2004 SUMMARY REPORT
of
EAST & WEST MEADOW LAKES

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

East & West Meadow Lakes, located in the village of Riverwoods, Vernon Township, are two small basins created when water flooded old gravel quarries. The lakes lie within the Des Plaines River floodplain and East Meadow Lake lies adjacent to land owned and maintained by the Lake County Forest Preserve District. East Meadow Lake (EML) has a surface area of 3.9 acres with mean and maximum depths of 6.3 and 3.2 feet, respectively. West Meadow Lake (WML) has a surface area of 3.8 acres with estimated mean and maximum depths of 6.2 and 3.1 feet, respectively. The watersheds of EML and WML are approximately 73.7 acres and 40.2 acres, respectively. The lakes are connected via a storm drain and West Meadow Lake flows into East Meadow Lake. They receive water primarily from runoff from residential areas surrounding them.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature and water clarity were measured and the plant community was assessed each month from May-September 2004. The total phosphorus (TP) concentration in EML (0.048 mg/L) was less than the county median (0.063 mg/L) and it appears that the TP concentrations are related to internal processes. Total suspended solids (TSS) concentrations were unchanged from May-July, increased in August and decreased again in September. Secchi depths (water clarity) followed TSS concentrations during the summer, increasing when TSS decreased. Conductivity in EML was higher than the county median and is thought to be related to springtime runoff, evaporation and loss of water volume by the end of the summer. The average TP concentration in WML (0.053 mg/L) was only slightly higher than EML and lower than the county median, but TSS concentrations were much higher than EML, indicating that some other factor is affecting the water quality of WML. Secchi depth followed TSS concentrations and the depths were much lower than the county median. WML also displayed high conductivity levels throughout the summer. Conductivity in May in WML appeared to be related to spring runoff but there was also an increase near the end of the summer that, as in EML, appears to be related to evaporation and loss of water volume.

Aquatic plants were nearly absent in both EML and WML. Both lakes are surrounded entirely by residential land, with a small amount of wooded Forest Preserve property to the east of EML. Both lakes displayed 20-30% erosion along their shorelines. Invasive plant species, including common buckthorn, purple loosestrife, honeysuckle, reed canary grass and yellow sweet clover were present along both shorelines. Steps should be taken to remove these plant species, as they do not provide quality wildlife habitat or erosion control. As a result of the dominance of residential habitat around the lakes, a low number of wildlife species were observed around East and West Meadow Lakes. It is, therefore, very important that the shoreline areas be naturalized and improved to provide appropriate habitat.

LAKE IDENTIFICATION AND LOCATION

East and West Meadow Lakes are located in the Village of Riverwoods, just north of Half Day Road (T 43N, R 11E, S 26). East Meadow Lake (EML) has a surface area of 3.9 acres, estimated mean and maximum depths of 3.2 feet and 6.3 feet, respectively, and an estimated volume of 12.22 acre-feet. The watershed of EML encompasses approximately 73.7 acres, draining West Meadow Lake and its watershed, and the area immediately surrounding it (Figure 1). West Meadow Lake (WML) has a surface area of 3.8 acres, mean and maximum depths of 3.1 feet and 6.2 feet, respectively, and a volume of 11.79 acre-feet. The watershed of WML encompasses approximately 40.2 acres, draining the area immediately surrounding it, as well as a retail shopping plaza to the west and part of Milwaukee Avenue (Figure 1). The watershed to lake surface area ratios of East and West Meadow Lakes are approximately 19:1 and 10:1, respectively. These are considered relatively small and are positive in that it may help prevent serious water quality problems that often accompany a larger watershed to lake ratio. However, lakes with small ratios often experience more severe water level fluctuations throughout the summer as well as the accumulation of solids and nutrients because lake retention time (the time it takes all the water in the lake to be replaced) is high. It takes approximately 58 and 88 days, respectively for all of the water volume of East and West Meadow Lakes to flush out of the lakes and be replenished by new water. This means the lakes flush four to five times per year and that solids and nutrients are not likely building up in the systems. Water level fluctuations during the summer 2004 were not large on West Meadow Lake, but were over 1.5 feet on East Meadow Lake. It is not clear why the lakes differed, and it is recommended that in the future, staff gauges be installed and readings be taken weekly or bi-weekly if possible. This will give lake managers a much better idea of lake level fluctuations relative to rainfall events and can aid in future decisions regarding lake level.

Based on the most recent land use survey of the East and West Meadow Lakes' watershed, conducted in 2000, residential areas dominate the watershed, making up approximately 61% of WML's and 67% of EML's watersheds (Figure 2). The lakes and a detention basin to the west make up 12-14% of each watershed (Table 1, Appendix A). The large amount of residential area that makes up the watersheds can be good or bad, depending on the activities of homeowners that live around the lake. If homeowners are educated about how their daily activities affect the lake and take steps to prevent additional sediment and nutrients from entering the water, there could be some improvement in water quality over time. However, if residents go about their daily activities with no regard as to how it may affect the lake, water quality could be degraded over time. West Meadow Lake outlets through a storm pipe to East Meadow Lake, which outlets to the Des Plaines River. The lakes are located in the Lower Des Plaines River sub basin, within the Des Plaines River watershed.

FIGURE 1

FIGURE 2

BRIEF HISTORY OF EAST AND WEST MEADOW LAKES

East and West Meadow Lakes were created as gravel quarries prior to the 1970's and were originally owned by Charles Russell. Development around the lakes began in 1978 and there are 13 homes on each lake. The lake association was formed in 1985 and comes together to manage the lakes with a small budget. The main uses of the lake are swimming and fishing with non-motorized boats.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

East and West Meadow Lakes have been treated with herbicides and algaecides by Aquatic Biologists, Inc. since 2001. Aquathol-K© was applied once per year from 2001-2003 in late May or early June to treat sago pondweed in both lakes. In 2004, Reward© was used along with Aquathol-K© in June to treat sago pondweed. Cutrine Plus© was applied twice per summer from 2001-2003 in May/July or June/August to treat planktonic algae. In 2004, only one application was carried out in June. On all occasions, nearly the entire lake was treated (2-3 acres).

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from EML and WML were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected near the surface from the deepest area of the lake (Figure 3). EML and WML remained mixed as a result of its shallow morphometry and the effects of wind and wave action across the lake. The surface waters of EML were well oxygenated all summer and dissolved oxygen (DO) concentrations remained above 5.0 mg/L (a level below which many aquatic organisms become stressed). However, DO concentrations near the surface of WML fell below 5.0 mg/l (a level below which many aquatic organisms become stressed) in July and remained low for the rest of the summer. The primary reason for the low DO concentrations the latter part of the summer is not known.

Phosphorus is a nutrient that can enter lakes through runoff or be released from lake sediment, and high concentrations of phosphorus typically trigger algal blooms or produce high plant density. The average total phosphorus (TP) concentration in EML was 0.048 mg/L, while WML had a TP concentration of 0.053 mg/L, both lower than the Lake County median of 0.063 mg/L (Table 2, Appendix A). TP concentrations for both lakes increased significantly between May and June, but then remained relatively consistent throughout the rest of the summer. The low TP concentration in May was likely the result of a high amount of precipitation. The increase in TP thereafter, when precipitation amounts were not as high, indicates that the source of phosphorus is internal and is likely coming from the lake sediment. Sediment resuspension due to carp activity and wind action on the lake may be releasing phosphorus back into the water column.

FIGURE 3

Total suspended solids (TSS) is a measure of the amount of suspended material, such as algae or sediment, in the water column. High TSS values are typically correlated with poor water clarity and can be detrimental to many aspects of the lake ecosystem, including the plant and fish communities. A large amount of material in the water column can inhibit successful predation by sight-feeding fish, such as bass, or settle out and smother fish eggs. High turbidity caused by sediment or algae can shade out native aquatic plants, resulting in their reduction or disappearance from the littoral zone. This eliminates the benefits provided by plants, such as habitat for many fish species and stabilization of the lake bottom. The average TSS concentrations in EML (11.4 mg/L), and in WML (17.7 mg/L) were higher than the median value for Lake County lakes (7.9 mg/L). TSS concentrations nearly doubled from July to August, before decreasing again in September. This corresponded with an increase in TP (Figure 4) as well as a ½ foot decrease in water level between July and August in EML. It appears that the source of TSS is also internal, that the TSS is primarily composed of resuspended sediment and that the large common carp population in the lakes is likely contributing to the resuspension of sediment. When the water level decreased, it concentrated TSS and TP into a smaller volume of water, increasing the measured amounts of both parameters. However, it appears that there is another unknown variable affecting TP and TSS. Although the water level decreased by another foot between August and September, TSS and TP decreased as well.

As a result of relatively low TP and TSS concentrations throughout the summer, average Secchi depth (water clarity) in EML (2.61 feet) and WML was just below the county median (3.08 feet) (Table 2, Appendix A). The virtual absence of plants in the lakes contributed to the high TSS and low Secchi depth. TSS and Secchi depth were closely related throughout the summer, with Secchi depth decreasing in response to an increase in TSS in August. Secchi depth may have been higher if more plants were present in the lakes. A diverse community of aquatic plants is beneficial to a lake in many ways, including stabilizing sediment to prevent resuspension, competing with planktonic algae for resources and providing habitat and a food base for a healthy fish community.

Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Conductivity has been shown to be highly correlated (in urban areas) with chloride ions found in road salt mixtures. Water bodies most subject to the impacts of road salts are streams, wetlands or lakes draining major roadways. Average 2004 conductivity in EML (0.9065 mS/cm) and in WML (1.0221 mS/cm) were much higher than the county median of 0.7652 mS/cm. Conductivity was highest in May, decreased dramatically in June and remained stable throughout the summer until it increased slightly in September. Typically, when road salt is the primary cause of an increase in conductivity, levels will be very high in May and June, when spring runoff brings a large amount of salt-laden water into the lake and then decreases throughout the summer. This appears to be the trend in both lakes. The higher conductivity in WML may be a result of the shopping center just to the west of the lake. This higher percent of impervious surface in WML's immediate watershed is likely contributing more salt directly to the lake during spring runoff. The slight increase in conductivity in EML for September is likely the result of evaporation and a decrease of water volume mentioned above. The high conductivity is cause for concern, however, non-point runoff, such as that which picks up road salt and enters the lake during rain events, is very difficult to control. Additionally, without a change in lake level or inflows, the low volume of water entering the lake due to the small watershed and high evaporation rate in the lake will continue to contribute to high conductivity readings.

FIGURE 4

FIGURE 5

Typically, lakes are either phosphorus (P) or nitrogen (N) limited. This means that one of these nutrients is in short supply relative to the other and that any addition of phosphorus or nitrogen to the lake might result in an increase of plant or algal growth. Other resources necessary for plant and algae growth include light or carbon, but these are typically not limiting. Most lakes in Lake County are phosphorus limited, but to compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than or equal to 10:1 indicate nitrogen is limiting. Ratios greater than or equal to 15:1 indicate that phosphorus is limiting. Ratios greater than 10:1, but less than 15:1 indicate that there are enough of both nutrients to facilitate excess algal or plant growth. EML had an average TN: TP ratio of 20:1, while WML had an average TN:TP ratio of 18:1. This indicates that the lakes were phosphorus limited, which means that, at times, there was not enough P in the water column to sustain algae growth and that any addition of P to the lakes could result in algae blooms.

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* (algae biomass) 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 moderate TSI value (TSI=40-49) indicates mesotrophic conditions, typically characterized by relatively low nutrient concentrations, low algae biomass, adequate DO concentrations and relatively good water clarity. High TSI values indicate eutrophic (TSI=50-69) to hypereutrophic (TSI ≥70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO levels, a rough fish population, and low water clarity. EML had an average phosphorus TSI (TSIp) value of 60 and WML had an average phosphorus TSI (TSIp) value of 61, indicating eutrophic conditions for both lakes. This means that the lake are enriched systems with relatively poor quality. EML and WML ranked 60th and 63rd, respectively, out of 161 lakes studied in Lake County since 2000 (Table 3, Appendix A).

Most of the water quality parameters just discussed can be used to analyze the water quality of EML based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, EML provides *Full* support of aquatic life and *Partial* of swimming and recreational activities as a result of high TP and non-volatile suspended solids (NVSS) concentrations in the water column. The lake provides *Partial* overall use. WML provides *Full* support of aquatic life and *Partial* of swimming and recreational activities also as a result of high TP and NVSS concentrations in the water column. The lake provides *Partial* overall use.

Figure 6.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See Appendix B for methodology). Shoreline plants of interest were also recorded. However, no quantitative surveys were made of these shoreline plant species and these data are purely observational. Light level was measured at one-foot intervals from the water surface to the lake bottom. When light intensity falls below 1% of the level at the water surface, plants are no longer able to grow. Based on 1% light level, EML and WML could have supported plants across the entire lake bottoms (Appendix C). However, very few plant species and very low plant density was observed in either lake. Only sago pondweed was naturally occurring in EWL. White water lily had been planted by several homeowners, but was not occurring naturally. Sago, leafy and small pondweeds were found in WML, but only in May and June and only in a few locations (Tables 4 & 5). The inability of aquatic plants to grow in all areas as determined by percent light level may be explained by the presence of inadequate substrate in many parts of the lake, as well as other factors such as herbicide treatments. Given the gravel quarry origin of the lake, there were many areas in which the substrate was very hard and full of both small and large rocks. This type of substrate is not ideal for plant growth, which typically does best in soft, organic substrate. Additionally, although there were very few plants found by our staff early in the summer, an herbicide treatment was carried out, targeting pondweed species. These treatments should be re-evaluated to determine if they are really necessary in East and West Meadow Lakes.

Of the 14 emergent and upland plant species observed along the shorelines of EML and WML, five (reed canary grass, purple loosestrife, honeysuckle, yellow sweet clover and buckthorn) are invasive species that do not provide ideal wildlife habitat.

Table 4. Aquatic and shoreline plants on East & West Meadow Lakes, May-September 2004.

<u>Aquatic Plants</u>	
East Meadow	
White Water Lily	*Nymphaea tuberosa*
Sago Pondweed	*Potamogeton pectinatus*
West Meadow	
Leafy Pondweed	*Potamogeton foliosus*
Sago Pondweed	*Potamogeton pectinatus*
Small Pondweed	*Potamogeton pusillus*
<u>Shoreline Plants</u>	
East Meadow & West Meadow	
Purple Loosestrife^	*Lythrum salicaria*
Yellow Sweet Clover^	*Melilotus officinalis*
Virginia Creeper	*Parthenocissus quinquefolia*
Reed Canary Grass^	*Phalaris arundinacea*
Tall Goldenrod	*Solidago gigantia*
Nannyberry	*Viburnum lentago*
Wild Grape	*Vitis* sp.
<u>Trees/Shrubs</u>	
East Meadow	
White Pine	*Pinus strobus*
Cottonwood	*Populus deltoides*
Common Buckthorn^	*Rhamnus cathartica*
Willow	*Salix* sp.
<u>Trees/Shrubs</u>	
West Meadow	
Silver Maple	*Acer saccharinum*
Red Osier Dogwood	*Cornus sericea*
Honeysuckle^	*Lonicera* sp.
White Pine	*Pinus strobus*
Cottonwood	*Populus deltoides*
Common Buckthorn^	*Rhamnus cathartica*
Willow	*Salix* sp.

^Exotic plant or tree species

FQI (Floristic Quality Index) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). Each floating or submersed aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of these plant species found in the lake. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2004 Lake County lakes is 14.3. EML has an FQI of 8.5 and ranked 122nd out of 150 lakes where aquatic plants have been studied, while WML has an FQI of 11.0 and ranked 103rd out of 150 lakes. These poor rankings reflect the lack of plant diversity in both lakes.

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at East and West Meadow Lakes on June 25, 2004. The shoreline was assessed for a variety of criteria (See Appendix B for methods), and based on these assessments, several important generalizations could be made. Both lakes are dominated by residential shoreline. 94% of EML's shoreline and 90% of WML's shoreline is developed. The developed shoreline of EML is dominated by an even combination of shrub (22%), woodland (23%), beach (20%) and buffer (20%) (Figure 7). Lawn, rip rap and seawall make up the remainder of the shoreline. The small amount of undeveloped shoreline on EML was classified as shrub. Although shrub, woodland and buffer are typically ideal shoreline types because they provide erosion control and wildlife habitat, if these types of shoreline are not maintained properly, they can lose their positive properties. The majority of the erosion occurring on EML was found along shrub, woodland and buffered shorelines (Figure 8). Additionally, without proper maintenance, these shoreline types can be overtaken by invasive plant species that do not provide the proper stabilization or habitat (see next paragraph). The shoreline of WML was more residential in nature and was dominated by beach (28%) and rip rap (27%). The rest of the developed shoreline was comprised of an even mix of shrub (9.5%), woodland (10%), lawn (10%), seawall (9%) and buffer (7%). The undeveloped shoreline was made up of woodland and overgrown rip rap (Figure 7). Erosion was occurring along 20% of the lake and was found along woodland and lawn areas (Figure 8). As mentioned above, it is very important to maintain wooded shorelines. Additionally, manicured lawn is considered undesirable because it provides a poor shoreline-water interface due to the short root structure of turf grasses. These grasses poorly of stabilize the shoreline which typically leads to erosion on most lakes. Erosion along all areas of the lake should be addressed immediately.

The invasive plant species mentioned above were present along 55% of EML's and 36% of WML's shorelines. Buckthorn, which provides poor shoreline stabilization and may

FIGURE 7

FIGURE 8

lead to increasing erosion problems in the future, was the dominant invasive species present and was primarily found along wooded areas of the shoreline. All other invasive species were found at very low densities. Although the plants and trees (with the exception of buckthorn) were scattered and only at a low density, they are extremely invasive and can exclude native plants from the areas they inhabit. Reed canary grass and purple loosestrife inhabit wetland areas and can easily out-compete native plants. Additionally, they do not provide the quality wildlife habitat or shoreline stabilization that native plants provide. Steps to eliminate invasive plant and tree species should be carried out in order to reduce competition with native species and enhance any wildlife habitat already present around East and West Meadow Lakes.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

A fish survey by the Illinois Department of Natural Resources (IDNR) has never been conducted on East and West Meadow Lakes and no known fish stocking of any kind has been carried out. Fish cribs, in the form of stacked pallets, were placed in WML sometime in the past five years. According to an avid fisherman living on West Meadow Lake, black crappie, bluegill, largemouth bass, catfish, walleye and hybrid sundfish are present in the lake. It is believed that common carp first infested the lake in 1989, when the Des Plaines River flooded into the lakes. Most lakefront residents view the large carp population as a negative aspect of the lake and are currently seeking a way to reduce the carp population.

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See Appendix B for methodology). As a result of the dominance of residential shoreline around East and West Meadow Lakes, a low number and diversity of wildlife species were observed on the lakes. Those species that were observed are those which have adapted well to urban environments (Tables 6 & 7). Therefore, it is very important that the woodland and shrub areas around the lakes be improved and maintained and that additional natural buffered areas be added in order to increase biodiversity. Due to a large goose population about four years ago, the residents of WML purchased a pair of breeding mute swans. The pair have successfully mated and produced several signets each year. The male, as is typical during nesting, was very aggressive and it appears that his presence has alleviated the Canada goose problem at this time.

Table 6. Wildlife species observed at East Meadow Lake, April-September 2004.

Birds	
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Green Heron	*Butorides striatus*
Eastern Pewee	*Contopus virens*
Blue Jay	*Cyanocitta cristata*
Catbird	*Dumetella carolinensis*
American Robin	*Turdus migratorius*
Starling	*Sturnus vulgaris*
Northern Cardinal	*Cardinalis cardinalis*
Amphibians	
American Toad	*Bufo americanus*
Bull Frog	*Rana catesbeiana*

Table 7. Wildlife species observed at West Meadow Lake, April-September 2003.

Birds	
Mute Swan	*Cygnus olor*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Great Egret	*Casmerodius albus*
Unknown Sandpiper	*Calidris* sp.
Blue Jay	*Cyanocitta cristata*
American Robin	*Turdus migratorius*
American Goldfinch	*Carduelis tristis*
Amphibians	
Bull Frog	*Rana catesbeiana*
Reptiles	
Painted Turtle	*Chrysemys picta*

EXISTING LAKE QUALITY PROBLEMS

- *Lack of a Quality Bathymetric Map*

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

- *Lack of Aquatic Vegetation*

One key to a healthy lake is a healthy plant community. East and West Meadow Lakes had virtually no aquatic vegetation present. The lake association is currently hiring an applicator to apply herbicides targeting pondweed species once per year. We were on the lake in early May and early June and observed only a few plants. In addition to the herbicide treatments, several areas of the lakes have very poor substrate for plant growth (because of the gravel origin of the lake). It is recommended that the plant management plan for East and West Meadow Lakes be re-evaluated to determine if herbicides are necessary. Instead of treating the lakes every year, regardless of plant density, lake managers may want to try to adjust herbicide treatments to only occur every other year or on an as needed basis.

- *Invasive Shoreline Plant Species*

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

- *Limited Wildlife Habitat and Shoreline Erosion*

Nearly 100% of East and West Meadow Lakes' shorelines are dominated by residential homes, which do not always encourage a diverse bird and animal community. Although many of the shorelines of these residential plots are made up of woodland, shrub and buffer, they are not well maintained and do not provide wildlife habitat. It is recommended that any residents who already have buffer consider widening their strips and those residents with wooded property improve and maintain those areas, removing buckthorn and addressing shoreline erosion. It is also recommended that those residents that do not have a buffer strip or are experiencing shoreline erosion consider planting at least a 10-20 foot wide strip of native plants along their shoreline. This could increase wildlife habitat, reduce the amount of nutrients and soil particles entering the lake and decrease shoreline erosion. Slight to moderate erosion is occurring along 28% of EML and 19% of WML, especially along areas dominated by woodland, shrub and lawn.

- *Excessive Numbers of Common Carp*

East and West Meadow Lakes became infested with common carp in 1989, when the Des Plaines River flooded the two lakes. Carp can have many negative impacts on a lake ecosystem, including (1) increasing TSS through resuspended sediment with their feeding and spawning activities, negatively affecting clarity and plants, (2) increasing TP in the water column through their feces and through resuspended sediment, (3) decreasing water clarity through higher TSS, (4) reducing the size and diversity of the plant community through their feeding activities and by reducing clarity and (5) negatively impacting the fish community by decreasing water clarity and impacting the plant community, which provides fish habitat. It is difficult to remove all carp during a rotenone treatment, and, typically, the lake can be repopulated within a few years. However, until the Des Plaines River floods again, the lakes could be relatively free of common carp after a rotenone treatment. Additionally, rotenone could be an affordable option because the lakes are small in size.

POTENTIAL OBJECTIVES FOR THE EAST AND WEST MEADOW LAKES MANAGEMENT PLAN

I. Create a Bathymetric Map, Including a Morphometric Table
II. Eliminate or Control Invasive Species
III. Enhance Wildlife Habitat Conditions
IV. Control Shoreline Erosion
V. Control Excessive Numbers of Carp

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

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

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

Objective II: Eliminate or Control Invasive Species

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

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

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

Option 1: No Action

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

Pros

There are few advantages with this option. Some of the reasons exotics were brought into this country are no longer used or have limited use. However, in some cases having an exotic species growing along a shoreline may actually be preferable if the alternative plant is commercial turfgrass. Since turfgrass has shallow roots and is prone to erosion along shorelines, exotics like reed canary grass or common reed (*Phragmites australis*) will control erosion more effectively. Native plants should take precedent over exotics when possible. Tables 8 & 9, Appendix A lists several native plants that can be planted along shorelines.

Cons

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

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

Costs

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

Option 2: Control by Hand

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

Pros

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

Cons

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

Costs

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

Option 3: Herbicide Treatment

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

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

Pros

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

Cons

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

Costs

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

Objective III: Enhance Wildlife Habitat Conditions

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

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

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

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

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

Pros

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

Cons

If environmental conditions change or substantial land use actions occur (i.e., development) wildlife use of the area may change. For example, if a new housing development with manicured lawns and roads is built next to an undeveloped property, there will probably be a change in wildlife present.

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

Costs

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

Option 2: Increase Habitat Cover

This option can be incorporated with Option 3 (see below). One of the best ways to increase habitat cover is to leave a minimum 25-foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes (see Table 8 & 9, Appendix A for costs and seeding rates). This will provide cover from predators and provide nesting structure for many wildlife species and their prey. It is important to control or eliminate non-native plants such as buckthorn, purple loosestrife, garlic mustard, and reed canary grass, since these species outcompete native plants and provide little value for wildlife.

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

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

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

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

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

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

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

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

Option 3: Increase Natural Food Supply

This can be accomplished in conjunction with Option 2. Habitats with a diversity of native plants will provide an ample food supply for wildlife. Food comes in a variety of forms, from seeds to leaves or roots to invertebrates that live on or are attracted to the plants. Plants found in Tables 8 & 9, Appendix A should be planted or allowed to grow. In addition, encourage native aquatic vegetation, such as water lily (*Nuphar* spp. and *Nymphaea tuberosa*), sago pondweed (*Stuckenia pectinatus*), largeleaf pondweed (*Potamogeton amplifolius)*, and wild celery (*Vallisneria americana*) to grow. Aquatic plants such as these are particularly important to waterfowl in the spring and fall, as they replenish energy reserves lost during migration.

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

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

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

Pros

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

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

Cons

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

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

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

Costs

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

Option 4: Increase Nest Availability

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

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

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

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

Pros

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

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

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

Cons

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

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

Costs

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

Objective IV: Control Shoreline Erosion

Erosion is a potentially serious problem to lake shorelines and occurs as a result of wind, wave, or ice action or from overland rainwater runoff. While some erosion to shorelines is natural, human alteration of the environment can accelerate and exacerbate the problem. Erosion not only results in loss of shoreline, but negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. This effect is felt throughout the food chain since poor water quality negatively affects everything from microbial life to sight feeding fish and birds to people who want to use the lake for recreational purposes. The resulting increased amount of sediment will over time begin to fill in the lake, decreasing overall lake depth and volume and potentially impairing various recreational uses. East and West Meadow Lakes have slight to moderate erosion along 29% and 19% of their shorelines, respectively. The erosion on EML is concentrated along shrub, woodland, buffer and manicured lawn. The erosion on WML is concentrated along woodland, beach and manicured lawn. The lake association should address those small areas that are eroded or could become eroded in the future.

Option 1: No Action

Pros

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

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

Cons

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

Costs

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

Option 2: Create a Buffer Strip

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

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

Buffer strips can be constructed in a variety of ways with various plant species. Generally, buffer strip vegetation consists of native terrestrial (land) species and emergent (at the land and water interface) species. Terrestrial vegetation such as native grasses and wildflowers can be used to create a buffer strip along lake shorelines. Table 8, Appendix A gives some examples, seeding rates and costs of grasses and seed mixes that can be used to create buffer strips. Native plants and seeds can be purchased at regional nurseries or from catalogs. When purchasing seed mixes, care should be taken that native plant seeds are used. Some commercial seed mixes contain non-native or weedy species or may contain annual wildflowers that will have to be reseeded every year. If purchasing plants from a nursery or if a licensed contractor is installing plants, inquire about any guarantees they may have on plant survival. Finally, new plants should be protected from herbivory (e.g., geese and muskrats) by placing a wire cage over the plants for at least one year.

Emergent vegetation, or those plants that grow in shallow water and wet areas, can be used to control erosion more naturally than seawalls or rip-rap. Native emergent vegetation can be either hand planted or allowed to become established on its own over time. Some plants, such as native cattails (*Typha* sp.), quickly spread and help stabilize shorelines, however they can be aggressive and may pose a problem later. Other species, such as those listed in Table 8, Appendix A should be considered for native plantings.

Pros

Buffer strips can be one of the least expensive means to stabilize shorelines. If no permits or heavy equipment are needed (i.e., no significant earthmoving or filling is planned), the property owner can complete the work without the need of professional contractors. Once established (typically within 3 years), a buffer strip of native vegetation will require little maintenance and may actually reduce the overall maintenance of the property, since the buffer strip will not have to be continuously mowed, watered, or fertilized. Occasional high mowing (1-2 times per year) for specific plants or physically removing other weedy species may be needed.

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

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

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

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

Cons

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

Costs

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

Objective V: Controlling Excessive Numbers of Carp

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

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

There are several techniques to remove carp from a lake. However, rarely does any technique completely eradicate carp from a lake. Commonly, once a lake has carp, it has carp forever. However, it is up to the management entity to dictate how big the problem is allowed to become. Rotenone is the only reliable piscicide (fish poison) on the market at this time, but it kills all fish that 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, we do not recommended it at this time.

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

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

Pros

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

Cons

There are many negative aspects to a no action management plan for carp management. The feeding habits of carp cause most of the associated problems.

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

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

Costs
There is no cost associated with the no action option.

Option 2: Rotenone

Rotenone is a piscicide that is naturally derived from the stems and roots of several tropical plants. Rotenone is approved for use as a piscicide by the USEPA and has been used in the U.S. since the 1930's. It is biodegradable (breaks down into 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 non-fish 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 additional rotenone treatments need 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

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. Because of the proximity and similar water quality of East and West Meadow Lakes, an alternative option is to remove a large number of sport fish from one lake and place them in the other lake, complete the rotenone treatment and then replace the sport fishery to the original lake. This method was carried out in Lindenhurst in the fall of 1999 on Waterford Lake and Lake Linden. Waterford Lake was electroshocked by a hired contractor and largemouth bass and bluegill were removed. They were placed in a saline holding tank (two tablespoons salt per gallon of water) to kill any carp eggs that might be attached to the fish. They were then released into Lake Linden, a smaller lake adjacent to Waterford Lake and similar in water quality. In October 1999, Waterford Lake was drawndown three feet and treated with Rotenone. Approximately 45 days later, minnow species were placed in the lake in various locations to test the potency of the rotenone remaining in the lake. Because a large number of these minnows died, it was determined to wait until Spring 2000 to restock the lake. In the spring, Lake Linden was electroshocked and large sized largemouth bass and bluegill were restocked into Waterford Lake. Additionally, fathead minnow (guaranteed carp-free) and YOY bluegill were stocked to provide a forage base for the largemouth bass.

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. 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 offset with lake draw down to reduce treatment volume.

The water clarity of East and West Meadow Lakes will likely increase dramatically after reduction of the carp population with a rotenone treatment. If there is an adequate aquatic plant seed bank in the lakes, it is possible that the plant community could recover. This could further increase the water clarity by stabilizing bottom sediment and filtering incoming sediment and soil particles in the water column, as well as provide quality habitat for the newly revived fishery. If the plant community begins to reach nuisance levels that impede recreational activities or cause fish stunting due to overpopulation of small panfish, it is recommended that LIMITED herbicide spot treatments are carried out to maintain the plant community at a non-nuisance level without eradicating plants from the lakes.

Costs

As with most intensive lake management techniques, a good bathymetric map is needed so that an accurate lake volume can be determined. This typically costs \$3,000 per lake to create, but the small sizes of East and West Meadow Lakes may reduce this cost considerably. To achieve a concentration of 6 ppm, which is the rate needed for most total rehabilitation projects (remove carp, bullhead and green sunfish), 2.022 gal/AF is required.

(Lake volume in Acre Feet)(2.022 gallons) = Gallons needed to treat lake

(Gallons needed)(Cost/gallon*) = Total cost

*Cost/gallon = $50-75 range

The following are estimates, as a quality bathymetric map is required to determine lake volume. Additionally, this does not include labor costs for electroshocking or carp removal (no labor charges are associated with the application of rotenone by the IDNR). Carp removal and clean-up could be completed by lake volunteers. Costs may be reduced by drawing down the water level of the lakes.

EAST MEADOW:
(12.22 acre feet)(2.022 gal.) = 24.71 gallons
(24.71 gallons) ($50-75/gallon) = $1, 235.44-$1,853.25

WEST MEADOW:
(11.79 acre feet)(2.022 gal.) = 23.84 gallons
(23.84 gallons) ($50-75/gallon) = $1, 191.97-$1,788.00

In waters with high turbidity and/or planktonic algae blooms, the ppm may have to be higher. A IDNR fisheries biologist will be able to determine if higher concentrations will be needed. In order to prevent the early re-infestation of carp to the lakes, it is advisable that no live bait be permitted when fishing.