2000 SUMMARY REPORT
of
SAND POND

Lake County, Illinois

Prepared by the

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Lake Name: Sand Pond

State: IL

County: Lake

Nearest Municipality: Zion

Township/Range: T 46N, R 12E, Section 15 DE ¼

Basin Name: Lake Michigan Watershed

Subbasin Name: Dead River Watershed

Major Tributaries: Kellogg Creek

Receiving Water Bodies: Lake Michigan

Surface Area: 19.9 acres

Shoreline Length: 0.7 miles

Maximum Depth: 9.6 feet

Mean Depth: 4.8 feet

Storage Capacity: 95.50 acre-feet

Lake Type: Impoundment (flooded sand/gravel pit)

The contour of Sand Pond is divided into two oblong bowls connected by a shallow saddle that runs north and south. The deepest point is in the northeastern portion of the eastern bowl, which deepens dramatically and quickly from the shore/saddle to its deepest spot. The western bowl of the lake gradually deepens to a large five-foot shelf. The depths along the saddle range from three feet, in the center, to five feet towards the shore in either direction. This description of the morphometry of the lake is based on depth measurements taken during the 2000 water quality study. The bathymetric map created in 1987 by the Illinois Natural History Survey is not consistent with this description and it is recommended that this map be reviewed and, possibly, recreated.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Sand Pond were analyzed for a variety of water quality parameters (See *Appendix A* for methodology). Samples were collected at 3 foot and 7 foot depths from the deep hole location in the lake (Figure 1). Sand Pond did not thermally stratify 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 (Dissolved Oxygen (DO)=0.0 mg/l) by mid-summer. The absence of stratification was determined by assessing the water quality data, which showed that concentrations of most parameters collected from shallow water samples were similar to those same parameters collected from deep water samples, especially with regard to temperature and dissolved oxygen concentrations. Although a small volume of water in the deepest areas of Sand Pond became hypoxic (DO<1.0 mg/l) in August, the lake was mixed and oxygenated throughout most of the summer. As a result, only data from the epilimnetic samples will be discussed.

The low dissolved oxygen concentrations in the lake during June and July were, likely, the result of a die-off of a high density of Eurasian watermilfoil in late June after a herbicide application. Due to the immense amount of vegetation present and the fact that the entire lake was treated at the same time, dissolved oxygen was used up quickly by the decomposition of the Eurasian watermilfoil. This resulted in DO concentrations below 5.0 mg/l at the water surface in July and near the bottom in June, July and August. These relatively low DO concentrations are stressful to many sport fish, and are especially stressful to trout, which require well-oxygenated water to thrive. The artificial aerator located in the center of the lake was built and installed in 1983 by IDNR staff, and one diffuser is running on 1/3 horsepower (HP). According to our calculations, this aerator is undersized. Recommendations regarding the aeration of Sand Pond can be found under *Existing Lake Quality Problems and Management Suggestions* (p. 6). The complete data set for Sand Pond is located in Table 1. Below is a continued discussion of the analysis of the water quality data collected over the five month study of Sand Pond.

Overall, Sand Pond has excellent water quality. The average concentration of phosphorus, a nutrient that can trigger algal blooms, was low (0.023 mg/l), and was well below the Lake County average of 0.066 mg/l (1995-2000). It is possible that much of the phosphorus in the lake was being taken up and stored by the Eurasian watermilfoil. Average total suspended solids (TSS) in Sand Lake were 1.58 mg/l, over five times lower than the Lake County average. In general, all of the solids measured (total volatile and nonvolatile solids, total dissolved solids) were low. As a result, Secchi depths in Sand Pond were higher than average (5.0 feet) throughout the summer and increased from 5.0 feet in May to over 7.0 feet from June through September. The high Secchi depths and low solids measurements were due to a high density of aquatic plants, which compete with algae for resources and prevent the resuspension of sediment from the lake bottom by wave and wind action.

Another measure of water quality is nutrient (nitrogen and phosphorus) levels. 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. Sand Pond had a TN:TP ratio of 43:1. 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 this pond.

The current small source of phosphorus to Sand Pond appears to be internal. Fluctuations in phosphorus levels in the epilimnion did not coincide with varying rainfall levels from month to month, as would be expected if the source of phosphorus was external. Phosphorus increases in the lake may have occurred internally by either chemical or biological mechanisms. Chemical reactions at the sediment surface, triggered by the loss of oxygen in bottom waters in August, may have resulted in some phosphorus release from the sediment. Biological sources of phosphorus may have included plant senescence. Phosphorus taken up from sediments through plant roots is distributed through the plant to its leaves and stem. While they are living, plants will slowly release a dissolved form of this phosphorus, which is readily available to algae or other plants. However, when plants die and begin to decompose, a large amount of dissolved phosphorus will be rapidly released from the plants back into the water column. Eurasian watermilfoil died as a result of the herbicide application in late June and early July. The decomposition of the very dense beds of Eurasian watermilfoil may have released the relatively small amount of phosphorus observed in the water column of Sand Pond.

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 $\geq$70) lake conditions. Sand Pond has a phosphorus TSI value of 49.4, indicating mesotrophic conditions. This means that the lake is a moderately productive system with relatively low nutrient levels, low algal biomass and good water quality. However, lakes with high plant densities can often 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 Sand Pond may have been higher. Regardless, the TSI of the pond is better than most lakes in Lake County, where the majority of man-made lakes fall into the eutrophic and hypereutrophic categories. In fact, Sand Pond ranked 13^{th} of 86 lakes in the county based on phosphorus TSI values (Table 2).

Most of the water quality parameters just discussed can be used to analyze the water quality of Sand Pond based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Sand Pond 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 Sand Pond varied between 8.0 feet and the lake bottom throughout the summer, suggesting that plants could grow on nearly 100% of the lake surface area.

The aquatic plant population in Sand Pond was very unbalanced. Eurasian watermilfoil and *Chara* dominated, occurring in 75% and 68% of the sampling sites, respectively, throughout the summer. Small densities of three other plant species (curly leaf pondweed, horned pondweed and sago pondweed) were found only during May and June. Only Eurasian watermilfoil and *Chara* were found during plant surveys in July and September, while Eurasian watermilfoil, *Chara* and a very small amount of slender naiad were found in August (Tables 3 & 4). The lack of plant diversity was the result of an herbicide treatment (5 gallons Diquat) in late June which killed the native plants in the lake, as well as the Eurasian watermilfoil. Eurasian watermilfoil had sustained extensive damage due to the presence of a large population of the milfoil weevil (*Euhrychiopsis lecontei*) in Sand Pond by the end of June, and may have crashed naturally by the end of July. However, once the milfoil was knocked back in late June and throughout July by the herbicide treatment, the weevils either perished or moved on to another lake. Additionally, despite the herbicide application, the Eurasian watermilfoil had returned to its original density by August. *Chara*, a macroalgae, was not damaged by the herbicide, which only affects higher plants (Table 4).

Table 3: Aquatic Plants on Sand Pond, May-September 2000

Aquatic Plants	
Chara	*Chara* sp.
Eurasian watermilfoil	*Myriophyllum spicatum*
Slender naiad	*Najas flexilis*
Curlyleaf pondweed	*Potamogeton crispus*
Sago pondweed	*Potamogeton pectinatus*
Horned pondweed	*Zannichellia palustris*

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

Due to the absence of developed areas on Sand Pond, a shoreline assessment was not conducted during the 2000 study. The immediate watershed consists of prairie and hardwood forest. Farther east, the topography becomes dominated by sand dunes, with more prairie plants and fewer trees. The type of shoreline present along Sand Pond is very desirable and buffers the lake by filtering nutrients and sediment from runoff before they reach the lake.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Rainbow trout and channel catfish have been stocked in the pond each year for the past 10 years. Fisheries assessments were carried out in 1993, 1994 and 1997. Largemouth bass were stocked each year through 1994, at which time the fishery assessment determined that efforts to maintain a structured largemouth bass population through stockings had been futile based on a lack of recruitment. From 1992-1994, 15.0 gallons of Diquat was applied to the lake each summer. In 1995, 4.0 quarts of Sonar™ were applied at a concentration of 17 ppb. The effects lasted through 1997. In 1998, another application of Sonar™ at the same concentration was applied. The effects lasted until 2000, when 5 gallons of Diquat were applied to control Eurasian watermilfoil.

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See *Appendix A* for methodology). All observations were visual and several types of waterfowl were observed over the course of the study (Table 5). Wildlife habitat in the form of prairie and forest was good around Sand Pond, and the diversity of waterfowl observed during the 2000 study was proof of that. In fact, both state threatened and state endangered waterfowl species 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 5: Observed Wildlife Species on Sand Pond, May-September 2000

Birds

Pied-billed Grebe+	*Podilymbus podiceps*
Canada Goose	*Branta canadensis*
Mallards	*Anas platyrhnchos*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Osprey*	*Pandion haliaetus*
Purple Martin	*Progne subis*
Red-winged Blackbird	*Agelaius phoeniceus*

+Threatened in Illinois
***Endangered in Illinois**

Existing Lake Quality Problems And Management Suggestions

Highpoints of the lake

A. Good Water Quality/Clarity
B. Isolated Location/Limited Access
C. Sandy Bottom
D. Natural Shoreline Buffer
E. Presence of Milfoil Weevils

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. Sand Pond does have a bathymetric map. However, it is outdated (1987), conflicts with depth measurements made during the summer of 2000, 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 consultants for costs that vary from $3,000-$10,000, depending on lake size.

- *Low Dissolved Oxygen*

Due to its shallow morphometry and the massive biological oxygen demand required when Eurasian watermilfoil began decomposing after herbicide application, Sand Pond experienced low dissolved oxygen levels throughout the lake in June and July, and in bottom waters during August. Low DO levels can cause fish stress and, if continual, can eventually lead to fish mortality. This is especially true for the rainbow trout stocked in Sand Pond. These low DO concentrations occurred despite the continuous operation of an aerator in the center of the lake. It has been determined by calculations which incorporate lake size and aerator power, that the aerator in Sand Pond is undersized by as much as 1.7 HP. This means that 4-6 times the current HP would be required to completely mix and oxygenate the lake. If the trout population is to flourish in Sand Pond, the IDNR should consider purchasing (or making) an adequately sized aerator (1.4-2.0 HP), and possibly increasing the number of diffusers in the lake. The diffusers should also be placed in a deep area of the lake. The current diffuser is at a depth of approximately 5.0 feet. Placing several diffusers in deeper areas will completely mix the water column and increase total dissolved oxygen throughout the lake. We also recommend turning off the current aerator and monitoring DO and temperature to determine if it is having any effect or is even necessary.

- *Nuisance Plant Species*

One key to a healthy lake is a healthy aquatic plant community. Sand Lake is plagued by nuisance densities of the exotic plant species, Eurasian watermilfoil (covering approximately 85% of the surface area of the lake). The density of these plants is, most likely, negatively impacting the plant and fish communities, and severely hampering recreational fishing activities on the lake. In order to improve Sand Pond, Eurasian watermilfoil densities must be reduced. In 2000, this was observed to be occurring naturally. The milfoil weevil, *Euhrychiopsis lecontei*, was present in high densities on the Eurasian watermilfoil in May and June and had caused severe damage to the plants. Unfortunately, application of an herbicide treatment of Diquat in late June killed all of the Eurasian watermilfoil. The weevils were then forced to move to another lake or perish with the plants. A return of the milfoil in August indicated that the Diquat was a very short-term solution to the milfoil problem.

During the week of June 4, 2001, 5 gallons of Diquat were applied to Sand Pond to treat the Eurasian watermilfoil present. It is recommended that no additional treatment be carried out during the summer of 2001 and that herbicide treatments be withheld from Sand Pond in 2002 in order to determine if the milfoil weevils return. Sand Pond presents an ideal habitat for these weevils, who not only need a healthy amount of milfoil to feed upon, but a natural shoreline upon which to overwinter. As a result, the weevil population in the pond in 2000 was large and thriving, slowly damaging and reducing the Eurasian watermilfoil. If the pond is left untreated, we believe that the weevils will return and could serve as a long-term biological control for the Eurasian watermilfoil, reducing, and eventually eliminating, the need for aquatic herbicides in Sand Pond. This will not only save the IDNR money, but will produce a healthier, more diverse plant community and improve fishery health in the pond. If aquatic herbicides are required while the milfoil is being reduced by the weevil, spot treatments of 2,4-D (which typically has better results on milfoil than Diquat) are suggested. This herbicide could be applied in slow release pellet form in order to reduce chemical drift. If spot treatments were made around the edge of the lake or in several non-continuous areas throughout the lake, approximately 4 acres should be treated. At a cost of $350-$425 per surface acre, the cost to spot treat Sand Pond would be approximately $1,400-$1,700 (as opposed to the approximately $6,500 currently being used to treat 15 acres of the lake with Diquat). Additionally, if Sonar™ is ever applied to Sand Pond again (this is not recommended, as it would remove the weevil population), a much lower application concentration is highly recommended. Concentrations as low as 6-8 ppb (less than half of the current application rate of 17 ppb) have been very effective at removing Eurasian watermilfoil, while leaving more desirable pondweed species to serve as fish habitat. At the current rate of 17 ppb, all vegetation is removed, an undesirable situation for any fish community. Therefore, a reduction in this application concentration is highly recommended if Sonar™ is ever used again.