vegetation is viewed as a nuisance. In order to allow for uninhibited use of the lake but also to maintain better clarity, herbicide treatments should be better coordinated to allow for some aquatic plants to grow in North Tower Lake.

- *Lake Data*

  The lack of quality lake data is a common problem for many of the lakes in Lake County. This is either due to poor record keeping or the lack of involvement on the part of the management entity/residents. The TLIA has been actively managing the lake for decades but accurate records may not have always been kept. Additionally, data such as Secchi depth, water fluctuations, and D.O. profiles are not collected or monitored on a regular basis. Collection of this type of lake data can be very important in making decisions on the management of the lake. This data can be used to track changes (or lack of) in lake quality over many years. Additionally, this data is very important to agencies, such as the LMU, when conducting studies of the lake and allows for a more complete analysis. It is the recommendation of the LMU that North Tower Lake (TLIA) becomes involved in the IEPA's Volunteer Lake Monitoring Program (VLMP). This program uses volunteer lake residents to collect bimonthly lake data for the IEPA. This program is worth the time and effort and provides valuable information about the lake.

- *Lack of a Current Bathymetric Map*

  There has never been a bathymetric map (depth contour) made for North Tower Lake. These maps can be of great use to fishermen as well as lake managers. Bathymetric data can show where possible problematic areas may be located (i.e., shallow areas). Bathymetric maps can also provide data that can be utilized for management techniques such as aeration and volumetric applications such as alum, fluridone, and rotenone. These practices can not be properly executed without a good bathymetric map and accompanying data. These maps can be easily made using different methods. All lakes in the County should have a current, good quality bathymetric map.

POTENTIAL OBJECTIVES FOR SYLVAN LAKE MANAGEMENT PLAN

I. Shoreline Improvement and Erosion Control
II. Wildlife Habitat Improvement
III. Aquatic Plant Management
IV. Volunteer Lake Monitoring Program
V. Create a Bathymetric Map and Morphometric Data Table

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

Objective I: Shoreline Improvement and Erosion Control

Even though the shorelines of North Tower Lake were assessed as having no erosion it could be a potential problem in the future due to several deteriorating areas of rip rap. The goal of this objective is to outline several techniques that could be utilized to improve the condition of North Tower Lake's shorelines before erosion does become a problem. Shoreline erosion occurs as a result of wind, wave, or ice action or from overland rainwater runoff. While some erosion to shorelines is natural, human alteration of the environment can accelerate and exacerbate the problem. Erosion not only results in loss of shoreline, but negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. This effect is felt throughout the food chain since poor water quality negatively affects everything from microbial life to sight feeding fish and birds to people who want to use the lake for recreational purposes. The resulting increased amount of sediment will over time begin to fill in the lake, decreasing overall lake depth and volume and potentially impairing various recreational uses.

Option 1: No Action

Pros

There are no short-term costs to this option. However, extended periods of erosion may result in substantially higher costs to repair the shoreline in the future. Eroding banks on steep slopes can provide habitat for wildlife, particularly bird species (e.g. kingfishers and bank swallows) that need to burrow into exposed banks to nest. In addition, certain minerals and salts in the soils are exposed during the erosion process, which are utilized by various wildlife species.

Cons

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

Costs

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

Option 2: Install Rock Rip Rap

Rip rap is the term for using rocks to stabilize shorelines. Size of the rock depends on the severity of the erosion, distance to rock source, and aesthetic preferences. Generally, four to eight inch diameter rocks are used. *The use of rip rap should be viewed as a last resort* after other alternatives such as biologs have been tried or are inappropriate. Rip rap can be incorporated with other erosion control techniques such as plant buffer strips. If any plants will be growing on top of the rip rap fill will probably be needed to cover the rocks and provide an acceptable medium for plants to grow on. *It is imperative that filter fabric be used under the rip rap to provide quality, long lasting results.* Prior to the initiation of work, permits and/or surveys from the appropriate government agencies need to be obtained (see costs below). Rip rap is best used for areas of gentle to moderately sloped shores (<2:1). If rip rap is to be used on shorelines steeper than 2:1, then grading must be done in order to reduce grade to $\leq$ 2:1, preferably 3:1. Every effort should be made to use more natural, less intrusive methods of shoreline stabilization (buffer strips and biologs). However, the site must be prepared (grading, etc.) accordingly.

Pros

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

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

Cons

A major disadvantage of rip rap is the initial expense of installation and associated permits. Installation is expensive since a licensed contractor and heavy equipment are generally needed to conduct the work. Permits are required if replacing existing or installing new rip rap and must be acquired prior to work beginning. If any fill material is placed in the floodplain along the shoreline; compensatory storage may also be needed. Compensatory storage is the process of excavating in a portion of a property or floodplain to compensate for the filling in of another portion of the floodplain. While rip rap absorb wave energy more effectively than seawalls, there is still some wave deflection that may cause resuspension of sediment and nutrients into the water column.

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

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

Costs

Cost and type of rip rap used depend on several factors, but average cost for installation (rocks and filter fabric) is approximately $30-45 per linear foot. Based on currently rip rapped shorelines, North Tower Lake would need approximately 1554 linear feet of rip rap to properly replace *all* existing rip rap. This would come to a cost of approximately $46,620 – $69,930. This could be a cost sharing joint project between the lake front property owners and the TLIA. In addition, costs will increase with poor shoreline accessibility and increased distance to rock source. Costs for permits and surveys can be $1,000-2,000 for installation of rip rap, depending on the circumstances. Additional costs will be incurred if compensatory storage is needed. Contact the Army Corps of Engineers, local municipalities, and the Lake County Planning and Development Department.

Option 3: Buffer Strips

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 shorelines with **slight erosion** and 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 more 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 or rip rap. Furthermore, it is the recommendation of the LMU that buffer strips be established along all applicable shorelines of North Tower Lake regardless of shoreline type (including beach and seawalls).

Buffer strips can be constructed in a variety of ways with various plant species. Generally, buffer strip vegetation consists of native terrestrial (land) species and emergent (at the land and water interface) species. Terrestrial vegetation such as native grasses and wildflowers can be used to create a buffer strip along lake shorelines. Table 6 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., muskrats) by placing a wire cage over the plants for at least one year.

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

Emergent vegetation, or those plants that grow in shallow water and wet areas, can be used to control erosion more naturally than seawalls or rip rap. Native emergent vegetation can be either hand planted or allowed to become established on its own over time. Some plants, such as native cattails (*Typha* sp.), quickly spread and help stabilize shorelines, however they can be aggressive and may pose a problem later. Other species, such as those listed in Table 6 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 and "weedy" aquatic plants. Buffer strips can filter as much as 70-95% of sediment and 25-60% of nutrients and other pollutants from runoff.

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

Many fish and wildlife species prefer the native shoreline vegetation habitat. This habitat is an asset to the lake's fishery since the emergent vegetation cover may be used for spawning, foraging, and hiding. Various wildlife species are even dependent upon shoreline vegetation for their existence. Certain birds, such as marsh wrens (*Cistothorus palustris*) and endangered yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) nest exclusively in emergent vegetation like cattails and bulrushes. Hosts of other wildlife like waterfowl, rails, herons, mink, and frogs to mention just a few, benefit from healthy stands of shoreline vegetation. Dragonflies, damselflies, and other beneficial invertebrates can be found thriving in vegetation along the shoreline as well. Two invertebrates of particular importance for lake management, the water-milfoil weevils (*Euhrychiopsis lecontei* and *Phytobius leucogaster*), which have been shown to naturally reduce stands of exotic Eurasian water-milfoil. Weevils need proper over wintering habitat such as leaf litter and mud which are typically found on naturalized shorelines or shores with good buffer strips. Many species of amphibians, birds, fish, mammals, reptiles, and invertebrates have suffered precipitous declines in recent years primarily due to habitat loss. Buffer strips may help many of these species and preserve the important diversity of life in and around lakes.

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

Cons

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

Costs

If minimal amount of site preparation is needed, costs can be approximately $10 per linear foot, plus labor. Cost of installing willow posts is approximately $15-20 per linear foot. Based on the total length of all applicable shorelines (lawn, rip rap, and seawall, North Tower Lake would need approximately 2756 linear feet of buffer strip. This would come to a cost of $27,560. This could be a cost sharing joint project between the lake front property owners and the TLIA. However, some of this shoreline would be better suited for use of biologs incorporated with buffer vegetation, which includes the use of buffer strips. 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 II: Wildlife Habitat Improvement

The key to increasing wildlife species in and around a lake can be summed up in one word: habitat. Due to its residential, developed nature the preservation/development of wildlife habitat on highland lake has been neglected. 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 variety of habitats are needed. In most cases quality is more important than quantity (i.e., five 0.1-acre plots of different habitats may not attract as many wildlife species than one 0.5 acre of one habitat type).

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

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

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

This option means that the current land use activities will continue. No additional techniques will be implemented on Highland Lake. 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 is 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 6 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 out compete 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.

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. Additionally, buffer strips 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. 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. 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.

Cons

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

Costs

The cost of this option would be minimal. The purchase of native plants can vary depending upon species and quantity. Based upon 100 feet of shoreline, a 25-foot buffer planted with a native forb and grass seed mix would cost between $165-270 (2500 sq. feet would require 2.5, 1000 sq. feet seed mix packages at $66-108 per package). This could be a cost share project between the Association and individual homeowners in order to offset costs. This price does not include labor that would be needed to prepare the site for planting and follow-up maintenance, which could be done y the homeowner. 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 6 should be planted or allowed to grow. In addition, encourage native aquatic vegetation, such as water lily, sago pondweed, largeleaf pondweed, and wild celery 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 exasperate 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 is 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. See *Option 2: Increase Habitat Cover* above for prices.

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. This is an excellent option for the residents to become actively involved with improving wildlife opportunities on North Tower Lake Lake.

Objecitive III: Aquatic Plant Management

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

Currently, the aquatic herbicide fluridone is used to treat nuisance aquatic vegetation. Fluridone (trade name Sonar™) is being used as a whole lake treatment in early May. Fluridone is a slow acting, nonselective herbicide with plant death taking at least 30 days to appear. As a result, by June there are no aquatic plants in North Tower Lake. Additionally, algicides are being used to treat nuisance filamentous algae blooms. Below are listed some alternative management options that could be applied to both aquatic plants and the filamentous algae.

Option 1: No Action

If the lake is dominated by *native*, *non-invasive* species, the no action option could be ideal. Under these circumstances native plant populations could flourish and keep nuisance plants from becoming problematic. However, if a no action aquatic plant management plan in a lake with non-native, invasive species, nothing would be done to control the aquatic plant population of the lake regardless of the type and extent of the vegetation. Nuisance vegetation could continue to grow until epidemic proportions are reached. Growth limitations of the plant and the characteristics of the lake itself (light penetration, lake morphology, substrate type, etc.) will dictate the extent of infestation. Rooted plants, such as curly leaf pondweed (*Potamogeton crispus*) and elodea (*Elodea canadensis*), will be bound by physical factors such as substrate type and light availability. Plants such as Eurasian watermilfoil and coontail, which can grow unrooted at the surface regardless of water depth, could grow to cover 100% of the water's surface. This could cause major inhibition of the lakes recreational uses and impact fish and other aquatic organisms adversely.

Pros

There are positive aspects associated with the no action option for plant management. The first, and most obvious, is that there is no cost. However, if an active management plan for vegetation control were eventually needed, the cost would be substantially higher than if the no action plan had not been followed in the first place. Another benefit of this option would be the lack of environmental manipulation. Under the no action option, no chemicals, mechanical alteration, or introduction of any organisms would take place. This is important since studies have shown that nuisance plants are more likely to invade disrupted areas. If the lake contains native, non-invasive plant species, expansion of the native plant population would increase the overall biodiversity and health of the lake. Habitat, breeding areas, and food source availability would greatly improve. Use of the lake would continue as normal and in some cases might improve (fishing) if native plants keep "weedy" plants under control.

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

Cons

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

Water quality could also be negatively impacted with the implementation of the no action option. Deposition of large amounts of organic matter and release of nutrients upon the death of the massive stands of vegetation is a probable outcome of the no action option. These dead plants will contribute to the sediment load of the lake and could accelerate its filling in. The large nutrient release when the plants die back in the fall could lead to lake-wide algae blooms and an overall increase of the internal nutrient load. In addition, the decomposition of the massive amounts of vegetation will lead to a depletion of the lakes dissolved oxygen. This can cause fish stress, and eventually, if the stress is frequent or severe enough, fish kills. All of the impacts above could in turn have negative impacts on numerous aspects of the lake's ecosystem.

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

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

Option 2: Aquatic Herbicides
Aquatic herbicides are the most common method to control nuisance vegetation/algae. When used properly, they can provide selective and reliable control. Products can not be licensed for use in aquatic situations unless there is less than a 1 in 1,000,000 chance of any negative effects on human health, wildlife, and the environment. Aquatic herbicides are not allowed to be environmentally persistent, bioaccumulate, or have any bioavailability. Prior to herbicide application, licensed applicators should evaluate the lake's vegetation and, along with the lake's management plan, choose the appropriate herbicide and treatment areas, and apply the herbicides during appropriate conditions (i.e. low wind speed, D.O. concentration, temperature).

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

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

Fluridone is being used at a rate of approximately 10 ppb (based on LMU calculated volume) to manage vegetation in North Tower Lake. This rate is more than adequate to remove all vegetation from the lake for the entire summer (June-September). However, this over removal has brought about undesirable impacts on water clarity. A properly planned herbicide treatment would not bring about this decline in water quality. The TLIA should consider lowering the fluridone concentration. This would allow for some vegetation to remain in the lake. Additionally, diquat could be used to spot treat selected areas of the lake leaving other areas untreated.

Pros

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

The fisheries and waterfowl populations of the lake would benefit greatly due to an increase in quality habitat and food supply. Dense stands of plants would be thinned out and improve spawning habitat and food source availability for fish. Waterfowl population would greatly benefit from increases in quality food sources, such as large-leaf pondweed (*Potamogeton amplifolius*). Another environmental benefit of using aquatic herbicides over other management options is that they are organism specific. The metabolic pathways by which herbicides kill plants are plant specific which humans and other organisms do not carry out. Organisms such as fish, birds, mussels, and zooplankton are generally unaffected.

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

Cons

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

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

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

Over-removal, and possible regrowth of nuisance vegetation that may follow will drastically impair recreational use of the lake. Swimming could be adversely affected due to the likelihood of increased algal blooms. Swimmers may become entangled in large mats of filamentous algae. Blooms of planktonic species, such as blue-green algae, can produce harmful toxins as well produce noxious odors. If regrowth of nuisance vegetation were to occur, motors could become entangled making boating difficult. Fishing would also be negatively impacted due to the decreased health of the lake's fishery. The overall appearance of the lake would also suffer due to an increase in unsightly algal blooms and massive stands of vegetation. This in turn could have an unwanted effect on property values. Studies have shown that problematic algal blooms can decrease property values by 15-20%.

Costs

At a concentration of 10 ppb (the current concentration used in North Tower Lake), the cost for a fluridone treatment of North Tower Lake would be approximately $375. At a concentration of 8 ppb the cost would be approximately $340. While this is not a big savings, this lower concentration could leave some vegetation in the lake. If over removal still occurs at 8 ppb, the concentration could be further reduced to 6 ppb. An alternative to fluridone would be to use diquat. Since diquat is used as a spot treatment, as compared to whole lake treatments with fluridone, it can be selectively used to treat problematic areas of the lake while leaving other areas untreated. The costs for diquat spot treatments would be approximately $350-$425 per acre with total cost dependent on the total area treated.

Option 3: Hand Removal

Hand removal of excessive aquatic vegetation is a commonly used management technique. Hand removal is normally used in small ponds/lakes and limited areas for selective vegetation removal. This may be one of the best alternative management techniques for a lake as small as North Tower Lake. Areas surrounding piers and beaches are commonly targeted areas. Typically tools such as rakes and cutting bars are used to remove vegetation. These are easily obtainable through many outdoor supply catalogs or over the internet. Some rakes are equipped with tines as well as cutting edges. Tools can also be hand made by drilling a hole in the handle of a heavy-duty garden rake and tying it to a length of rope. Weights may be needed in order to provide forceful contact with the plants. In many instances, homeowners on lakes with near shore vegetation problems simply cut swaths through the weeds to create pathways to open water. Due to the limited amount of biomass removed, harvested plant material is often used as fertilizer and compost in gardens.

Pros

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

Cons

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

Costs

Plant removal rakes can range in price from $50-150 and cutting tools commonly range in price from $50-200. Both are available from numerous catalogs and from the internet.. A homemade rake would cost about $20-40.

Objective V: Volunteer Lake Monitoring Program

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

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

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

For more information about the VLMP contact the program's Regional Coordinator:

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Objective VI: Create a Bathymetric Map and Morphometric Data

A bathymetric (depth contour) map is an essential tool for effective lake management since it provides critical information on the morphometric features of the lake (i.e., acreage, depth, volume, etc.). This information is particularly important when intensive management techniques (i.e., chemical treatments for plant or algae control, dredging, fish stocking, etc.) are part of the lake's overall management plan. Some lakes in Lake County do have a bathymetric map, but they are frequently old, outdated and do not accurately represent the current features of the lake. There is not a bathymetric map for North Tower Lake and the TLIA should seriously consider one made. Maps can be created by agencies like the Lake County Health Department - Lakes Management Unit or other companies. Costs vary, but can range from $3,000-10,000 depending on lake size.