2001 SUMMARY REPORT
of
SYLVAN LAKE

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Sylvan Lake is a U-shaped 32 acre man made lake in Fremont Township near the intersection of Midlothian and Gilmer Roads. Sylvan Lake was created in 1936 by damming a small tributary of Indian Creek. Shortly after lake construction, the Sylvan Lake Improvement Association was formed, which oversees the management of the lake. Over the past 65 years, Sylvan Lake has experienced many lake quality problems including sedimentation in of the lake, nuisance vegetation, low dissolved oxygen, and increasing turbidity, which have all been addressed with various management techniques.

Overall, Sylvan Lake has *below average* water quality as compared to other County lakes. Data collected by the Lakes Management Unit found that phosphorus concentrations were high, which causes summer long nuisance algae blooms. In 2001, average phosphorus concentrations for Sylvan Lake was 0.079 mg/L, which is well above the Lake County median value of 0.047 mg/L. Furthermore, this was a substantial increase (32%) over the 1996 average TP concentration of 0.060 mg/L. This increase is due to insufficient aeration, which is allowing internal phosphorus release events. This is due to mixing events during the summer months. The 2001 study also found high concentrations of total suspended solids (TSS) in Sylvan Lake. Average TSS in 2001 was 15.1 mg/L, which is three times higher than the County median value of 5.0 mg/L.

Both the high phosphorus and TSS concentrations can also be linked to the lack of a healthy aquatic plant community. In the past, Sylvan Lake has used herbicides and grass carp to manage excessive aquatic vegetation. However, it appears that the aquatic vegetation was over managed and now Sylvan Lake has no aquatic plant community. Surveys in 2001 found aquatic vegetation at only eight out of 84 sites, despite the fact that there was enough light for plants to grow in about 90% of the lake area. In addition to the use of herbicides and stocking of grass carp, Sylvan Lake also has an excessive number of common carp. Due to their disruptive feeding and spawning habits, carp uproot aquatic vegetation and resuspended sediment/nutrients, which negatively impacts water quality/clarity. As a result, the quality of Sylvan Lake can not be expected to substantially improve until the common carp are eliminated from the lake and a healthy aquatic plant community is reestablished.

The shoreline of Sylvan Lake is almost fully developed (99.8%). Most of the developed shoreline is made up of rip rap (39%), seawalls (31%), and buffer strips (19%). As a result, the presence of shoreline erosion on Sylvan Lake is low (*slight* – 6.0% and *moderate* – 3.7%). However, shoreline development has had a negative impact on wildlife habitat. Often, the only shoreline habitat consisted of invasive species (purple loosestrife, buckthorn, etc.), that offer little/poor quality habitat. Every effort should made to eliminate these invasive plants from the shores of Sylvan Lake. 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 could be planted in near shore areas. This will benefit not only the water quality of Sylvan Lake, but should also improve the wildlife habitat surrounding the lake.

LAKE IDENTIFICATION AND LOCATION

Sylvan Lake is near the intersection of Midlothian and Gilmer Roads in Fremont Township (T45N, R10E, Section 21, 22) entirely within unincorporated Lake County. Sylvan Lake is a U-shaped 32 acre man made lake with a current maximum depth of 14 feet and an average depth of 7.5 feet (Lake County Health Department – Lakes Management Unit [LMU] estimate) (Figure 1). Lake volume is approximately 240 acre-feet (LMU calculation). Sylvan Lake is part of the Indian Creek drainage basin, which is part of the Des Plaines River watershed. Sylvan Lake's immediate watershed is relatively small (approximately 209 acres) and consists of drainage from two creeks that enter the lake at the western end of the bays (Figure 2). Watershed usage is mainly residential with some minor agricultural inputs. Additionally, Sylvan Lake receives stormwater inputs from the surrounding neighborhood. There is a spillway on the east side of the lake, which controls the flow out of the lake and into the Sylvan Lake drain. This drainage flows into Indian Creek eventually making its way to the Des Plaines River.

BRIEF HISTORY OF SYLVAN LAKE

Sylvan Lake was created in 1936 by excavation and damming of a small tributary of Indian Creek. The Sylvan Lake Improvement Association (SLIA) was formed shortly after in 1938. Management of the lake is overseen by the Sylvan Lake Management Committee, which was formed in October of 1978. The SLIA oversees management activities such park maintenance, algae management, and fish stocking. Algae blooms are treated with copper sulfate on an as needed basis during the summer months. There have been many concerns about the quality of Sylvan Lake over the last two decades including sedimentation, dissolved oxygen levels, runoff, and shoreline erosion. Many of these problems were briefly addressed in the early 1980s but interest in improving the lake seemed to have waned by the late 1980s. Past lake improvement projects have included limited dredging of the bays (1980) and installation of an aeration system (1980) to alleviate low dissolved oxygen problems. Additionally, the lake conducted a total fish rehabilitation project in 1970. However, this rehabilitation was short lived. Grass carp were stocked in the lake in the late 1980s/early 1990s to control nuisance vegetation. These grass carp have denuded the entire lake. Recently there has been a resurgence of interest in improving the lake. Aquatic herbicides were used in the past to control nuisance vegetation. Sylvan Lake is involved in the Indian Creek Watershed Project (ICWP), which is a not-for-profit organization dedicated to the improvement of all bodies of water within the Indian Creek Watershed. It is with the help of the ICWP, Sylvan Lake was awarded a grant from the Illinois Environmental Protection Agency's 319 program in 2001. This money is going towards the rehabilitation of the two inlets into the lake at Maple and Ravinia Parks. This project began in the spring of 2001 and is to be completed by of 2003. Additional grants are being applied for in order to rehabilitate the spillway.

SUMMARY OF CURRENT AND HISTROICAL LAKE USES

Access to Sylvan Lake is entirely private and SLIA owns approximately 87% of the lake bottom. The other 32% is owned by a handful of private homeowners. There are seven SLIA owned access points on the lake that are open year round to members of the SLIA (Figure 1). Launching of watercraft by non-association and non-approved personal is prohibited. Recreational opportunities on Sylvan Lake have gone unchanged since its creation over 65 years ago and largely consist of boating (no motors of any kind allowed), swimming, and fishing. The park immediately northwest of the spillway has a Illinois Department of Public Health licensed swimming beach, which is monitored for fecal coliform bacteria levels. This beach is tested on a bimonthly basis by the Lake County Health Department-Lakes Management Unit (LMU) from Memorial Day through Labor Day. Additionally, there are two swimming platforms located just offshore of this park. During the 2001 sampling season the beach was never closed. In addition to the licensed beach, several residents on Sylvan Lake have private beaches on their property. The access points in the bays, Maple Park and Ravinia Park, are wooded areas that have a network of trails leading to the lake. The other five access points on the lake are in differing stages of use and development. They provide access to residents without direct lake access (frontage).

LIMNOLOGICAL DATA - WATER QUALITY

Water samples collected from Sylvan 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 (10-12 foot deep) from the deep hole location in the lake (Figure 1). During certain periods of the summer, Sylvan Lake is thermally stratified. This means the lake divides into warm upper water (epilimnion) and cool lower water (hypolimnion). This stratification is due to the deeper lake morphology of Sylvan Lake (see *Interpreting Your Lake's Water Quality* for further explanation). However, during July, Sylvan Lake mixed and then weakly stratified again in August, and remained stratified until fall turnover. This lapse in stratification (termed polymictic) could be due to a change in weather, wind, and precipitation. The separation of the lake into layers (and mixing of the lake in July) is reflected in the water quality data. Below is a discussion of highlights from the complete data set for Sylvan Lake (*Table 1, Appendix A*).

Temperature stratification (and periodic mixing) of the lake is reflected in the dissolved oxygen (D.O.) levels as well as other water quality data such as temperature. D.O. concentrations were not problematic in Sylvan Lake during the 2001 study (see *Appendix C: Multiparameter Data for Sylvan Lake*). However, average epilimnetic D.O. concentrations (3 foot sample) fluctuated during the 2001 study. D.O. concentrations in the surface waters were highest in July (13.68 mg/L), which was due to an increase in algal blooms that month. During biological processes (photosynthesis) these algae blooms produce oxygen, which is released into the surrounding environment (lake water). September had the lowest surface D.O. concentration (6.2 mg/L). This is due to fall turnover at which time D.O. concentrations are diluted by the mixing of lower D.O.

concentrations from lower water with the upper layer. Additionally, the depth at which the lake had enough D.O. to support aquatic life (>5.0 mg/L) varied on a monthly basis from as shallow as 5.5 feet in July to as deep as 14 feet (the lake bottom) in September. Since an accurate bathymetric map does not exist for Sylvan Lake it is difficult to determine the actual percentage of the lake that is inhabitable by aquatic organisms.

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 water clarity (Secchi depth), Sylvan lake has *below average* water quality compared to other lakes in Lake County. Historically, Sylvan Lake has been turbid due to algae blooms and suspended sediment and as a result has had poor Secchi disk readings for the past two decades (Figure 3). Average Secchi disk depth on Sylvan Lake during the 2001 study was 2.68 feet, which was *below* the Lake County median Secchi depth of 4.18 feet (1995-2001). Overall, Secchi depth declined over the five-month study with the deepest Secchi reading in June (3.67 feet) and the shallowest reading in September (1.94 feet). The 2001 average Secchi depth on Sylvan Lake corresponds well with the historical average for the lake of 2.39 feet (1979-1995).

High concentrations of suspended organic and inorganic particles measured as total suspended solids (TSS) and total dissolved solids (TDS) are two of the reasons Sylvan Lake has such poor water clarity. In 2001, average TSS in Sylvan Lake was 15.1 mg/L, which is three times the County median value of 5.0 mg/L. TSS increased from 12.0 mg/L in May to as high as 27.7 mg/L in July, which is over 5 times the County median value. Calculated average nonvolatile suspended solids (NVSS), which is the portion of the TSS that can be attributed to inorganic (soil particles) was 10.3 mg/L. This means that 66% of TSS (turbidity) was caused by inorganic particles such as silts and clays. The other 33% can be attributed to organic particles such as algae.

TDS concentrations in Sylvan Lake were also high. TDS is a measurement of the concentration of dissolved minerals such as chlorides. Average TDS in 2001was 521 mg/L, which is higher than the Lake County median value of 452 mg/L. Furthermore, average TDS on Sylvan Lake in 2001 was significantly higher than that of the 1996 LMU Sylvan Lake study (294 mg/L). Additionally, there was also a significant increase in the average conductivity in the last five years from 0.546 milliSiemens/cm in 1996 to 0.8508 milliSiemens/cm in 2001. Conductivity is a measurement of water's ability to conduct electricity via dissolved minerals (i.e. chlorides) in the water column. The increase in conductivity and TDS may be linked to runoff containing road salt from nearby Gilmer and Midlothian Roads. Both TDS and conductivity measure chlorides, which are a major component of road salts. In the spring, these road salts are washed into the lake. Data indicates that as the study progressed and spring rains subsided (the influx of road salts decreased), both conductivity and TDS decreased. This phenomenon is also occurring in other County lakes with major roads near by.

The other major contributor to low water clarity on Sylvan Lake in 2001 were nuisance 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 (total Kjeldahl nitrogen [TKN] + nitrate nitrogen [NO_3-N]) 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. In these phosphorus-limited lakes even a small addition of P can trigger algae blooms. In 2001, Sylvan Lake had an average TN: TP ratio of 17:1, which means that phosphorus is slightly limiting. This ratio is a change from the LMU study in 1996 when Sylvan Lake was still phosphorus limited but the TN:TP ratio was slightly higher at 28:1. This change is due to an overall decrease in nitrate nitrogen (NO_3-N) concentration as well as a substantial increase in total phosphorus from 1996 to 2001 (*Table 1, Appendix A*).

Overall, average total nitrogen (TKN + NO_3-N) decreased as compared to the LMU study in 1996. TKN increased from 1.12 mg/L in 1996 to 1.26 mg/L in 2001. However, nitrate significantly decreased from 0.543 mg/L in 1996 to 0.096 mg/L in 2001. The increase in TKN is very small and is probably due yearly variations. The decrease in nitrate is substantial. Rainfall data collected during the summer suggest a correlation between rainfall (runoff) and nitrate (Figure 4). One possible explanation for the decrease in nitrate could be lower concentrations in the runoff entering the lake from the surrounding watershed.

Average seasonal phosphorus concentration in Sylvan Lake during the 2001 study (0.079 mg/L) was *well above* the County average (0.047 mg/L). Phosphorus concentrations were nearly double the County average or greater for most of the summer (*Table 1, Appendix A*). Epilimnetic phosphorus concentrations drastically increased in July and though slightly lower in August and September, were still high. This increase in the TP concentrations correlated with an increase in TSS (Figure 5) and a decrease in Secchi depth (Figure 6). Algal blooms started in July and continued the rest of the study, which kept TSS elevated (as compared to May and June) and Secchi depth low. The pulse in phosphorus (and subsequent high TP concentrations) can be attributed to periodic mixing of the epilimnion and hypolimnion (polymixis). Due to the thermal separation of these layers, the hypolimnion becomes hypoxic (D.O. <1.0 mg/L) as the summer progresses. Under these low D.O. conditions, nutrients are released into the hypolimnion due to biological and chemical processes. Due to stratification, these nutrients are sequestered in the hypolimnion and continue to build up during the course of the summer. However, when a summer mixing event occurs, these nutrients are released into the surface waters and are then available for algae growth. Analysis of the temperature and D.O. data found that mixing events occurred in July (and to some extent August), in addition to fall turnover in September. This is evident by comparing July phosphorus concentrations in the epilimnion and hypolimnion, which were very similar, indicating that the lake had recently mixed. Additional analysis of temperature and D.O. profiles found that these mixing events did not occur in 1996, which would explain the increase in average

TP from 1996 to 2001. Furthermore, if the July phosphorus is not used in the average, 2001 average TP would be 0.065 mg/L, which is very similar to the average TP in 1996 (0.060 mg/L). Due to the lack of morphometric data, it is impossible to determine the exact volume of the lake that is hypoxic. This would further reinforce that these internal release and mixing events are major source of TP for Sylvan Lake. These mixing events, and subsequent spike in phosphorus, did not occur in 1996 because the lake never stratified due to an artificial aeration system. The aeration system that prevented stratification from occurring in Sylvan Lake has not been run at full capacity since 1996. Since 1997, the aerator has been in disrepair and is only run intermittently and never at full capacity. During the summer of 2001 the aerator was never in operation. To eliminate these polymictic events, the aerator at Sylvan Lake should be repaired and run at full capacity. Additionally, the current compressor size is not enough to prevent stratification based on the size of Sylvan Lake. If the compressor unit is fixed it should be upgraded to a larger size. However, upgrading the compressor size will not drastically improve the clarity/quality of Sylvan Lake compared to the possible cost associated with larger units.

In lakes, phosphorus originates from two sources, from within the lake (internal) and from outside the lake (external). External inputs consist of a variety of sources. They can include fertilizer runoff, failing septic systems, and erosion. However, since Sylvan Lake experiences periodic mixing events and corresponding phosphorus pulse, and has a small watershed, these external sources could be minor in comparison to internal sources in 2001. Rain data indicates that during periods of elevated rainfall (May - July) phosphorus concentrations were actually lower than the rest of the summer when there was little rainfall (August and September). Internal phosphorus sources are common in manmade lakes, which by their nature contain nutrient rich sediment. Sediment bound phosphorus is mixed into the water column by wind/wave action, carp and lack of aquatic plants (which stabilize sediment). Additionally, biological and chemical processes can release phosphorus from anoxic lake sediment, which then can be released into the surface waters during mixing events such as those in Sylvan Lake during 2001.

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 67.3, Sylvan Lake is classified as eutrophic ($\geq$50, <70 TSI). This means that Sylvan Lake is a highly productive system that has above average nutrient levels and high algal biomass (growth). Field observations reinforce that Sylvan 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, Sylvan Lake ranks 59 out of 102 lakes based on average phosphorus TSI (Table 2). For comparison, Sylvan Lake ranked slightly higher than most Indian Creek watershed lakes: Bresen-85, Countryside Lake-83, Forest Lake-71, and Salem Lake-66. Similarly, many of the same problems that plague Sylvan Lake such as poor water clarity, high phosphorus concentrations, and the lack of aquatic vegetation impact these lakes.

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). These standards rate a given lake based on several water quality parameters. Based on above average phosphorus concentrations, Sylvan 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, Sylvan Lake is categorized as providing only *Partial* support. This is due to poor Secchi disk readings and high phosphorus levels, which lead to high algal biomass (increased turbidity) and decreased visibility. Additionally, Illinois Department of Public Health recommends at least a 48” Secchi disk depth for safe swimming. In 2001, Sylvan Lake’s average Secchi disk was only 32.2”. Based on the Recreational Use Index, Sylvan Lake was also categorized as providing only *Partial* support. This is due to a high TSI value and high levels of suspended solids, which result in poor visibility and contribute to an overall reduction in use of the lake. Additionally, Sylvan Lake provided *Full* support based on the Aquatic Life Use index. Based on the average of all use impairment indices, Sylvan Lake is listed as providing only *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 (Table 3). However, no surveys were made of these shoreline species and all data is purely observational. 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 Sylvan Lake could have been as high as 90% of the surface area (bottom coverage) and grown to a depth of 12 feet. However, surveys indicate that plants did not grow anywhere in Sylvan Lake except for a few sporadic occurrences in the very shallow parts of the bays. This was despite the fact that there was adequate light penetration throughout most of the lake. Poor substrate type and carp may be a possible explanations for the lack of aquatic plant growth. Visual observations confirm that the substrate in the shallower depths of the main body of Sylvan Lake may be too rocky to support aquatic plant growth. In contrast, the bays have a much more organic substrate due to sedimentation over the past two decades and therefore are more suited for plant growth. The presence of carp may be another possible explanation. Due to their disruptive feeding habits, carp uproot aquatic vegetation preventing vegetation from becoming established. Additionally, Sylvan Lake stocked grass carp approximately 10 years ago. These herbivorous fish can cause a variety of water quality problems resulting from the over-removal of aquatic vegetation. **Under no circumstances should Sylvan Lake stock grass carp again.** The shallowest part of the bays may have been too shallow for the carp (both types) to disrupt what plant growth was there.

A healthy aquatic plant population is critical to good lake health. Aquatic vegetation provides important wildlife habitat and food sources. Additionally, aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available resources. Aquatic plant *diversity* on Sylvan Lake is *extremely low* and only consisted of two species (Table 3). Additionally, plant *densities* were low to nonexistent. During the course of the study, Sylvan Lake had only eight samples out of 84 that had any vegetation (*Table 4, Appendix A*). These eight samples were at the same locations, the shallowest parts of the bays, just in different months. However, even these sites had very little vegetation, consisting of only a plant or two. As a result, Sylvan Lake is experiencing a variety of water quality problems including poor clarity, increased turbidity, nuisance algae blooms, and poor fishery health.

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, Sylvan Lake has a FQI of 9.2. The average FQI of lakes studied by the LMU in 2000-2001 was 14.0. This low FQI supports that Sylvan Lake has *poor* aquatic plant diversity compared to other lakes in Lake County.

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

<u>*Aquatic Plants*</u>	
Sago Pondweed	*Stuckenia pectinatus*
Flatstem Pondweed	*Potamogeton zosterifomis*
<u>*Shoreline Plants*</u>	
Tall Bur Marigold	*Bidens coronata*
Purple Loosestrife	*Lythrum salicaria*
Swamp Smartweed	*Polygonum coccineum*
Common Buckthorn	*Rhamnus cathartica*

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Sylvan Lake on August 9, 2001. Shorelines were assessed for a variety of criteria (*Appendix B* for methodology). Based on this assessment, several important generalizations can be made. Almost all of Sylvan Lake's shoreline is developed (99.8%). The majority of developed shoreline consists of rock rip rap (39 %: 2,652 feet) (Figure 7). Seawalled shoreline was the second most abundant type (31%: 2,128 feet). Both of these shoreline types are considered *undesirable*. Rip rap offers little habitat and can be prone to erosion if not installed properly. Several rock rip rapped areas on Sylvan Lake were in disrepair and could be at risk to erosion in the future. Seawalls are undesirable because of their tendency to reflect wave action back into the lake. This can cause resuspension of near shore sediment, which can lead to a variety of water quality problems. There was a low occurrence of other types of *undesirable* shoreline, such as manicured lawn, which made up 2.2% (375 feet) of Sylvan Lake's shoreline. The low occurrence of lawn at the land-water interface is encouraging. This type of shoreline can experience problems due to the poor root structure of turf grasses, which are unable to stabilize soils and may lead to erosion. The occurrence of *desirable* buffered shoreline was moderate and accounted for 19% (1,316 feet) of total shoreline length. Shorelines that have established *well-maintained* buffer strips are less likely to experience erosion and also provide improved habitat for wildlife. It is the recommendation of the LMU that the SLIA 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, SLIA should promote the use of buffer strips of 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.

Shorelines were also assessed for the presence of erosion. The overall occurrence of erosion on Sylvan Lake is *low* (Figure 8). Based on the LMU assessment, 90% (6,180 feet) of the Sylvan Lake shoreline was listed as having no form of erosion. This is largely due to the overwhelming dominance of rip rap and seawalled shorelines, which are typically reduce erosion. Of the total shoreline, only 6 % was assessed as having *Slight* erosion and 4 % as having *Moderate* erosion. Furthermore, there were no shorelines assessed as having severe erosion. These eroded shorelines were made up of poorly maintained or installed rip rap, manicured lawns, and buffer areas. Individual homeowners could easily address these slightly eroded areas by establishing *well-maintained* buffer strips consisting of prairie grasses and wildflowers with the use of biologs or coconut rolls to aid in stabilization of steeper areas. In addition to the dominance of rip rap and seawalls, low water level fluctuations on Sylvan Lake also help deter shoreline erosion. Extreme water level fluctuations can have a negative impact on shoreline. In the spring/early summer, lake levels only changed 2.9 inches from May to June. After spring rains, the lake fell 6.7 inches but then remained stable (+/- 1.8 inches) the rest of the study.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling actives (Table 5). All observations were purely visual. There was little wildlife observed on Sylvan Lake. This was due to a lack of quality habitat in and around the lake. There are some healthy populations of mature trees that provide good habitat for a variety of bird species. Additionally, there are several shrub areas in the bays and at a few locations on the main lake that provide habitat for smaller bird and mammal species. However, there are several areas for habitat improvement. There are two invasive species, purple loosestrife and buckthorn, that were observed along the shores of Sylvan Lake at 34 different locations (Figure 9). These plants are seldom used by wildlife for food or shelter. These nuisance species should be controlled or eliminated before they spread and become more established, and displace more desirable native species. Additionally, shoreline habitat should be improved after their removal and should include buffer strips and more naturalized shoreline areas.

Past studies by the Illinois Department of Natural Resources have found the fishery of Sylvan Lake in poor health. This is due to a lack of quality habitat as well as poor water clarity. In the past, the SLIA stocked game fish on a regular basis. However, fish are no longer stocked in Sylvan Lake due to poor water clarity and lack of habitat. To see any appreciable change in the fishery of Sylvan Lake, some form of habitat must be established and the carp population must be brought under control.

Table 5. Observed wildlife species on Sylvan Lake, May – September 2001.

Birds	
American Crow	*Corvus brachyrhynchos*
Red Wing Black bird	*Agelaius phoeniceus*
Great Blue Heron	*Ardea herodias*
Ring-billed Gull	*Larus delawarensis*
Mallard	*Anas platyrhnchos*
Amphibians	
Bull Frog	*Rana catesbeiana*

EXISTING WATER QUALITY PROBLEMS

Sylvan Lake has *below average* water quality due to high nutrient and suspended sediment concentrations. This is a common problem throughout Lake County and especially in many of the Indian Creek Watershed lakes. Below are listed the main problems Sylvan Lake is currently facing.

- Polymixis Leading to Internal Phosphorus Loading

  As lakes thermally stratify, the hypolimnion may become devoid of oxygen. Under these low D.O conditions, nutrients, most importantly phosphorus, are released into the hypolimnion. Due to stratification these nutrients can remain in the hypolimnion until fall turnover. However, Sylvan Lake experiences polymixis (periodic mixing events) during the summer. As a result, the hypolimnetic phosphorus is mixed into the rest of the lake where it is then available for algal growth. This phenomenon is causing an increase in algae blooms and a reduction in clarity, which was evident in water quality data from July through September of the 2001 study. Even without these mixing events Sylvan Lake has above average nutrient concentrations. This is a common problem in many County lakes as well as many of the Indian Creek watershed lakes. However, these mixing events were not present in past LMU studies of Sylvan Lake and are significantly increasing seasonal nutrient concentrations. In the past, Sylvan Lake has operated an aerator that prevents thermal stratification from occurring. As a result, there was a smaller build up of phosphorus and subsequent mixing. Sylvan Lake should resume aeration of the lake to prevent these phosphorus pulses. The system that is currently installed in the lake is in disrepair and is not being operated. There are plans to fix the compressors in the spring of 2002 and resume aeration of Sylvan Lake on a regular basis. However, the compressor units need to be upgraded to a higher horsepower rating in order to provide enough air to keep Sylvan Lake destratified all summer. Additionally, high internal phosphorus concentrations could be reduced using aluminum sulfate (alum). However, alum treatments are often cost prohibitive and their longevity may be a problem on Sylvan due to an excessive number of carp and shallow depth of the lake.

- *Poor Plant Diversity/Densities*

  One key to a healthy lake is a healthy aquatic plant population. Sylvan Lake has poor plant *densities* as well as poor plant *diversity*. The negative impacts associated with the absence of a quality aquatic plant community are wide spread and include those on water quality and fishery health. The lack of quality aquatic plants, and subsequent loss of water quality, is more than likely the result of carp activity since there is adequate light available. Establishment of a healthy aquatic plant community is essential in improving the quality of Sylvan Lake. Establishing aquatic vegetation will stabilize sediment and help to reduce algae blooms which will improve clarity. Additionally, these vegetated areas will provide valuable fish and wildlife habitat.

This is a long-term process and involves other management practices as well. The first step is the elimination of carp, which are possibly the biggest limiting factor in plant growth for Sylvan Lake.

- *Wildlife Habitat*

  Overall, wildlife habitat on Sylvan Lake is *fair* at best. The main problem is the lack of quality shoreline habitat. Almost all (98%) of Sylvan Lake's shoreline is developed and offers no/little habitat. This is a common problem on residential lakes with highly developed shorelines (rip rap, seawalls, lawns, etc.). Often, the only shoreline habitat consisted of invasive species, which offer little/poor quality habitat. The wildlife habitat of Sylvan Lake can be greatly improved by the use of other management techniques, such as the use of buffer strips for erosion control, and removal of invasive species such as purple loosestrife and buckthorn. Additionally, it would be beneficial to establish wildlife sanctuary areas around the lake. This has already started to take place in the bays as part of the rehabilitation project. However, efforts should not stop with these two areas. IDNR surveys have found on several occasions that the fishery of Sylvan Lake is in poor health due to the lack of habitat and overabundance of carp. The rehabilitation of the lake's fishery can be an intensive process involving removal of the carp and establishment of habitat but is necessary to see any improvements in Sylvan Lake's quality.

- *Invasive Species*

  There are many invasive species that have become established in Lake County and Sylvan Lake is no exception. Two exotic invasive species that were commonly found along Sylvan Lake's shoreline are buckthorn and purple loosestrife. These two plants were found along 39% of the shoreline. Neither of these species provide quality food or habitat to wildlife. Furthermore, both species are extremely aggressive and will displace desirable, native vegetation, which will lead to further loss of food and habitat. The spread of these two aggressive species must be stopped before they become further established on Sylvan Lake. Both of these noxious weeds can easily be controlled using several different management techniques. The SLIA should educate residents about these two unwanted shoreline plants and promote their immediate removal.

- *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 lack of involvement on the part of the management entity/residents. The SLIA 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/monitored. 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 Sylvan Lake 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 Bathymertic Map*

  There has never been a bathymetric map (contour) made for Sylvan 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 volumetric data that can be utilized for management techniques such as aeration and volumetric applications such as alum, herbicides, 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. Destratification Using Artificial Aeration
II. Wildlife Habitat Improvement
III. Fishery Rehabilitation
IV. Eradicate/Control Invasive Species
V. Shoreline Erosion Control
VI. Volunteer Lake Monitoring Program
VII. Create a Bathymetric Map and Morphometric Data

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

Objective I: Destratification Using Artificial Aeration

Fish and other aquatic organisms need oxygen to live. As water moves past their gills (or other breathing apparatus), microscopic bubbles of oxygen gas in the water, called dissolved oxygen (D.O.), are transferred from the water to their blood. Like any other gas diffusion process, the transfer of D.O. to aquatic organisms can only occur above certain concentrations. In other words, oxygen can be present in the water, but at too low a concentration to sustain aquatic life. Oxygen also is needed by virtually all algae and all aquatic plants, and for many chemical reactions that are important to lake functioning. Lake D.O. concentrations naturally vary and are controlled by several biological, chemical and physical processes.

Dissolved oxygen concentrations in a lake can vary greatly depending on the time of day. This is mainly due to oxygen being produced during photosynthesis and consumed during respiration and decomposition. Because it requires light, photosynthesis occurs only during the daylight hours. Respiration and decomposition, on the other hand, occurs 24 hours a day. This difference alone can account for large daily variations in D.O. concentrations. During the night, when photosynthesis cannot counter balance the loss of oxygen through respiration and decomposition, D.O. concentration may steadily decline. D.O. concentrations are generally lowest just before dawn, when photosynthesis resumes.

Ice-covered (nutrient-enriched) lakes may also develop variations of D.O. dependent on depth. If there is little or no snow cover to block sunlight, algae and some plants may continue to photosynthesize, resulting in a small increase in D.O. just below the ice. But as microorganisms continue to decompose material in the lower water column and in the sediment, they consume oxygen, and the D.O. is depleted. No oxygen input from the air occurs because of the ice cover, and, if snow covers the ice, it becomes too dark for photosynthesis. This condition can cause high fish mortality during the winter, known as "winter kill." Lakes in this area that do not have at least 25% of their surface area with a depth of at least 10 feet are prone to winter kill. Since no bathymetric map exists for Sylvan Lake it is impossible to calculate if Sylvan Lake meets this requirement.

Temperature effects can also cause reduced D.O. in deeper lakes (usually greater than 10 feet deep) as thermal stratification may cut-off all oxygen sources from reaching the lower depths. D.O. concentrations drop as organisms continue to respire and consume oxygen. The bottom layer of the lake may eventually become anoxic, that is, totally devoid of oxygen. Oxygen losses can also occur in summer if large amounts of plants or algae quickly die naturally, or as a result of an application of fast acting aquatic herbicides or algicides. Decomposition is more rapid in the summer due to warmer water temperature, which uses a large amount of D.O. very quickly, causing a D.O. crash. The anoxia causes chemical reactions which result in the release of phosphorus in this bottom layer. If the phosphorus is then distributed to the surface layer through frequent mixing of the water column, algae blooms could result. This appears to be occurring in Sylvan Lake. If the entire water column remained oxygenated throughout the summer, internal phosphorus release should decrease or be eliminated and should result in a decrease of planktonic (and possibly filamentous) algae.

Option 1. No Action

Lakes that experience low D.O. concentrations either during the summer or winter are almost always nutrient-enriched or eutrophic lakes that are very productive biologically. Lakes such as Lake Michigan that are deep, but nutrient-poor rarely have problems with low D.O.. Therefore, D.O. measurements should be collected at least monthly in summer and winter to determine if low D.O. is a problem for the specific lake. If low D.O. is a problem, then the underlying cause should be investigated and additional tests conducted prior to taking management actions. As stated previously, lakes have natural variations of D.O. dependent on physical processes and the amount of biological and chemical activity. With a no action management plan for lakes with low D.O., nothing would be done to improve the D.O. concentrations. The D.O. concentrations would continue to vary and fluctuate dependent on time and lake condition.

Pros

If no efforts are made to increase D.O. concentrations, there are no D.O. management expenses. Although, equipment costs and other management options may increase in price over time. In most cases, low D.O. in the lower water layer of a thermally stratified, productive lake is a natural, physical and chemical phenomenon and is not necessarily bad. In many cases, the amount of total volume that has low D.O. is relatively small (sometimes less than 30% in Lake County). Thus, ample volume can exist with sufficient D.O. for aquatic organisms to survive. Generally, nutrients released from sediment, due to low D.O. in a thermally stratified lake, are contained in the lower water and are not available for additional growth of plants and algae until fall turnover. As stated above, this is not the case in Sylvan Lake. The phosphorus released from bottom sediment appears to be making its way into the epilimnion during the summer. No action may also be warranted in cases of productive, shallow lakes that regularly experience fish kills as it may not be cost effective to maintain suitable conditions (year-round) for gamefish populations. In some cases, D.O. management options such as aeration (artificial circulation) have increased phosphorus concentrations and/or exacerbated algae blooms.

Cons

If no action is taken, fish in lakes that experience D.O. concentrations of less than 3.0 mg/l (bass/bluegill/pike) or 5.0 mg/l (trout) throughout the water column can suffer severe oxygen stress. Under severe D.O. depletion in summer or winter, fish kills can occur. Lakes that frequently experience low D.O. concentrations throughout the water column usually can only support tolerant fish species such as carp and green sunfish. Also, some lakes have a small amount of the lake volume that has sufficient oxygen (<30%) which is entirely in the sunlit zone. Fish are squeezed into a smaller volume and can be easily seen, which may cause increased predation leading to an unbalanced fish population. A high quality fishery will be difficult to sustain or achieve under these circumstances. Other aquatic organisms such as invertebrates require 4.0 mg/l to avoid severe oxygen stress. Besides the direct effects to aquatic organisms, low D.O. levels (<1 mg/l) can lead to increased release of phosphorus from the sediment that can fuel algal blooms when mixed into the sunlit zone. It also leads to the buildup of chemically reduced compounds such as ammonium and hydrogen sulfide (H_2S, rotten egg gas) which can be toxic to bottom dwelling organisms. In extreme cases, sudden mixing of H_2S into the upper water column can cause fish kills. These gases are released causing potential odor problems and reduced enjoyment for lakeside residents. Since aerobic (with oxygen) decomposition breaks down organic matter faster than anaerobic (without oxygen), organic matter may buildup faster in the sediment due to low D.O. concentrations.

Cost:
There is no cost associated with the no action option.

Option 2: Aeration via Artificial Circulation

Artificial circulation of lakes has been employed as a management technique since at least the early 1950s. Initially it was used to prevent fish kills during winter in shallow, ice-covered lakes. Since the 1960s it has also been used as a technique to obtain additional water quality improvements and control nutrient enrichment. Artificial circulation is probably the most widely used lake management technique for lake rehabilitation. Sylvan Lake installed an aeration system in the spring of 1980. This unit was operated every summer through 1996 at which time it was only run when it was working and even then not at full power. In the summer of 2001, the system was not in operation.

The principal, and probably most reliable if properly sized, effect of artificial circulation is to raise the D.O. content throughout the lake. In fact, artificial circulation should be called stratification prevention, as the mixing process prevents thermal stratification. This lack of stratification allows water undersaturated with oxygen to come in contact with the air at the surface permitting oxygen diffusion to occur. While the vertical movement of water is usually achieved by entraining water through releasing compressed air at some depth, little oxygen increase is achieved through direct diffusion from bubbles (King, 1970; Smith et al. 1975). In order to vertically move the entire water volume, the system must be sized properly. A recommended air flow rate for a typical disk diffuser aeration system is equivalent to 1.33 standard cubic feet per minute (scfm) per lake surface acre (Lorenzen and Fast, 1977). Case studies have shown that artificial circulation can be achieved at a flow rate as low as 0.7 scfm/acre (Kortmann, personal communication 2001). Our Unit recommends that the minimum sizing flow rate should be 0.9 scfm/acre, but to ensure success to use 1.33 scfm/acre as finances allow. The higher flow rate per acre should be chosen for lakes that strongly stratify thermally and that have very high relative thermal resistance to mixing. The physical shape of the lake should also be considered. Mixing a lake that is shaped like a “martini glass” is a lot easier than mixing a big "spaghetti" bowl. Lakes shaped like a martini glass that have a single deep hole may only require one diffuser that can handle the required flow rate. Whereas, a lake with multiple holes and bays may require several diffusers and a flow manifold to properly distribute the required airflow. Lakes that are less than 6 feet deep rarely stratify in the summer and usually do not benefit from this option as they are already circulated. These shallow lakes may benefit from this option in the winter months.

There are several types and manufacturers of electrical compressors and blowers on the market and even windpowered systems that force the required airflow through submersed tubing to a diffuser or air stone that releases the air and circulates the water column. The most commonly used electrical compressor is a carbon vane compressor. This compressor operates at low pressure (usually below 10 pounds per square inch or PSI) and produces a large volume of airflow. This type of compressor is designed for continual operation, low maintenance and has the average lifespan of 15-25 years. This type of compressor works well in lakes that are less than 25 feet deep as water pressure effects performance. These compressors do not require oil for lubrication and thus, no oil will move into the lake with the compressed air. Some rotary vane compressors only operate at 5 PSI and thus would not work well in lakes deeper than 11 feet. For these deeper lakes, or for large airflow requirements, electrical high-pressure units such as piston or rotary screw compressors are utilized. These compressors can operate at or higher than 100 PSI, which can easily overcome lake water pressure effects for all lakes in Lake County. Some of the piston compressors, like the rotary vanes are oil-free, whereas the rotary screw compressors all require oil for lubrication. Special biodegradable oils are a must as miniscule quantities of oil are carried in the air to the lake. Both compressors are also for continuous operation, although the rotary screws do require more maintenance than the oil-free piston and rotary vane compressor. Additionally, the higher operating pressure does reduce the amount of airflow generated by the compressor and more horsepower may be required than a low-pressure system.

There are several types and manufacturers of diffusers. They are generally subdivided into fine and coarse bubble units. All diffusers are rated for a specific minimum and maximum flow rate. It is very important to properly size the diffusers with the amount of compressed airflow to ensure performance. Most fine bubble units are either a membrane air diffuser or an air stone. The major advantages of the membrane air diffuser are low maintenance, ease of installation and higher oxygen transfer efficiency. Air stones tend to produce a medium bubble and may need to be removed and cleaned with acid if clogging occurred. Coarse bubble diffusers are also low maintenance, easy to install, but may provide less oxygen transfer efficiency. However, they are able to transfer more oxygen to the water since they can operate at much higher gas flow rates with less required pressure than the fine bubble units. Line diffusers (soaker hoses) consist of porous hose lines that distribute small bubbles over a large area near the water bottom. They, like fine bubble units, produce high oxygen transfer efficiencies. However, if high gas flow rates are required, the length of hose must be extended. Simple slits in the air tubing can also cause mixing to occur. This is usually used in winter aeration strategies to open specific areas of lake ice.

Pros

When properly sized for the lake, these systems can improve D.O. concentrations in the water column to help prevent fish kills and increase habitat for aquatic life. Zooplankton and warmwater fish such as bass and bluegill can inhabit a larger volume of the lake, due to higher D.O. concentrations throughout the lake.

Algal blooms may be controlled, possibly through one or more of these processes: 1) mixing to the lake's bottom will increase an algae cell's time in darkness, leading to reduced net photosynthesis due to light limitation; 2) introduction of dissolved oxygen to the lake's bottom may inhibit phosphorus release from the sediment; 3) rapid contact of water with the atmosphere, as well as the introduction of carbon dioxide-rich water during the initial period of mixing, can lower pH, leading to a shift from blue-greens to less noxious green algae; and 4) when zooplankton are mixed to the lake's bottom, they are less vulnerable to sight-feeding fish, resulting in the increase of consumption of algal cells by the zooplankton (Olem & Flock, 1990; Lorenzen and Fast, 1977; Vandermeulen, 1992).

Internal loading of phosphorus can theoretically be decreased through increased circulation. By aerating the sediment-water interface of lakes where iron is controlling phosphorus solubility, phosphorus would be prevented from migrating into the water column.

Artificial circulation in winter can help alleviate low oxygen conditions when the systems are able to keep about 2.3% of the lake's surface free from snow and ice cover (Wirth, 1988). Usually, critically low D.O. concentrations do not appear until late in winter. Weekly D.O. measurements may be necessary to determine the need for operating an aeration system. If the lake's D.O. was found to be 4.0 mg/L less than 2 to 3 feet below the ice, operation of the aeration system should begin.

Cons

Mixing anoxic water from the hypolimnion (deep water) with oxygen poor surface waters can cause D.O. concentrations in the entire water column to fall below the amount needed for fish survival. Aeration systems should be started just after spring/fall turnover to avoid this situation. Also if artificial circulation is only used during the winter and the D.O. concentration is well below 4.0 mg/l near the surface, it may be too late to activate the aeration system. Mixing the anoxic water near the bottom with marginally oxygenated water near the surface can cause the entire water column to have D.O. concentrations below what is needed for fish survival.

Calcium may control phosphorus solubility in most of the hardwater Lake County lakes or the iron/phosphorus ratio may be too low, in which case the phosphorus release rate could be largely a function of aerobic decomposition of organic matter (Kamp-Nielsen, 1975). In that event, internal phosphorus loading may actually increase as temperature at the sediment-water interface is raised in the circulation process. Also, some sediment have a high organic and water content and are very flocculent, and may have a high loosely bound phosphorus fraction (Bostrom, 1984) which may be disturbed causing increased loading. If nutrient-rich waters are brought to the surface by the circulating water, algae and plant growth can become a greater nuisance. For shallow lakes where light is not a limiting factor, algae populations may not decrease. In some lakes, they may actually increase, as explained above.

Depending on the size and type of the compressor(s), seasonal or annual electrical costs may run in the hundreds or thousands of dollars. Some Lake Associations utilize the entire annual budget on electrical costs and maintenance of the aeration system. Therefore, proper sizing and monitoring of the aeration system's performance is requisite.

Costs

Sylvan Lake purchased a aeration unit in the spring on 1980. The system consisted of a 2.5 horsepower compressor, three diffuser heads, and tubing. This unit was of adequate size to prevent stratification and maintained good D.O. concentrations based on lake volume. Since then the compressor has been altered an now consists of two motors that produce a combined 1.25 horsepower. These units are currently not functioning and are going to be replaced in the spring of 2002. To properly aerate Sylvan Lake and prevent stratification, the compressor unit(s) should have a horsepower rating of 2.25-3.0. The cost for this size would be approximately $1,200 -$1,700. The electricity for this size of a unit should be between $500 and $700 per year. Additionally, a manifold ($100) should be used in order to control the flow of air to the diffusers.

Option 3. Reduce Lake Phosphorus Concentrations

If a lake has an overabundance of plants and algae, severe oxygen losses can occur if they rapidly die and decompose. Reducing phosphorus can decrease algal populations and (possibly) plant populations. In-lake phosphorus can be reduced by using alum (aluminum sulfate). Alum does not directly kill algae as copper sulfate does. Instead, alum binds phosphorus, making it unavailable, thus reducing algal growth. Alum binds water-borne phosphorus and forms a flocculent layer that settles on the bottom. This floc layer can then prevent sediment bound phosphorus from entering the water column through internal loading. Phosphorus inactivation using alum has been in use for 25 years. However, cost and sometimes unreliable results deterred its wide spread use. Currently, alum is commonly being used in ponds and small lakes, and its use in larger lakes is increasing. Alum treatments typically last 1 to 20 years depending on various parameters. Lakes with low mean depth to surface area ratio benefit more quickly from alum applications, while lakes with high mean depth to surface area ratio (thermally stratified lakes) will see more longevity from an alum application due to isolation of the flocculent layer. Lakes with small watersheds are also better candidates because external phosphorus sources can be limited. Alum treatments must be carefully planned and carried out by an experienced professional. If not properly done, there may be many detrimental side effects. One of the most serious side effects has to do with pH. The application of alum can dramatically reduce the pH of a lake, resulting in the formation of toxic, soluble forms of aluminum and the death of many aquatic organisms.

An alum application would probably dramatically reduce the amount of phosphorus in Sylvan Lake and prevent internal phosphorus loading for several years. However, due to the shallow, polymictic nature of Sylvan Lake, the longevity of an alum application may not be more than 3-5 years. To properly calculate the cost of an alum treatment for Sylvan Lake is difficult without an accurate bathymetric map and morphometric data. However, alum treatments can be quite expensive. Given the high cost of the treatment and possible short longevity, an alum treatment may be financially risky to consider alum as an algae management option at this time.

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 sylvan 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). More information about non-native (exotic) plants can be found in the section *Objective IV: Eliminate or control invasive species***.**

Option 1: No Action

This option means that the current land use activities will continue. No additional techniques will be implemented on Sylvan 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.

<u>Option 2: Increase Habitat Cover</u>

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, 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 out compete native plants and provide little value for wildlife. Currently, there are a few native emergent vegetation test areas around the lake. This is a good step in the right direction towards naturalizing Sylvan Lake's shoreline. This program should continue and be expanded.

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 homewoner. 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 (Appendix A) 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 Sylvan Lake.

Objective III: Fishery Rehabilitation

<u>Option 1: Conduct a Fisheries Assessment</u>

Many lakes in Lake County have a fish stocking program in which fish are stocked every year or two to supplement fish species already occurring in the lake or to introduce additional fish species into the system. However, very few lakes that participate in stocking check the progress or success of these programs with regular fish surveys. Lake managers should have information about whether or not funds delegated to fish stocking are being well spent, and it is very difficult to determine how well stocked fish species are surviving and reproducing or how they are affecting the rest of the fish community without a comprehensive fish assessment.

A simple, inexpensive way to derive direct information on the status of a fishery is to sample anglers and evaluate the types, numbers and sizes of fish caught by anglers actively involved in recreational fishing on the lake. Such information provides insight on the status of fish populations in the lake, as well as a direct measure of the quality of fishing and the fishing experience. However, the numbers and types of fish sampled by anglers are limited, focusing on game and large, catchable-sized fish. Thus, in order to obtain a comprehensive assessment of the fish community status, including non-game fish species, more quantitative methods must be employed. These include gill netting, trap netting, seining, trawling, angling (hook and line fishing) and electroshocking. Each method has its advantages and limitations, and frequently multiple gear and approaches are employed. The best gear and sampling methods depend on the target fish species and life stage, the types of information desired and the environment to be sampled. The table below lists examples of suitable sampling gear for collecting adults and young of the year (YOY) of selected fish species in lakes.

Typically, fish populations are monitored at least annually. The best time of year depends on the sampling method, the target fish species and the types of data to be collected. In many lakes and regions, the best time to sample fish is during the fall turnover period after thermal stratification breaks down and the lake is completely mixed because (1) YOY and age 1+ (one year or older) fish of most target species should be present and vulnerable to most standard collection gear, including seines, trap nets and electroshockers; (2) species that dwell in the hypolimnion during the summer may be more vulnerable to capture during fall overturn; and (3) lower water temperatures in the fall can help reduce sampling-related mortality. Sampling locations are also species-, life stage-, and gear-dependent. As with sampling methods and time, locations should be selected to maximize capture efficiency for the target species of interest and provide the greatest gain in information for the least amount of sampling effort.

The Illinois Department of Natural Resources (IDNR) will perform a fish survey at no charge on most public and some private water bodies. In order to determine if your lake is eligible for a survey by the IDNR, contact Frank Jakubecik, Fisheries Biologist at (815) 675-2319. If a lake is not eligible for an IDNR fish survey, or if a more comprehensive survey is desired, two known consulting firms have previously conducted fish surveys in Lake County: EA Engineering, Deerfield, IL, (847) 945-8010 and Richmond Fisheries, Richmond, IL, (815) 675-6545.

Option 2: Carp Removal

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

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

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

Rotenone is a piscicide that is naturally derived from the stems and roots of several tropical plants. Rotenone is approved for use as a piscicide by the USEPA and has been used in the U.S. since the 1930's. It is biodegradable (breaks down into CO_2 and H_2O) and there is no bioaccumulation. Because rotenone kills fish by chemically inhibiting the use of oxygen in biochemical pathways, adult fish are much more susceptible than fish eggs (carp eggs are 50 times more resistant). Other aquatic organisms are less sensitive to rotenone. However, some organisms are effected enough to reduce populations for several months. In the aquatic environment, fish come into contact with the rotenone by a different method than other organisms. With fish, the rotenone comes into direct contact with the exposed respiratory surfaces (gills), which is the route of entry. In other organisms this type of contact is minimal. More sensitive nonfish species include frogs and mollusks but these organisms typically recover to pretreatment levels within a few months. Rotenone has low mammalian and avian toxicity. For example, if a human consumed fish treated with normal concentrations of rotenone, approximately 8,816 lbs. of fish would need to be eaten at one sitting in order to produce toxic effects. Furthermore, due to its unstable nature, it is unlikely that the rotenone would still be active at the time of consumption. Additionally, warm-blooded mammals have natural enzymes that would break down the toxin before it had any effects.

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

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

Pros

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

Cons

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

Costs

As with most intensive lake management techniques, a good bathymetric map is needed so that an accurate lake volume can be determined (for costs see *Objective VI: Create Bathymetric Map with Morphometric Table*). To achieve a concentration of 6 ppm, which is the rate needed for most total rehabilitation projects (remove carp, bullhead and green sunfish), approximately 485 gallons of rotenone would be needed. This would come to a total cost of between $24,260 – 36,370. In waters with high turbidity and/or planktonic algae blooms, the ppm may have to be higher which will further increase costs. A IDNR fisheries biologist will be able to determine if higher concentrations will be needed. To reduce costs the lake could be drawn down to reduce the volume that is being treated.

Objective IV: 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 athartica*), and reed canary grass (*Phalaris arundinacea*) are three examples. These exotic and invasive plants have made their way onto the shores of Sylvan Lake. The outcome is a loss of plant and animal diversity. This section will address terrestrial shoreline exotic species.

Purple loosestrife is responsible for the “sea of purple” seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Reed canary grass is an aggressive plant that if left unchecked will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of purple loosestrife, buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Allilaria officianalis*) or honeysuckle (*Lonicera* spp.) as well as some aggressive native species, such as box elder (*Acer negundo*).

Presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself. However, problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. A monitoring program should be established, problem areas identified, and control measures taken when appropriate. This is particularly important in remote areas of lake shorelines where the spread of exotic species may go unnoticed for some time.

Option 1: No Action

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

Pros

There are few advantages with this option. Some of the reasons exotics were brought into this country are no longer used or have limited use. However, in some cases having an exotic species growing along a shoreline may actually be preferable if the alternative plant is commercial turfgrass. Since turfgrass has shallow roots and is prone to erosion along shorelines, exotics like reed canary grass or common reed (*Phragmites australis*) will control erosion more effectively. Native plants should take precedent over exotics when possible. Table 6 (Appendix A) lists several native plants that can be planted along shorelines.

Cons

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

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

Costs

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

Option 2: Hand Removal

Controlling exotic plants by hand removal is most effective on small areas (< 1 acre) and if done prior to heavy infestation. This is probably the best method (combined with herbicides) for removal of invasive species on Sylvan Lake. 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 excavated. This is probably the most effective method of removal on Sylvan Lake for purple loosestrife. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored. Many exotic species, such as purple loosestrife, buckthorn, and garlic mustard are proficient at colonizing disturbed sites.

Pros

Removal of exotics by hand eliminates the need for chemical treatments. Costs are low if stands of plants are not too large already. Once removed, control is simple with yearly maintenance. Control or elimination of exotics preserves the ecosystem's biodiversity. This will have positive impacts on plant and wildlife presence as well as some recreational activities.

Cons

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

Costs

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

Option 3: Herbicide Treatment

Treatment with herbicides is one of the best options for controlling **mature stands** of invasive species on Sylvan Lake. 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. The label is the law. Table 7 (Appendix A) contains herbicides that are approved for use near water for control of nuisance vegetation. Included in this table are rates, costs, and restrictions on use.

Pros

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

Cons

Since most herbicides are non-selective, they are not suitable for broadcast application. Thus, chemical treatment of large stands of exotic species may not be practical. Native species are likely to be killed inadvertently and replaced by other non-native species. Off target injury/death may result from the improper use of herbicides. If herbicides are applied in windy conditions, chemicals may drift onto desirable vegetation. Care must also be taken when wicking herbicides as not to drip on to non-targeted vegetation such as native grasses and wildflowers. Another drawback to herbicide use relates to their ecological soundness and the public perception of them. Costs may also be prohibitive if plant stands are large. Depending on the device, cost of the application equipment can be high.

Costs

See Table 7 (Appendix A) for herbicide rates and prices. Total cost to treat the limited amount of purple loosestrife and other invasive species on Sylvan Lake would be minimal and could be done by individual homeowners or the SLIA. Hand-held and backpack sprayers costs from $25-$45 and $80-150, respectively. Wicking devices are $30-40. For other species, such as buckthorn, a device such as a Hydrohatchet®, a hatchet that injects herbicide through the bark (about $300) may be needed. Another injecting devise, E-Z Ject® is $450. Hand-held and backpack sprayers costs from $25-$45 and $80-150, respectively. Wicking devices are $30-40. A low cost alternative to specialized spray equipment is the use of household spray bottles (commonly used for window and bathroom cleaners). These bottles can be purchased at department stores for minimal costs. However, after there use for herbicide application they should not be used for anything else. Similarly, spray canisters like those used to apply lawn chemicals also provide lower costs alternatives to commercial spray equipment.

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 VLMP Regional Coordinator:

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Northeast Illinois Planning Commission
222 S. Riverside Plaza, Suite 1800
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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. Sylvan Lake does not have a bathymetric map. If management activities intensify, Sylvan Lake should consider having a detailed bathymetric map 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.