2000 SUMMARY REPORT
of
FOURTH LAKE

Lake County, Illinois

Prepared by the

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Lake Name: Fourth Lake

State: IL

County: Lake

Nearest Municipality: Lindenhurst and Grayslake

Township/Range: T 45N, R 21E, S 10,11,12

Basin Name: Des Plaines River Watershed

Subbasin Name: Mill Creek Watershed

Major Tributaries: Lake Miltmore drainage/flooding

Receiving Water Bodies: Mill Creek

Surface Area: 304.6 acres

Shoreline Length: 5.4 miles

Maximum Depth: 5.5 feet

Mean Depth: 2.75 feet

Storage Capacity: 840.68 acre-feet

Lake Type: Glacial

There are multiple bottom-owners of Fourth Lake, including the Lake County Forest Preserve District, Lake Villa Township, a sportsman's club and individual residents. Fourth Lake and Lake Miltmore used to be one lake with an island dividing them. The area around the island was then filled in, creating the two lakes. Most of the lake is between two and four feet deep and is very even-bottomed.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Fourth Lake were analyzed for a variety of water quality parameters (See *Appendix A* for methodology). Samples were collected at a depth of 2 feet from a location near the center of the lake (Site 1). Samples were also collected at a depth of 1 foot near a stormwater outlet discharging into the lake from the LakeWood Homes stormwater basin (Site 2) (Figure 1). Site 2 was established because large plumes of sediment had been observed entering the lake from this stormwater outlet in early spring. The sediment coming from the LakeWood Homes construction area was not settling out in the detention basin meant for that purpose because the sediment is dominated by small clay particles that are washed through the basin too quickly to settle. All water quality parameters analyzed at Site 1 were also analyzed at Site 2, except during May, when Conductivity, pH and Dissolved Oxygen (DO) were not analyzed at Site 2.

Fourth Lake did not thermally stratified in 2000. Thermal stratification occurs when a lake divides into an upper, warm water layer (epilimnion) and a lower, cold water layer (hypolimnion). When stratified, the epilimnetic and hypolimnetic waters do not mix, and the hypolimnion typically becomes anoxic (DO=0.0 mg/l) by mid-summer. Fourth Lake is simply too shallow to stratify. With an average depth of just under 3 feet, the water column is naturally mixed by wind and wave action. Neither temperature nor DO differences between the surface and 2-3 foot depths were observed in 2000.

Dissolved oxygen concentrations were relatively low at Site 1 in July and August (5.4 and 4.4 mg/l, respectively). Sport fish typically become stressed when DO concentrations fall below 5.0 mg/l. The decrease in DO observed over the course of the summer likely resulted from a combination of higher water temperatures and lack of water movement due to a high density of Eurasian watermilfoil. Typically, as water temperature increases, plant decomposition increases and DO decreases. The highest water temperature at Site 1 was recorded in August and coincided with the lowest DO concentration. Extremely high densities of Eurasian watermilfoil were present and were probably decomposing throughout the summer, gradually stripping the water of oxygen. The high density of plant matter was also minimizing water movement and mixing at the surface, hindering the diffusion of atmospheric oxygen to the water column.

As a side note, a winter fish kill was discovered on Fourth Lake on April 2, 2001. This is not surprising, given the shallowness of the lake and the high plant densities present during the summer. Winter fish kills will typically occur when a lake has iced over and at least 5 inches of snow cover the ice, completely blocking out light below. At this point, no photosynthesis by algae or plants can occur and, therefore, no oxygen is being produced. In a shallow, productive lake, like Fourth Lake, where the volume of water is relatively small and decomposition is relatively high, the remaining DO would be quickly used up by the respiration activities of fish, plants and bacteria. Once the lake became anoxic, or nearly so, most fish in the lake would perish and float up under the ice. This can happen relatively early in the winter, but may not be discovered until ice-out, when the fish can be seen floating at the water surface. Very little can be done to alleviate this problem in shallow, productive lakes. One option that can help to prevent winter fish kill is the installation of an aeration system that prevents ice from forming above it and oxygenates the water throughout the winter. Another, more expensive, option is to deepen the lake by dredging.

At Site 2, DO concentrations were very low throughout the summer (with the exception of September) and were also lowest during August. The DO concentrations recorded at Site 2 were well below levels that would support sport fish and were probably the result of relatively stagnant water and a high density of Eurasian watermilfoil and peaty sediment. As water from the detention basin passed through a large stand of cattails before entering the lake, water velocity was slowed, sometimes to the point of stopping. Additionally, a large amount of decomposition was occurring within the cattail stands as the water passed through. These two factors may have resulted in the discharge of poorly oxygenated water into the lake at Site 2. Once in the lake, the discharged water was prevented from picking up additional oxygen by a high density of Eurasian watermilfoil, which slowed water column mixing in this shallow, peaty area of the lake. In addition, decomposition of the Eurasian watermilfoil and peat during July and August may have depleted oxygen levels further, resulting in the low DO concentrations measured at Site 2. The much higher DO concentration measured in September may have been the result of a large drop in water temperatures from an average of 23^0C in August to an average of 12^0C in September, and a relatively large amount of rain which may have flushed some of the stagnant water out from the cattail stand.

The complete data set for Fourth Lake is located in Table 1. Below is a continued discussion of the analysis of the water quality data collected at Sites 1 and 2 over the five month study of Fourth Lake.

Despite the stormwater discharge at Site 2, most of the water quality parameters measured at both sites (TKN, NH_3, NO_3, TDS, TVS, COND, Secchi) were similar. Differences were found in Alkalinity, Total Phosphorus (TP), Total Suspended Solids (TSS), and pH. Overall, Fourth Lake had fairly good water quality. The average concentration of phosphorus, a nutrient that can trigger algal blooms, was low at Site 1 (0.018 mg/l), well below the Lake County average of 0.066 mg/l (1995-2000). Although the phosphorus concentration at Site 2 (0.033 mg/l) was nearly double that at Site 1, it was still only half of the County average. The source of the phosphorus to Site 2 was clearly external (the stormwater detention basin), as phosphorus levels followed increases and decreases in rainfall each month (Figure 2). However, much of the phosphorus bound to sediment originating from the basin was being filtered out as the water passed through approximately 180 feet of cattails before reaching the lake, resulting in relatively low phosphorus levels at Site 2. By the time the water being discharged at Site 2 reached Site 1, the phosphorus had been diluted , had dropped out of the water column and/or had been taken up by algae or plants, resulting in even lower phosphorus levels as compared to Site 2. The source of phosphorus to Site 1 (and the lake in general) appeared to be a combination of nonpoint runoff and resuspended sediment. Phosphorus levels were highest in May, when vegetation around the lake was not fully established and rainfall was the highest of any month sampled. This suggests that phosphorus was entering the lake via nonpoint runoff. Once the plants in Fourth Lake Fen and in the cattail stands surrounding the lake were well established, phosphorus levels in the lake fell, despite high rainfall levels in July and September (Table 1). This suggests that a second source of phosphorus was also important. Resuspended sediment, as a phosphorus source, appeared to vary in importance with the density of Eurasian watermilfoil present in the lake. This was determined through comparison of current and historical data. When Eurasian watermilfoil density was high, as it was in 2000, sediment resusupension and, therefore, phosphorus release from this sediment were low. However, it appears that when Eurasian watermilfoil density decreases in Fourth Lake, sediment stability is decreased and phosphorus is released into the water column from resuspended sediment. In 1998, a water quality study was performed on Fourth Lake, and water samples were collected from the surface and 2-3 foot depths at Site 1. At the time of this study, Eurasian watermilfoil density had been dramatically decreased by weevil activity. When data from the 2-3 foot depth samples were compared between 1998 and 2000, the average phosphorus concentration in 1998 was 2.5 times higher than the average 2000 concentration (Table 2), and the average total suspended solids (TSS) level in 1998 was 8.5 times higher than in 2000. This strongly suggests that the increase in phosphorus was due to increased sediment resuspension and that this was a likely source of phosphorus to Fourth Lake in 1998 and 2000.

Total Suspended Solids concentrations also differed between Site 1 and Site 2 during the 2000 water quality study. The average TSS level at Site 2 (5.7 mg/l) was three times higher than at Site 1 (1.8 mg/l), but was still well below the Lake County average (8.6 mg/l). As a result of the high density of Eurasian watermilfoil, which stabilized lake sediment, the source of the TSS in Fourth Lake in 2000 appeared to be external, as both Sites 1 and 2 TSS concentrations were dependent on monthly rainfall levels (Figure 3). The TSS at Site 1 was, most likely, coming from the stormwater detention basin as well as nonpoint sources. By the time the stormwater discharge from Site 2 reached Site 1, much of the suspended solids had dropped out of the water column and been trapped by Eurasian watermilfoil plants, resulting in lower TSS levels in Site 1 than in Site 2. The suspended solids in Site 1 may also have been coming from nonpoint runoff around the lake, but since the lake was so buffered by cattail stands, most of the suspended solids were trapped before the runoff reached the lake. Without the buffer of cattails around the lake or the dense stands of Eurasian watermilfoil in the lake, TSS concentrations may have been much higher at Site 1.

As for Site 2, estimates of the total sediment load flowing directly from the stormwater detention basin outflow pipe during 12 precipitation events (with rainfall greater than or equal to one inch) occurring between May and September were calculated by the LCHD-Lakes Management Unit. The estimates indicated that between 50 and 228 tons of sediment would have flowed into Fourth Lake during the 12-day period. TSS measurements taken at Site 2 during April and early May supported these high estimates. In April, an average TSS value of 700 mg/l (over 28 times higher than the highest TSS value ever recorded in Fourth Lake) was recorded in Fourth Lake at a site directly adjacent to the LakeWood Homes stormwater basin, and a plume of sediment was observed flowing into the lake. On May 18, 2000, a TSS value of 695 mg/l was recorded in the same location. However, TSS values measured at Site 2 throughout the rest of the summer never exceeded 13 mg/l, suggesting that the estimation of sediment load leaving the detention basin was accurate, but that the load was not entering the lake during the summer. The sediment was, most likely, being deposited in the cattail marsh through which the water traveled before reaching the lake. This is good for the lake, but bad for the cattail marsh, which will eventually fill if the sediment load to it is not decreased. The high TSS measurements at S2 in April and early May were probably due to the high water level, the lack of well established vegetation in the cattail marsh and the presence of muskrat trails that provided a way for water to flow freely into the lake. As vegetation became more established, more of the sediment was detained in the marsh and the plume of sediment observed flowing into the lake in April was no longer apparent from late May through late September.

Secchi depth can be a direct indicator of water clarity and overall water quality, which are typically reduced by either algae or sediment in the water column. Secchi depths in Fourth Lake were higher than average (5 feet) throughout most of the summer, and increased at Site 1 from 5.18 feet in May to the lake bottom (5.5 feet) from June through August, decreasing again to 4.33 feet in September. At Site 2, Secchi depth was very low in May (1.74 feet), but increased to the lake bottom (2.5 feet) for the rest of the summer. Secchi depth did not correlate with increases or decreases in TSS levels at either site in 2000. However, in 1998, when plant density in the lake was much lower, increases in TSS corresponded with decreases in Secchi depth throughout the summer (Figure 4). This suggests that during the 2000 study, Eurasian watermilfoil in the lake was not only stabilizing bottom sediment, but was removing suspended sediment from the water column, resulting in relatively high Secchi depths.

Typically, lakes are either phosphorus or nitrogen limited. This means that one of these nutrients is in short supply and that any addition of phosphorus or nitrogen to the lake will result in an increase of plant or algal growth. Other resources necessary for plant and algae growth, such as light or carbon, can be limiting, but this is rarely observed. Most lakes in Lake County are phosphorus limited, but to compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than or equal to 10:1 indicate nitrogen is limiting. Ratios greater than or equal to 15:1 indicate that phosphorus is limiting. Ratios greater than 10:1, but less than 15:1 indicate that there are enough of both nutrients to facilitate excess algal or plant growth. As a result of relatively high nitrogen and relatively low phosphorus concentrations, Fourth Lake had a TN:TP ratio of 57:1. This indicates that the lake is highly phosphorus limited and that care should be taken to ensure that the amount of phosphorus entering the lake does not increase. Even a small increase in phosphorus, especially if plant density was reduced, could lead to an explosion of algae in Fourth Lake.

Phosphorus levels can also be used to indicate the trophic state (productivity level) of a lake. The Trophic State Index (TSI) uses phosphorus levels, chlorophyll *a* levels and Secchi depth to classify and compare lake trophic states using just one value. The TSI is set up so that an increase in phosphorus concentration is related to an increase in algal biomass and a corresponding decrease in Secchi depth. A high TSI value indicates eutrophic (TSI=50-69) to hypereutrophic (TSI ≥70) lake conditions. Fourth Lake had a

2000 phosphorus TSI value of 46, indicating mesotrophic conditions. This means that the lake is a productive system and that moderately high nutrient levels and algal density are expected. However, Fourth Lake had very little algae and relatively low phosphorus levels. This is because plant-dominated lakes do not always follow the standards of these indices and can even give deceptively lower TSI values due to relatively high Secchi depths and low phosphorus levels that result from plant sediment stabilization and nutrient uptake. Without these plants and the benefits they provide, the TSI value of Fourth Lake may have been much higher. In fact, in 1998, when Eurasian watermilfoil density was much lower and the lake was not plant-dominated, the TSI value for Fourth Lake was 59, a full 13 points higher than in 2000. At this value, the lake is considered to be a productive, eutrophic system. Regardless, the TSI of Fourth Lake is typical of most lakes in Lake County, where the majority of the lakes fall into the eutrophic and hypereutrophic categories. Fourth Lake ranked 23th of 86 lakes in the county based on phosphorus TSI values (Table 3).

The water quality parameters just discussed can be used to analyze the water quality of Fourth Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Fourth Lake has *Full* overall support due to low phosphorus levels, and high Secchi depths. The lake also provides *Full* aquatic life and swimming support, but only *Partial* recreational use as a result of dense aquatic plant cover.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See *Appendix A* for methodology). Shoreline plants of interest were also observed and recorded. However, no quantitative surveys were made of these shoreline species and all data are purely observational. Based on the 1% light level, depth at which plant growth could occur in Fourth Lake was consistently at the lake bottom throughout the summer, supporting the observation that plants could grow on 100% of the lake surface area.

The aquatic plant population in Fourth Lake was very diverse, but unbalanced. Eurasian watermilfoil dominated the plant community, occurring in 86% of the sampling sites throughout the summer. Sixteen other aquatic plant species and one shoreline species were observed during the summer, including a state threatened pondweed (grass-leaved pondweed) (Table 4). Three pondweed species (Illinois, largeleaf, and sago) and white water lily were present in approximately 25% of the plant sampling sites throughout the summer, but the other plants were present in no more than 15% of the sampling sites, and most in only 5-10% of the sites (Table 5). This is typical in a lake infested with Eurasian watermilfoil, which out-competes nearly all other plant species and can begin growing much earlier in the spring and in much colder water than most native plants. If the density of Eurasian watermilfoil were reduced, Fourth Lake could have a very healthy, diverse plant community.

During the June plant survey, both species of the milfoil weevil were observed. *Euhrychiopsis lecontei* is the weevil which attacks the stem of the plant and is currently being used as a biological control for Eurasian watermilfoil. *Phytobius leucogaster* is not used as a biological control because it attacks the flowers of Eurasian watermilfoil and does not seem to have the ability to decrease the overall density of the plant. *Phytobius leucogaster* was found much more frequently and in several different stages of development. Approximately 50-75% of milfoil had been damaged by one of the two species of weevil. However, the milfoil never "crashed", or fell below the water surface, as sometimes happens as a result of this damage.

Table 4: Aquatic Plants on Fourth Lake, May-September 2000

Aquatic Plants	
Coontail	*Ceratophyllum demersum*
Chara	*Chara* sp.
Eurasian watermilfoil	*Myriophyllum spicatum*
Slender naiad	*Najas flexilis*
Yellow pond lily	*Nuphar advena*
White water lily	*Nymphaea tuberosa*
Largeleaf pondweed	*Potamogeton amplifolius*
Curlyleaf pondweed	*Potamogeton crispus*
Threadleaf pondweed	*Potamogeton filaformus*
Grass-leaved pondweed+	*Potamogeton gramineus*
Illinois pondweed	*Potamogeton illinoensis*
Sago pondweed	*Potamogeton pectinatus*
Flatstem pondweed	*Potamogeton zosterifomis*
Common bladderwort	*Utricularia vulgaris*
Eel grass	*Vallisneria americana*
Watermeal	*Wolffia columbiana*
Emergent Shoreline Plants	
Grass-leaved arrowhead	*Sagittaria graminea*

+Threatened in Illinois

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

The shoreline of Fourth Lake is dominated by cattail stands to the north, west and south. The shoreline to the east of the lake also consists of cattail marsh, but hardwood upland forest and several residential lots are set back from the shoreline here. A shoreline dominated by cattail/forested areas is very desirable and buffers the lake by filtering nutrients, toxins and sediment from runoff before they reach the lake. The immediate watershed to the north of the lake consists of Forest Lake Fen, a combination of prairie and wetland, and Lake Miltmore, which drains into Fourth Lake. Purple loosestrife (*Lythrum salicaria*) is quite abundant in Fourth Lake Fen and has also spread to the shoreline of Fourth Lake. The majority of Lake Miltmore is surrounded by residential shoreline.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See *Appendix A* for methodology). All observations were either visual or audible and many types of waterfowl and songbirds were observed over the course of the study (Table 6). Wildlife habitat in the form of cattail stands, Fourth Lake Fen and other areas dominated by prairie was good around Fourth Lake, and the diversity of waterfowl observed during the 2000 study was proof of that. In fact, both state threatened and state endangered waterfowl were observed on and around the lake during the summer. It is, therefore, very important that the natural areas around the lake be maintained to provide the appropriate habitat for these wildlife species in the future.

Table 6: Observed Wildlife Species on Fourth Lake, May-September 2000

<u>*Birds*</u>	
Pied-billed Grebe+	*Podilymbus podiceps*
Mute Swan	*Cygnus olor*
Canada Goose	*Branta canadensis*
Mallards	*Anas platyrhnchos*
Wood Duck	*Aix sponsa*
American Coot	*Fulica americana*
Ring-billed Gull	*Larus delawarensis*
Common Tern*	*Sterna hirundo*
Great Blue Heron	*Ardea herodias*
Spotted Sandpiper	*Actitis macularia*
Red-tailed Hawk	*Buteo jamaicensis*
Mourning Dove	*Zenaida macroura*
Belted Kingfisher	*Megaceryle alcyon*
Common Flicker	*Colaptes auratus*
Downy Woodpecker	*Picoides pubescens*
Barn Swallow	*Hirundo rustica*
Chimney Swift	*Chaetura pelagica*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristala*

Table 6: Observed Wildlife Species on Fourth Lake, May-September 2000 (cont'd)

Marsh Wren	*Cistothorus palustris*
Red-winged Blackbird	*Agelaius phoeniceus*
Northern Cardinal	*Cardinalis cardinalis*
American Goldfinch	*Carduelis tristis*
Swamp Sparrow	*Spizella pusilla*
+Threatened in Illinois	
***Endangered in Illinois**	
<u>Reptiles</u>	
Painted Turtle	*Chrysemys picta*
<u>Insects</u>	
Damselfly	
Cicadas	

Existing Lake Quality Problems And Management Suggestions

Highpoints of the lake:

A. Wetlands (cattails) dominate almost the entire shoreline
B. State threatened and endangered bird species observed
C. Both milfoil weevil species are present in the lake
D. Although the plant community is unbalanced, there is relatively good plant diversity (State threatened aquatic plant species observed)
E. All boating (except canoeing) on the lake was inhibited during summer 2000 by a high density of Eurasian watermilfoil

- *Lack of a Quality Bathymetric Map*

A bathymetric (depth contour) map is an essential tool in effective lake management, especially if the long term lake management plan includes intensive treatments, such as fish stocking, dredging, chemical application or aeration. Morphometric data, such as depth, surface area, volume, etc., obtained in the creation of a bathymetric map are necessary for calculation of equations for correct application of these types of techniques. Fourth Lake does have a bathymetric map. However, it is outdated (1966), and does not include morphometric data (which are pertinent for certain calculations). Maps can be created by the Lake County Health Department – Lake Management Unit or other agencies for costs that vary from $3,000-$10,000, depending on lake size.

- *Low Dissolved Oxygen*

Fourth Lake experienced low dissolved oxygen levels at Site 1 in July and August and at Site 2 from June through August. This was due to its shallow morphometry, the decomposition of cattails near Site 2 and Eurasian watermilfoil, and the prevention of water column mixing by dense stands of Eurasian watermilfoil at the water surface. Low DO levels can cause fish stress and, if continual, can eventually lead to fish mortality. An aerator could be placed in Fourth Lake, but given the lake's shallowness and the fact that it is prone to phosphorus release from resuspended sediments, this is not recommended. An aerator would probably increase phosphorus levels in the lake, further aggravating the Eurasian watermilfoil problem and possibly increasing algal density in the water column as well. A reduction in the density of Eurasian watermilfoil would be a less expensive and more successful way of increasing oxygen. By removing some of these plants, water circulation would increase and decomposition would decrease, boosting the DO concentration throughout the lake.

With the winter fish kill in 2000, fishery health is probably very poor at this time. Despite the condition of the fishery, fish stocking is not recommended in Fourth Lake due to the likelihood of future winter fish kills.

- *Nuisance Aquatic Plant Species*

One key to a healthy lake is a healthy aquatic plant community. Although plant diversity is relatively high, Fourth Lake is plagued by nuisance densities of the exotic plant species, Eurasian watermilfoil. The density of these plants is, most likely, negatively impacting the plant and fish communities, and resulting in low DO levels throughout the lake. It is also hindering navigation on the lake. In order to improve Fourth Lake, Eurasian watermilfoil densities should be reduced. In 2000, damage was being done to the Eurasian watermilfoil plants naturally. Both species of milfoil weevils, *Euhrychiopsis lecontei* and *Phytobius leucogaster* were present in high densities on the Eurasian watermilfoil throughout the summer and had caused severe damage to the plants. Unfortunately, the density of milfoil was so high that this damage was not obvious and did not cause the plants to fall out of the water column. Additional treatment may be necessary.

As illustrated above, the presence of Eurasian watermilfoil did benefit the lake in 2000 (as compared to 1998) but minimizing wind and wave action and stabilizing lake sediment to prevent resuspension and minimize phosphorus release. Therefore, a whole-lake herbicide treatment would not benefit the lake. It is recommended that spot treatments of herbicide be applied to Fourth Lake in early spring 2002 in order to reduce the density of Eurasian watermilfoil. This may allow some of the native plants to rebound, will improve the DO levels in the lake, and will free up areas of the lake for recreational use, without eliminating the benefits provided by the Eurasian watermilfoil plants. Additionally, weevils will continue to thrive in the areas not treated and weevil damage may be more apparent if plant density is reduced, as the damage will be concentrated on fewer plants. Fourth Lake presents an ideal habitat for weevils, which need a natural shoreline upon which to overwinter as well as a healthy amount of milfoil to feed upon. Therefore, the weevil population should thrive in the lake and control the milfoil to some degree.

The recommended herbicide for Fourth Lake is 2,4-D. This is a systemic herbicide that has been very effective on Eurasian watermilfoil and could be applied as slow release pellets in order to reduce chemical drift. It is recommended that, in order to keep costs down, only areas of the lake that are used for navigation be treated (i.e., boat navigation lanes leading to duck blinds used by the hunt club). This will allow for easier movement around the lake as well as provide an opportunity for native plants to rebound. At a cost of $350-$425 per surface acre, treatment of 10 acres in this fashion would be approximately $3,500-$4,250.

- *Presence of Exotic Shoreline Plant Species*

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. The outcome is a loss of plant and animal diversity. 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. Purple loosestrife is present along the shoreline of Fourth Lake and in Fourth Lake Fen, while Buckthorn has also invaded Fourth Lake Fen and some of the surrounding shoreline. The presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. 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.

Biological control (bio-control) is a means of using natural relationships already in place to limit, stop, or reverse an exotic species’ expansion. In most cases, insects that prey upon the exotic plants in its native ecosystem are imported. Since there is a danger of bringing another exotic species into the ecosystem, state and federal agencies require testing before any bio-control species are released or made available for purchase. Recently two beetles (*Galerucella pusilla* and *G. calmariensis*) and two weevils (*Hylobius transversovittatus* and *Nanophyes marmoratus*) have offered some hope to control purple loosestrife by natural means. These insects feed on either the leaves or juices of purple loosestrife, eventually weakening or killing the plant. In large stands of loosestrife, the beetles and weevils naturally reproduce and in many locations, significantly retard plant densities. The insects are host specific, meaning that they will attack no other plant but purple loosestrife. The Lake County Forest Preserve District has taken steps to address the purple loosestrife problem in Fourth Lake Fen by introducing the bio-control beetle on two occasions. In 1996, 2000 beetles were introduced by road release (beetles were simply released into the infested area) and in 1999, 12,000 beetles were introduced through high quality release, in which beetle-infested plant fragments were tied to the purple loosestrife plants in the Fen. No costs were associated with purchase of the beetles, as the Forest Preserve District obtained the beetles from the Illinois Natural History Survey at no charge. These beetles have, likely, already spread to the purple loosestrife located along Fourth Lake shoreline and no additional treatment measures should be required. However, shoreline owners can help by confirming that the beetles are present and monitoring increases or decreases in purple loosestrife around the lake.

The buckthorn invasion of Fourth Lake Fen is being addressed by the Lake County Forest Preserve District, who plan to restore approximately 40-50 acres of the Fen in the near future.