

**2000 SUMMARY REPORT
of
Broberg Marsh**

Lake County, Illinois

Prepared by the

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TABLE OF CONTENTS

LAKE IDENTIFICATION AND LOCATION	3
LIMNOLOGICAL DATA	
Water Quality	4
AQUATIC Plant Assessment	6
Shoreline Assessment	7
Wildlife Assessment	7
EXISTING LAKE QUALITY PROBLEMS AND MANAGEMENT SUGGESTIONS	9
TABLES AND FIGURES	
APPENDIX A: METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES	
APPENDIX B: MULTIPARAMETER DEPTH PROFILES	

LAKE IDENTIFICATION AND LOCATION

Lake Name: Broberg Marsh

State: IL

County: Lake

Nearest Municipality: Wauconda

Township/Range: T44N, R9E, Section 30, NW ¼

Basin Name: Fox River Watershed

Subbasin Name: Slocum Lake Drain

Major Tributaries: None

Receiving Water Bodies: Wauconda Bog

Surface Area: 87.9 acres

Shoreline Length: 2.1 miles

Maximum Depth: 5 feet

Mean Depth: 2.5 feet

Storage Capacity: Unknown

Lake Type: Marsh

Watershed Area: Unknown

LIMNOLOGICAL DATA – WATER QUALITY

Water quality samples were collected at the deep hole location between one and three feet from the surface from May through September (Figure 1). The complete water quality data set is located in Table 1.

Dissolved oxygen (D.O.) levels were dangerously low (at or below 5.0 mg/L) in July and September. This was despite an aerator that operates for several hours a day. These low D.O. levels can cause fish stress. Continual stress can eventually lead to mortality. These oxygen levels are characteristic of natural, boggy areas such as Broberg due to high biological oxygen demand (B.O.D.) from decomposition and other biological processes. These low oxygen levels are not problematic unless sport fishing is a management concern. Many non-game fish species are able to withstand these low oxygen conditions. Although, not high quality ones (i.e., T/E species need well-oxygenated conditions). However, Broberg Marsh is a natural area where sport fishing is a low priority so low D.O. levels are not of high concern.

Overall Broberg Marsh has *average* water quality. Measurements of the different types of solids; total dissolved solids (TDS), total solids (TS), and total volatile solids (TVS), were all well below the county average. Average TS (218 mg/L) was two times lower than the County average (438 mg/L). Average TDS concentrations (195 mg/L) were also two times lower than the County average (407 mg/L). Additionally, conductivity levels (0.3133 MilliSiemens/cm), which are closely related to TDS, were very good (Lake County average is 0.6683 MilliSiemens/cm) as it does not receive large quantities of chlorides, etc. Interestingly, nonvolatile suspended solids (NVSS) were elevated. NVSS is the part of TSS that is related to sediment particles. Elevated NVSS concentrations could be due to the shallow morphometry of marsh, which allows for sediment resuspension by wind and wave action. Additionally, the water quality-sampling site was located adjacent to a large storm water outlet in the western bay. Storm water can carry large amounts of sediment, which results in elevated NVSS concentrations. Visual observations showed that water clarity drastically improved away from the storm drain (and water quality-sampling site). Additionally, other parameters such as pH and alkalinity were near the County average. However, during several months of the study several parameters such as pH and nitrogen (NO_3 and NH_4) were above average, which negatively affects the overall water quality of Broberg Marsh.

Another measurement of water quality is nutrient levels. Algae need light and nutrients, most importantly carbon, nitrogen (N) and phosphorus (P), to grow. Light and carbon are not normally in short supply (limiting). This means that nutrients (N&P) are generally the limiting factors in algal growth. To compare the availability of these nutrients, a ratio of total nitrogen to total phosphorus is used (TN: TP). Ratios < 10:1 indicate nitrogen is limiting. Ratios of >15:1 indicate phosphorus is limiting. Ratios >10:1, <15:1 indicate that there is enough of both nutrients for excessive algal growth. Broberg Marsh has a TN:TP ratio of 21:1, which means that the lake is phosphorus limited. Average phosphorus levels in Broberg Marsh were 0.08 mg/L (Lake County average is 0.06 mg/L). However, May phosphorus concentrations were much higher than the rest of the

summer, which skewed the average. Without the May data, the average TP concentration is 0.06 mg/L, which is on par with the County average. Problematic algae growth usually starts to occur at levels of 0.05 mg/L and above. However, Broberg Marsh experienced less algae growth than would be expected with its phosphorus concentrations. This was largely due to the massive amounts of aquatic vegetation and macro algae (see *Limnological Data - Aquatic Plant Assessment*), which out compete the algae for available resources. Total Kjeldahl Nitrogen levels in Broberg was at or below the County average. Average nitrate (NO₃) levels in Broberg (0.066 mg/L) were well below the County average (0.201 mg/L).

Another way to look at phosphorus levels and how they affect productivity of the lake is to use a Trophic State Index (TSI) based on phosphorus. TSI values are commonly used to classify and compare lakes productivity levels (trophic state). The higher the phosphorus levels the greater amount of algal biomass, which then results in a higher TSI and corresponding trophic state. Based on a TSI phosphorus value of 67, Broberg Marsh is classified as eutrophic (>50, <70 TSI). A eutrophic lake is defined as an over productive system that has above average nutrient levels and high algal biomass (growth). Due to its wetland nature and high plant biomass, Broberg Marsh is naturally a highly productive system and is eutrophic. Based on a phosphorus TSI, Broberg Marsh ranks 62nd out of 87 lakes studied by our unit from 1988-2000 (Table 2).

Water quality is partially affected by external inputs such as runoff, stream inflow, etc. If these sources are of poor quality, water quality will be negatively effected. Broberg Marsh receives an appreciable amount of its water from runoff from rainfall. Over the course of the study, water levels increased by as much as 9" from May to July. This coincides with rainfall data that shows that in June and July there was substantial rainfall (Figure X). The largest decrease in water level occurred from August to September (9"), which coincides with rainfall amounts that were low during this period. Most runoff that enters Broberg must first flow through the wetland fringe before entering Broberg proper. However, some inputs (including discharge from storm water outlets) flow directly into Broberg. As mentioned previously, there is a large outlet in the western bay with the possibility of other smaller outlets around the more developed western edge of the marsh. The runoff from these storm water pipes is of questionable quality and could be having a negative impact on the quality of Broberg.

TSI values along with other water quality parameters can be used to make other analysis of Broberg Marsh based on use impairment indexes and water quality standards established by the Illinois Environmental Protection Agency (IEPA). There are several water quality standard impairments on Broberg Marsh. These included impairments based on phosphorus, nitrogen, pH, D.O., suspended solids, and noxious aquatic plant growth. However, many of these impairments are to be expected considering Broberg's wetland nature. Based on EPA use indices, Aquatic Life Use was listed at *Full*, Swimming Use was listed at *Partial*, and Recreation Use was listed at *Nonsupport* with Overall Use listed as *Partial* support. These impairments are of little concern since Broberg is not recreationally utilized.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for duration of the study (*Appendix A* for methodology). The extent to which these plants grow is largely dictated by light availability. Plants need at least 1% of surface light levels in order to survive. Due to the shallow nature of Broberg Marsh, light was able to penetrate all the way to the bottom and plants were able to grow throughout the lake regardless of depth. However, we found that plants did not grow in all areas of the lake. The main beds of submersed of aquatic plant growth was at the western side of the marsh. The further east in the marsh, the fewer submersed aquatic plants. This is largely related to depth (Broberg becomes more shallow in the eastern 2/3^{rds}) and sediment type (more flocculent in the eastern 2/3^{rds}). Both of these conditions are not conducive to submersed aquatic plant growth.

Broberg Marsh has average species diversity (Table 3). This was partially due to excessive growth of a few species, in addition to the shallow nature of the marsh. The most common aquatic plant species found in Broberg Marsh were leafy pondweed and sago pondweed. These two plants were wide spread throughout the western bay. Additionally, the macroalga *Chara* was also widespread in the western bay. The growth of these three species was very dense. However, due to the natural, low use nature of Broberg, the extent of this growth is inconsequential. Furthermore, due to the factors listed above, nuisance submersed aquatic plant growth is limited to the western third of the marsh.

Table 3. Aquatic Plants Found in Broberg Marsh (May – September 2000).

<u>Aquatic Plants</u>	
Coontail	<i>Ceratophyllum demersum</i>
American Elodea	<i>Elodea canadensis</i>
Common Duckweed	<i>Lemna minor</i>
Star Duckweed	<i>Lemna trisulca</i>
Giant Duckweed	<i>Spirodella polyrhiza</i>
Watermeal	<i>Wolffia columbiana</i>
Slender Riccia	<i>Riccia fluitans</i>
Slender Naiad	<i>Najas flexilis</i>
Curly Leaf Pondweed	<i>Potamogeton crispus</i>
Leafy Pondweed	<i>Potamogeton foliosus</i>
Flatstem Pondweed	<i>Potamogeton zosterifomis</i>
Sago Pondweed	<i>Stuckenia pectinatus</i>
Common Bladderwort	<i>Utricularia vulgaris</i>
<u>Macroalga</u>	
Chara	<i>Chara</i> sp.

Table 3. Aquatic Plants Found in Broberg Marsh (May – September 2000) (cont).

<u>Emergent Plants</u>	
Purple Loosestrife	<i>Lythrum salicaria</i>
Reed Canary Grass	<i>Phalaris arundinacea</i>
Common Reed	<i>Phragmites australis</i>
Water Smartweed	<i>Polygonum amphibium</i>
Common Arrowhead	<i>Sagittaria latifolia</i>
Grass-leaved Arrowhead	<i>Sagittaria graminea</i>
Hardstem Bulrush	<i>Scirpus acutus</i>
Chairmaker's Rush	<i>Scirpus americanus</i>
Common Bur-Reed	<i>Spaganium eurycarpum</i>
Common Cattail	<i>Typha latifolia</i>

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

Shoreline assessments were not conducted on Broberg Marsh during the study. This was due to the nature of shoreline. The actual shoreline (cattail-shore interface) was difficult to access and was not evaluated. The water-cattail interface does not experience erosion or other problems that plague normal shorelines. A major concern with regards to “shoreline” on Broberg Marsh is the continual encroachment by cattails. Broberg Marsh is at an elevated risk of encroachment due to the expansive, shallow shelf around the perimeter of the lake. The current extent of the cattails should be maintained and expansion should not be allowed. This will help to slow the gradual filling in of the shallow areas of Broberg Marsh. Another major concern is eliminating/preventing the spread of invasive species, which were observed at scattered locations around the lake.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling activities. All observations were visual. Several types of waterfowl were observed during the course of the study (Table 4). Included in these were three Illinois threatened and endangered species (Table 4). These included the yellow-headed black bird and black tern. Broberg is one of the few know nesting locations of these two bird species in Lake County. Overall, Broberg Marsh provides excellent habitat for waterfowl and is the marsh's single best attribute. The healthy populations of cattails and burreeds provide good habitat for a variety of bird species. Additionally, there are several shrub areas in and around the marsh that provide habitat for smaller bird and mammal species

(such as beaver and mink). There was a low occurrence of nuisance species such as purple loosestrife, reed canary grass, and buckthorn. These plants are seldom used by wildlife for food or shelter. When possible they should be eliminated before they spread and displace other native and more desirable plant species.

As stated above, due to the low D.O. levels in the lake, the presence of quality game fish is limited. However, Broberg Marsh may contain many non-game fish species including. Fishery studies would need to be conducted in order to determine the condition of the fishery in Broberg. Historically, Broberg has experienced fish kills due to low D.O. Most recently, a fish kill involving carp and bullhead (probably the only major fish species left in Broberg) occurred January 16, 2001.

Table 4. Observed Wildlife Species on Broberg Marsh (May – September 2000).

Amphibians

Bull Frog	<i>Rana catesbeiana</i>
Leopard Frog	<i>Rana pipiens</i>

Birds

Pied-billed Grebe+	<i>Podilymbus podiceps</i>
Canada Goose	<i>Branta canadensis</i>
Wood Duck	<i>Aix sponsa</i>
Mallard	<i>Anas platyrhynchos</i>
Bufflehead	<i>Bucephala albeola</i>
American Coot	<i>Fulica americana</i>
Black Tern*	<i>Chlidonias niger</i>
Great Egret	<i>Casmerodius albus</i>
Great Blue Heron	<i>Ardea herodias</i>
Green Heron	<i>Butorides striatus</i>
Belted King Fisher	<i>Megaceryle alcyon</i>
Red-winged Blackbird	<i>Agelaius phoeniceus</i>
Yellow-headed Blackbird*	<i>Xanthocephalus xanthocephalus</i>

Mammals

Mink	<i>Mustela vison</i>
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Reptiles

Painted Turtle	<i>Chrysemys picta</i>
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+ Threatened in Illinois

* Endangered in Illinois

EXISTING LAKE QUALITY PROBLEMS AND MANAGEMENT SUGGESTIONS

Broberg Marsh is a high quality wildlife area. Little should be done from a management standpoint except to maintain current quality and limit impacts from external sources. However, there are a few management concerns with regard to Broberg.

- *Invasive Species Management*

There was a low occurrence of invasive species at Broberg Marsh. However, since this is a natural wildlife area it is imperative that these infestations be controlled/eliminated as to prevent any further spread. Problems arise when nuisance plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. A monitoring program should be established, problem areas identified, and control measures taken when appropriate. This is particularly important in remote areas such as Broberg Marsh where the spread of exotic species may go unnoticed for some time. As stated previously, these invasive species rarely provide any beneficial habitat or food source. Removal of these troublesome plants can be accomplished several ways: hand removal, herbicides, and biocontrol.

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 excavated. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored. Many exotic species, such as purple loosestrife, buckthorn, and garlic mustard are proficient at colonizing disturbed sites.

Another technique for controlling/eliminating invasive species is the use of herbicides. 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.

Finally, another technique for managing invasive species is the use of biological controls. Recently two beetles (*Galerucella pusilla* and *G. californiensis*) and two weevils (*Hylobius transversovittatus* and *Nanophyes marmoratus*) have offered some hope to control purple loosestrife by natural means. The beetles have proven to be the most effective and are in widespread use throughout the state. From 1994 until 1998 53,800 beetles were released in adjacent by Wauconda bog. It is likely to assume that these beetles have spread into Broberg Marsh. Therefore, stocking of beetles into Broberg marsh may be unnecessary. The beetles may have not yet infested the purple loosestrife observed at the sight.

- *Low Epilimnetic Dissolved Oxygen Levels*

Due to the shallow morphometry and large biological oxygen demand during mid-summer months, Broberg Marsh experiences low dissolved oxygen levels. D.O. levels were dangerously low in July and September. Low D.O. levels can cause fish stress and if continual, stress can eventually lead to fish mortality. Historically, Broberg Marsh has experienced several fish kills. It is almost certain that Broberg Marsh will continue to experiences fish kills. This has probably lead to a very poor quality sport fishery and an over abundance of low D.O. tolerant fish species (i.e., carp, bullhead, and green sunfish). If fishing were to become a priority at Broberg Marsh, besides a stocking program, the low D.O. problems would have to be remedied. However, Broberg Marsh is a shallow natural area and should not be intended for sport fishing. Broberg Marsh should be left alone and not managed for anything else but what it is, a high quality wildlife area. Additionally, it would be advisable to remove the private aerator, as there is no great advantage in oxygenating Broberg Marsh except to save what fish still exist (carp and bullhead) along with keeping down some of the odors during the summer months.