

McDill Pond

Introduction

McDill Pond is a 261 acre **hard water impoundment**, located in the Village of Whiting, near Stevens Point. McDill Pond has a long history, dating back to 1853 when the original dam was first constructed for logging purposes. Ownership of the dam was transferred to the McDill brothers in 1964, and a sawmill began operating at the site shortly afterwards. Through the use of the McDill dam and others, the Plover River became one of the most extensively used streams in central Wisconsin until the 1870's when lumber rafting began being replaced by railroad shipment. In 1885 a grist mill was constructed to grind grain from area farmers. The site was later used as a graphite mill and a pulp mill (McDill Pond Lake Management Plan 2001).

The Village of Whiting bought the land and the mills in 1954. By this time the original dam was badly deteriorated, so the pond was drained in 1959 to begin construction of a new dam. During the drawdown several areas were excavated to deepen the pond, and the bottom was cleaned and dredged. By 1962 the new concrete dam was completed and the pond refilled. It remained there until 1999 when the Wisconsin Department of Transportation and Portage County replaced a portion of the dam as part of the Highway HH reconstruction (MPLMP 2001). The last large-scale operation on the pond occurred in 2003 when extensive dredging took place.

McDill Pond has a maximum depth of 14 feet and a bottom consisting of primarily sand, with some gravel, silt, and muck. There is a small park below the dam that serves an abundance of waterfowl and an osprey nest near the northern tip of this urban pond. Panfish and largemouth bass are the common fish species in McDill, with smallmouth bass and northern pike also present. A public boat launch is present on the east shore of the pond. Exotic aquatic plant species including Eurasian water-milfoil and curlyleaf pondweed have altered the pond's ecosystem, and harvesting throughout the summer is part of the aquatic plant management activities in McDill Pond.

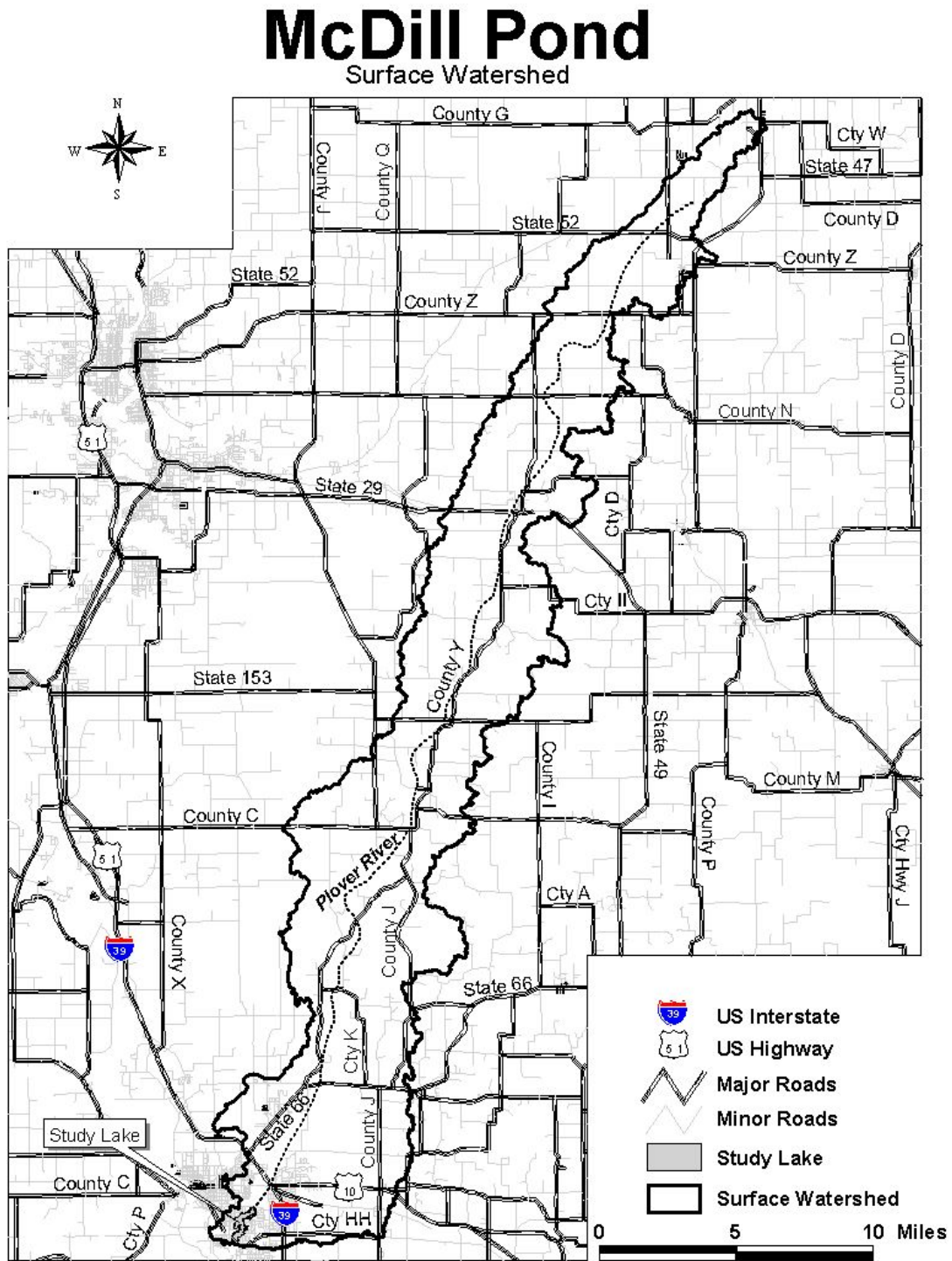
Land Use and Watershed

The surface **watershed** of McDill Pond is 120,922 acres, going north up the Plover River through Portage County, Marathon County, and into Langlade County (Figure 1). Land use data for the **watershed** is derived from the Wisconsin Department of Natural Resources (WISCLAND) coverage from 1992. It shows the area predominantly forested (34%), and under cultivation (23%). Also making up a large portion of the land use in the surface **watershed** is wetlands (20%) and grasslands (18%). Urban development has increased markedly around the millpond but still makes up only a small portion of the land use for the entire **watershed** (Figure 2 and Figure 3).

However, the 'urban' land use category in WISCLAND does not account for rural homes throughout the **watershed**. Records were only readily available for the Portage County part of the **watershed**. According to these records in 2002, there are 63 potentially failing septic systems and three former landfill sites present in the **watershed**.

*Terms in bold, see glossary pp 12-16

Figure 1. McDill Pond surface watershed boundary in Portage, Marathon, and Langlade Counties.



*Terms in bold, see glossary pp 12-16

Figure 2. Land use in the McDill Pond watershed (WISCLAND 1992).

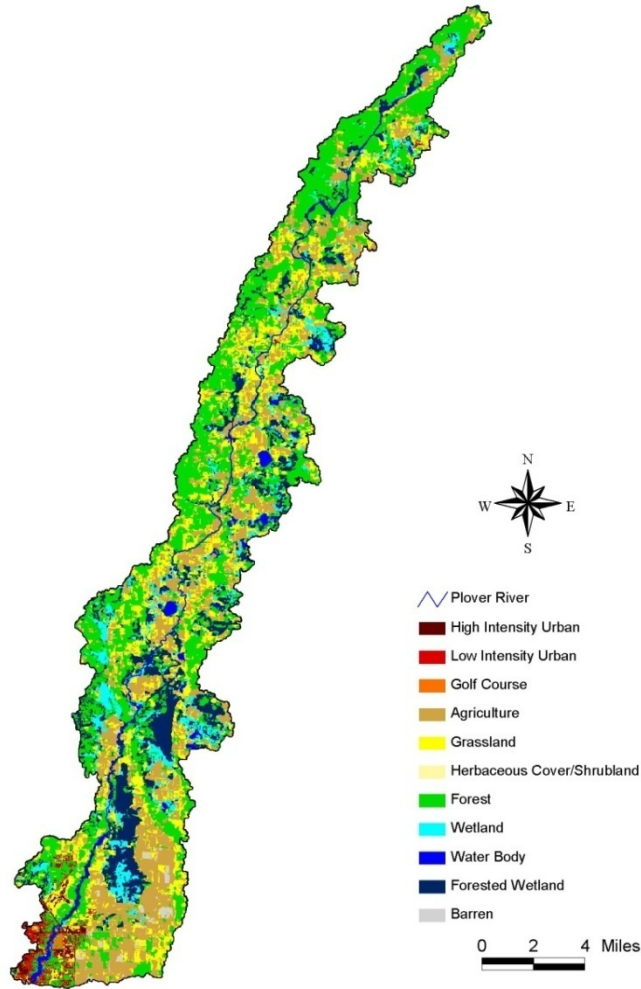
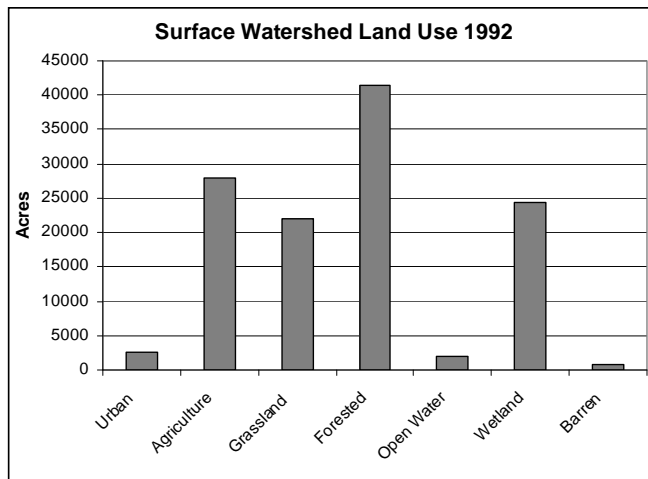


Figure 3. Land Use in the McDill Pond surface watershed (1992).



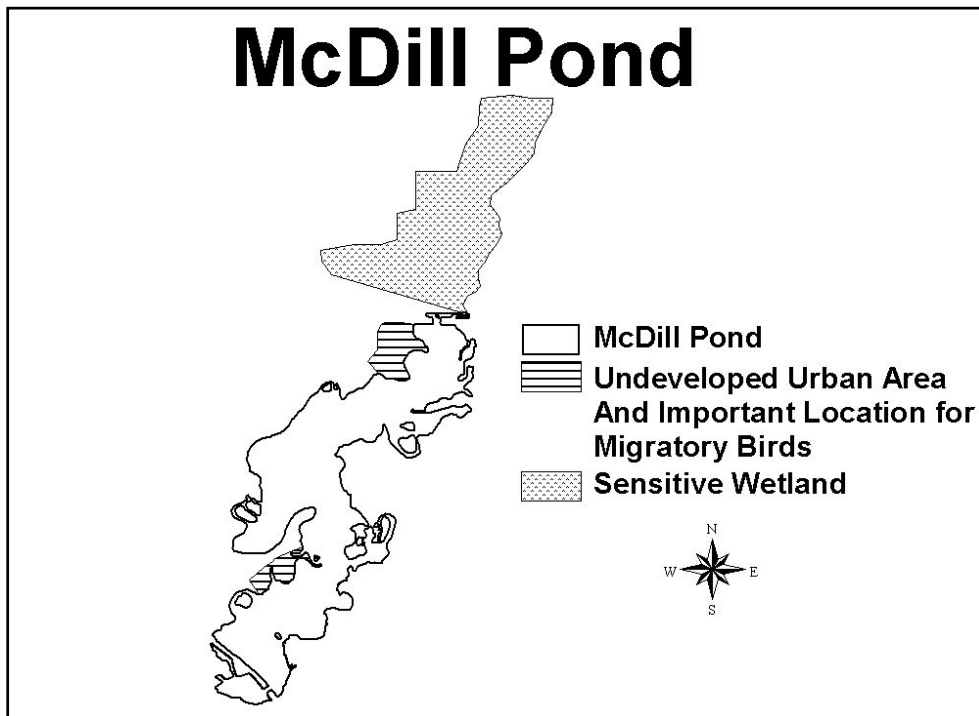
*Terms in bold, see glossary pp 12-16

As with the other **impoundments**, data on the **groundwater watershed** for McDill Pond is beyond the scope of this study. However, based on the Plover River hydrology, the **groundwater watershed** is likely to be very similar to the surface **watershed**.

Upland Sensitive Areas

The survey of upland sensitive areas was conducted to note areas immediately around the lakeshore that are particularly valuable, or sensitive to disruption. McDill Pond is adjacent to some unique lands which have become important locations for migratory birds. These areas are currently undeveloped urban areas. Development would have adverse effects on the habitat they currently provide. There is a good-sized wetland north of the pond that follows the course of the Plover River. Currently it is included in Iverson Park.

Figure 4. Upland sensitive areas near McDill Pond.



Reptiles and Amphibians

Amphibians (frogs and toads) were included in this survey because with their permeable skin and biphasic lifecycle (meaning that the young live in water while adults can survive on land) they are considered excellent indicators of overall ecosystem health. Furthermore, both turtles and amphibians utilize both aquatic and terrestrial habitats and especially the shoreline interface between these two habitats, and thus are of particular relevance.

Large sections of continuous natural shoreline on lakes are ideal habitats for many frog species. Natural areas with large amounts of submergent, emergent, and floating-leaf vegetation provide protection and a place for attachment of eggs during the breeding season. The upland areas surrounding these lakes also provide important habitat as many frog species migrate to lakes and

*Terms in bold, see glossary pp 12-16

other bodies of water in the spring or fall to breed and spend the summer months foraging in the uplands. Several species also use the surrounding uplands for overwintering. The turtle species found associated with lakes are predominantly aquatic, usually departing from the water only to deposit eggs in a nest. Nests are usually on south facing slopes above the shoreline where there is open vegetation and sandy soil. The newly hatched young then find their way to the water. Thus, both turtles and amphibian are intimately associated with lakes and the associated habitats of a **watershed**.

Five frog species were identified during the survey of McDill Pond (spring peeper [*Pseudacris crucifer*], American toad [*Bufo americanus*], green frog [*Rana clamitans*], gray treefrog [*Hyla versicolor*], and northern leopard frog [*Rana pipiens*]). The primary amphibian habitat can be found in several areas throughout the pond (sensitive areas are identified in red on Figure 5). Some of the key features of this habitat include protected areas of marsh with large amounts of submergent, emergent, and floating-leaf vegetation as well as downed trees. The good news is that several frog species are present, along with a number of large sections of natural shoreline. At the same time, however, there is also a high level of shoreline development that has significantly altered the shoreline habitat.

During the survey of reptiles McDill Pond was found to contain two species of turtles (painted turtle [*Chrysemys picta*] and snapping turtle [*Chelydra serpentina*]). There are also historical records of spiny softshell turtle (*Apalone spinifera*) and wood turtle (*Clemmys insculpta*) (both threatened species).

Figure 5. Regions of primary amphibian habitat around McDill Pond.



*Terms in bold, see glossary pp 12-16

Aquatic Plants

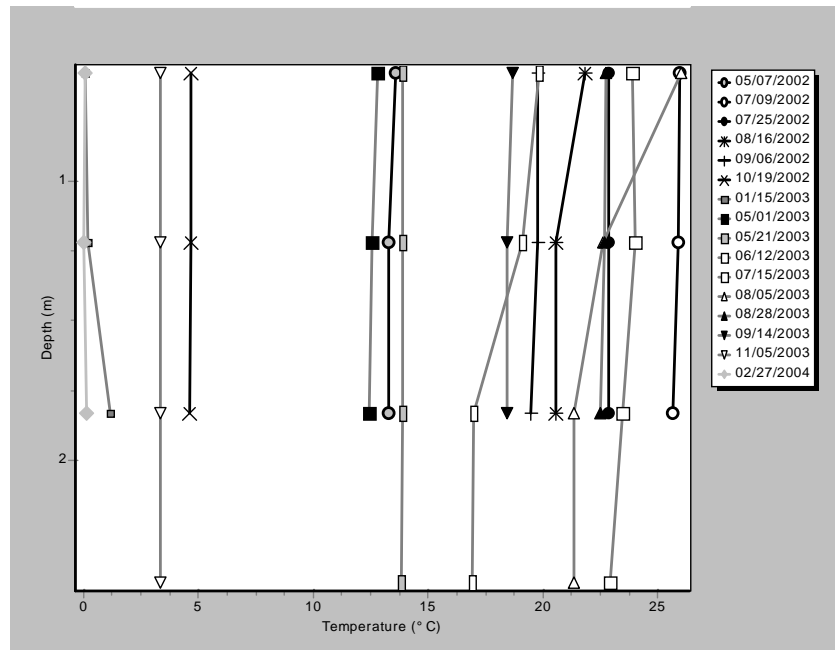
There are **65** species of aquatic or wetland **vascular plants** that have been found in McDill Pond or on the wet areas of the shore. This value is above average for Portage County lakes. The average **coefficient of conservatism (c-value)** is **4.8**, which is about average. The **floristic quality index** is **38.9**, which is above average for Portage County lakes.

The increase in the abundance of curlyleaf pondweed (*Potamogeton crispus*) and the recent arrival of Eurasian water-milfoil (*Myriophyllum spicatum*) threaten the quality and diversity of the native aquatic plants of McDill Pond. Although much of the shoreline consists of houses and lots, with considerable lawn areas, some areas of native vegetation have been left. Especially notable for diverse, mostly native vegetation is the area in the vicinity of Koziczkowski Park and the new Godfrey-Maybelle Erickson Natural Area.

Current Water Quality Conditions

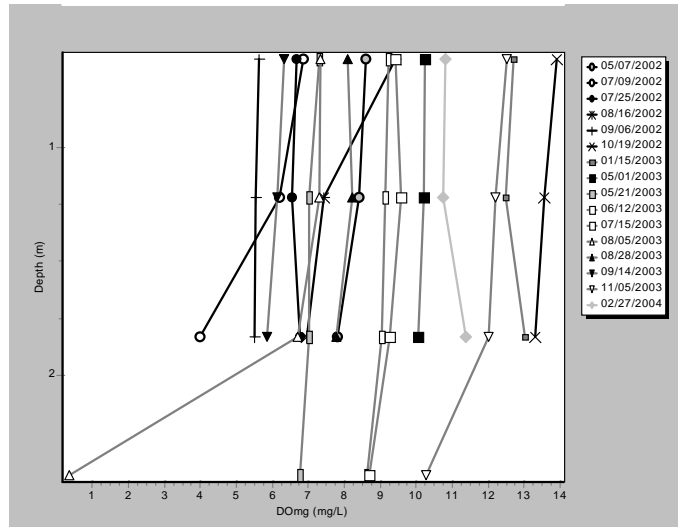
Water quality in lakes is assessed by measuring different characteristics including temperature, dissolved oxygen, water **clarity**, **chlorophyll a**, water chemistry, and the algal community. During this study temperature and dissolved oxygen were measured with depth on each sampling date. As would be expected in a small **impoundment** like McDill, the water is mixed from top to bottom throughout the year (Figure 6 and Figure 7). This provides enough oxygen to support many species of aquatic biota.

Figure 6. Profile of temperature in McDill Pond 2002-2004.



*Terms in bold, see glossary pp 12-16

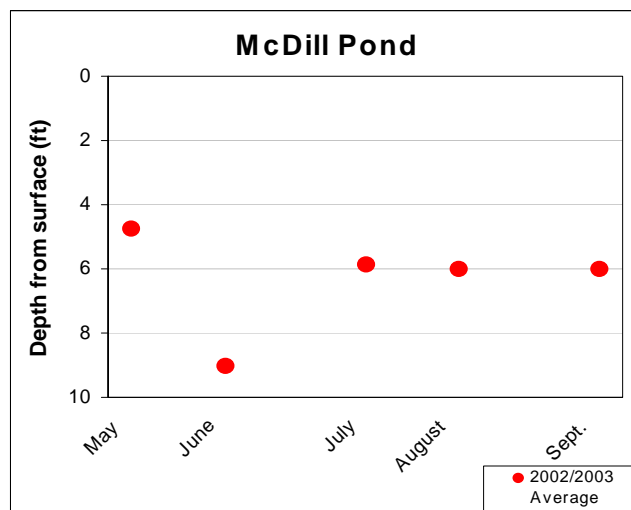
Figure 7. Profile of dissolved oxygen in McDill Pond 2002-2004.



Water **clarity** is a measure of how deep light can penetrate. It is an aesthetic measure and is related to how deep **rooted aquatic plants** can grow. Water **clarity** is affected by water **color** and suspended materials in the water (**turbidity**). **Turbidity** consists of **suspended solids**, such as suspended sediments and **algae (chlorophyll a)**. **Turbidity** was low and **color** was less than measures at Jordan Pond, but still was affected by the brown staining from wetland tannins. **Chlorophyll a** was elevated much of the summer and ranged from 2.6 to 16.2 **mg/L**

The water **clarity** in McDill Pond is considered good when compared with the average **Secchi disc** depth for similar ponds in the region which is 5 feet. McDill Pond usually has slightly better **clarity** than this. During the 2002-03 growing seasons, the water **clarity** of McDill Pond was the best during the month of June and the worst during May. These fluctuations throughout the summer are normal as **algae** populations and **sedimentation** increase and decrease.

Figure 8. Monthly average water clarity measurements in McDill Pond 2002-2003.



*Terms in bold, see glossary pp 12-16

Nutrients (**phosphorus** and **nitrogen**) are important measures of water quality in lakes because they are used for growth by **algae** and aquatic plants (similar to houseplants and crops). Most of the **nitrogen** in the water samples collected from McDill Pond was in the form of **nitrate**. **Nitrate** is readily available for uptake by **algae** and aquatic plants. In lakes, **nitrate** above 0.3 **mg/L** is enough to fuel **algae** growth throughout the summer, and concentrations in McDill Pond are well above that. **Phosphorus** concentrations were quite variable with TP ranges from 12 to 59 $\mu\text{g/L}$ during 2002/4 (Table 1).

Chloride levels, and to a lesser degree **sodium** and **potassium** levels, are commonly used as an indicator of how strongly a lake is being impacted by human activity. **Potassium** concentrations were low, but **sulfate**, **chloride**, and **sodium** were all elevated (Table 2). Although these constituents are not detrimental to the aquatic ecosystem, they indicate that sources of contaminants (road salt, fertilizer, animal waste and/or septic system effluent) are entering the lake from either surface runoff or via **groundwater**. **Chloride** is also a component of many fertilizers. **Sulfate** is often a result of the combustion of sulfur rich fossil fuels. **Atrazine** was found in low concentrations in the pond water (0.07 and 0.12 $\mu\text{g/L}$), however some toxicity studies have indicated that reproductive system abnormalities can occur in frogs at these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering McDill Pond.

Table 1. 2002-2003 water quality seasonal averages in McDill Pond.

McDill Pond	TP ($\mu\text{g/L}$)	RP ($\mu\text{g/L}$)	TN (mg/L)	NO₂+NO₃ (mg/L)	NH₄ (mg/L)	Alkalinity (mg/L)	Total Hardness (mg/L)	Calcium Hardness (mg/L)	Color (CU)	Turbidity (NTU)	Chlorophyll a (ppm)
Spring Averages	46.0	4.5	2.3	1.5	0.02	130	152	88	59.5	2.4	8.9
Summer Averages	34.2	2.9	1.7	1.4	0.03	185	201	102	19	2.1	6.9
Fall Averages	15.0	7.0		2.2	0.03	167	201	112	39.5	1.2	
Winter Averages	10.0	8.5		1.5	0.13						
2002-2004 Averages	29.2	5.7	2.0	1.6	0.05	161	185	100	39.3	1.9	7.9

TP=total **phosphorus**; RP=reactive or soluble **phosphorus**; TN=total **nitrogen**; NO₂+NO₃=**nitrite** and **nitrate** **nitrogen**; NH₄=**ammonia nitrogen**

Table 2. 2002-2003 McDill Pond average water chemistry and reference value

McDill Pond	<i>Low</i>	<i>Medium</i>	<i>High</i>	Reference Values	<i>Low</i>	<i>Medium</i>	<i>High</i>
Sulfate		11.25		Sulfate	<10	10-20	>20
Chloride		11.86		Chloride	<3	3-10	>10
Potassium	1.70			Potassium*	<2.16	2.16-4.30	>4.30
Sodium			6.08	Sodium*	<2.28	2.28-5.09	>5.09

*Ranges of low, medium, high defined by taking the median values from the lake study and dividing into thirds.

Algal Community

The algal community in McDill Pond was not diverse. The dominant groups were the green **algae** (Chlorophyta, 31% of all cells counted), yellow-green **algae** and **diatoms** (Ochrophyta, 23% of all cells counted), and the **blue-green algae** (Cyanobacteria, 20% of all cells counted) (Table 3). These three phyla represented 74% of all cells counted over the 2003 sampling season. In the 3,505 cells counted during this period there were 3 genera of Cyanobacteria, 9 genera of Chlorophyta, 9 genera of Ochrophyta (including 8 **diatom** genera), 2 genera of Euglenophyta (3 species), 2 genera of Dinophyta, and 1 genus of Cryptophyta identified.

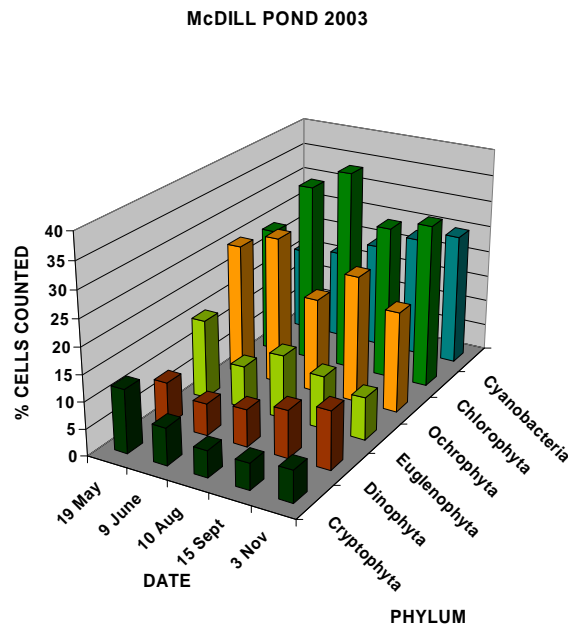
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There was very little cycling of the algal community during the 2003 sampling period. Generally the cyanobacteria, greens, and ochrophytes accounted for about 3 of 4 cells counted regardless of sampling period. In May and June the greens and ochrophytes dominated with the **blue-green algae** subdominant. In August and September the greens dominated with the ochrophytes and cyanobacteria subdominant. In November it was greens blue-greens, and ochrophytes in that order (Figure 9).

Table 3. Algal phyla and mean seasonal composition in McDill Pond from May to November 2003.
McDILL POND

PHYLUM	% CELLS COUNTED BY PHYLUM AND DATE					MEAN
	19 May	9 June	10 Aug	15 Sept	3 Nov	
Cyanobacteria	16	17	20	23	25	20
Chlorophyta	24	34	38	29	31	31
Ochrophyta	25	28	18	24	19	23
Euglenophyta	15	8	12	10	8	11
Dinophyta	8	6	7	9	11	8
Cryptophyta	12	7	5	5	6	7

Figure 9. Algal community composition by date in McDill Pond from May to November 2003 (total phylum cells counted divided by total cells counted).



Green **algae** dominated during the 2003 sampling period. Small, buoyant, planktonic genera of green **algae** (*Coelastrum*, *Planktosphaeria*, *Golenkinia*) dominated in four of five sample periods and held 6 of 15 top abundance slots (Figure 10). The chain-forming **diatom** genus *Fragilaria* dominated in May and was a subdominant in June and September. Two **blue-green algae**

*Terms in bold, see glossary pp 12-16

(*Anabaena*, *Coelosphaerium*) were third most common in June, September, and November. The motile euglenoid genus *Trachelomonas* was subdominant in May and August while the cryptophyte genus *Cryptomonas* was third most common in May (Table 4).

The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for McDill Pond presents a picture of a **mesotrophic** lake. The 27 genera identified during the sample periods were relatively common, and none of those that reached numerical dominance in the sample counts are associated with toxins or health issues. The late season surge of blue-greens could be the result of increasing cultural **eutrophication** in the **watershed** and should be considered a warning sign. Mats of blue-greens can carpet the shallow reaches, and as they trap photosynthetically-produced oxygen in the interwoven mat material they will lift off the bottom and float to the surface. At the surface they get too much sunlight, bleach to yellow/white and then decay. The decay can be aesthetically displeasing, and in some cases, the bacterial decomposition of this material leads to oxygen depletion and perhaps to fish kills.

Figure 10. Algal community composition by phylum in McDill Pond from May to November 2003.

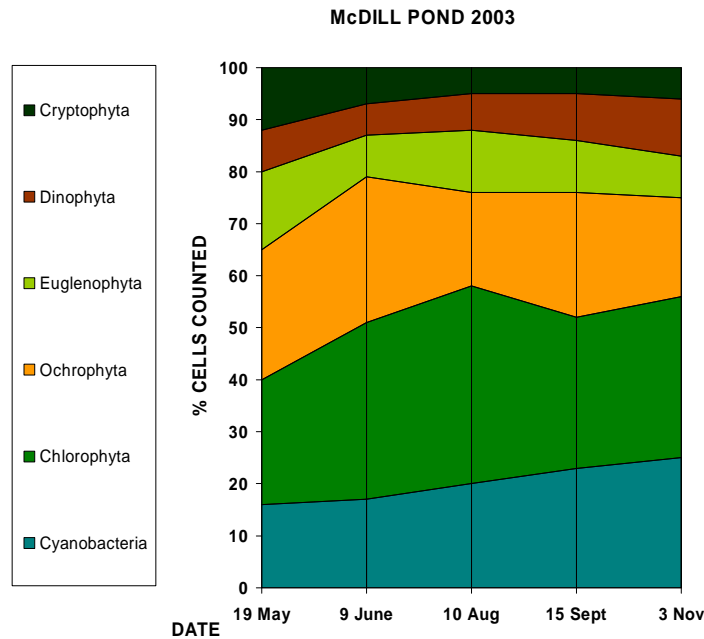


Table 4. Most common algal genera by date in McDill Pond from May to November 2003.

DATE	TOP THREE TAXA (MOST ABUNDANT, LEFT TO RIGHT)		
19 May	<i>Fragilaria</i> 2	<i>Trachelomonas</i> 1	<i>Cryptomonas</i>
9 June	<i>Coelastrum</i>	<i>Fragilaria</i> 2	<i>Anabaena</i>
10 August	<i>Planktosphaeria</i>	<i>Trachelomonas</i> 1	<i>Selenastrum</i>
15 September	<i>Golenkinia</i>	<i>Fragilaria</i> 2	<i>Anabaena</i>
3 November	<i>Golenkinia</i>	<i>Planktosphaeria</i>	<i>Coelosphaerium</i>

*Terms in bold, see glossary pp 12-16

McDill Pond Study Highlights

- McDill Pond is adjacent to some unique lands which have become important locations for migratory birds. These areas are currently undeveloped urban areas. Development would have adverse effects on the habitat they currently provide. There is a good-sized wetland north of the pond that follows the course of the Plover River. Currently it is included in Iverson Park.
- The number of aquatic or wetland **vascular plants** that have been found in McDill Pond or on the wet areas of the shore is above average for Portage County lakes. The average **coefficient of conservatism** is about average. The **floristic quality index** is above average for Portage County lakes.
- The increase in the abundance of curlyleaf pondweed and the recent arrival of Eurasian water-milfoil threaten the quality and diversity of the native aquatic plants of McDill Pond. Although much of the shoreline consists of houses and lots, with considerable lawn areas, some areas of native vegetation remain.
- Five frog species were identified during the survey of McDill Pond (spring peeper, American toad, green frog, gray treefrog, and northern leopard frog). The primary amphibian habitat can be found in several areas throughout the pond. The good news is that several frog species are present, along with a number of large sections of natural shoreline. At the same time, however, there is also a high level of shoreline development that has significantly altered the shoreline habitat.
- During the survey of reptiles McDill Pond was found to contain two species of turtles (painted turtle and snapping turtle). There are also historical records of spiny softshell turtle and wood turtle (both threatened species).
- Most of the **nitrogen** in the water samples collected from McDill Pond was in the form of **nitrate**. In lakes, **nitrate** above 0.3 **mg/L** is enough to fuel **algae** growth throughout the summer, and concentrations in McDill Pond are well above that. **Phosphorus** concentrations were quite variable but were high enough to result in **algae** blooms and to enhance the growth of aquatic plants.
- **Potassium** concentrations were low, but **sulfate**, **chloride**, and **sodium** were all elevated. **Atrazine** was found in low concentrations in the pond water, however some toxicity studies have indicated that reproductive system abnormalities can occur in frogs at these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering McDill Pond.
- The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for McDill Pond presents a picture of a **mesotrophic** lake. The **algae** were relatively common, and none of those that reached numerical dominance in the sample counts are associated with toxins or health issues. The late season surge of blue-greens could be the result of increasing cultural **eutrophication** in the **watershed** and should be considered a warning sign. The decay can be aesthetically displeasing, and in some cases, the bacterial decomposition of this material leads to oxygen depletion and perhaps to fish kills.

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Glossary

Algae:

One-celled (phytoplankton) or multicellular plants either suspended in water (plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of chlorophyll a (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Numerous species occur. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short.

Alkalinity:

A measure of the amount of carbonates, bicarbonates, and hydroxide present in water. Low alkalinity is the main indicator of susceptibility to acid rain. Increasing alkalinity is often related to increased algae productivity. Expressed as milligrams per liter (mg/L) of calcium carbonate (CaCO₃), or as microequivalents per liter (ueq/l). 20 ueq/l = 1 mg/L of CaCO₃.

Ammonia, Ammonium:

A form of nitrogen found in organic materials and many fertilizers. It is the first form of nitrogen released when organic matter decays. It can be used by most aquatic plants and is therefore an important nutrient. It converts rapidly to nitrate (NO₃) if oxygen is present. The conversion rate is related to water temperature. Ammonia is toxic to fish at relatively low concentrations in pH-neutral or alkaline water. Under acid conditions, non-toxic ammonium ions (NH₄⁺) form, but at high pH values the toxic ammonium hydroxide (NH₄OH) occurs. The water quality standard for fish and aquatic life is 0.02 mg/L of NH₄OH. At a pH of 7 and a temperature of 68° F (20° C), the ratio of ammonium ions to ammonium hydroxide is 250:1; at pH 8, the ratio is 26:1.

Atrazine:

The nation's most widely used weedkiller for both grassy and broadleaf weeds.

Blue-Green Algae:

Algae that are often associated with problem blooms in lakes. Some produce chemicals toxic to other organisms, including humans. They often form floating scum as they die. Many can fix nitrogen (N₂) from the air to provide their own nutrient.

Chloride (Cl⁻):

Chlorine in the chloride ion (Cl⁻) form has very different properties from chlorine gas (Cl₂), which is used for disinfecting. The chloride ion (Cl⁻) in lake water is commonly considered an indicator of human activity. Agricultural chemicals, human and animal wastes, and road salt are the major sources of chloride in lake water.

Chlorophyll a:

Green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae and is therefore used as a common indicator of water quality.

Clarity:

see "Secchi disc."

Coefficient of Conservatism (c-value):

Indicates on a scale of 0 to 10 the degree to which a species can tolerate disturbance to a native plant community; a species with a c value of 10 is found only in relatively undisturbed areas of native plant community, whereas a species with a c value of 0 never grows in undisturbed areas of native plant communities. Plants with low numbers tend to occur in a wide range of more-or-less disturbed plant communities. Alien species are also assigned a c value of 0. The c values are used in this report in calculating the Floristic Quality Index for each lake.

*Terms in bold, see glossary pp 12-16

Color:

Measured in color units that relate to a standard. A yellow-brown natural color is associated with lakes or rivers receiving wetland drainage. The average color value for Wisconsin lakes is 39 units, with the color of state lakes ranging from zero to 320 units. Color also affects light penetration and therefore the depth at which plants can grow.

Concentration Units:

Express the amount of a chemical dissolved in water. The most common ways chemical data is expressed is in milligrams per liter (mg/L) and micrograms per liter (ug/L). One milligram per liter is equal to one part per million (ppm). To convert micrograms per liter (ug/L) to milligrams per liter (mg/L), divide by 1000 (e.g. 30 ug/l = 0.03 mg/L). To convert milligrams per liter (mg/L) to micrograms per liter (ug/L), multiply by 1000 (e.g. 0.5 mg/L = 500 ug/L). Microequivalents per liter (ueq/L) is also sometimes used, especially for alkalinity; it is calculated by dividing the weight of the compound by 1000 and then dividing that number into the mg/L.

Diatoms:

A major group of eukaryotic algae, which are one of the most common types of phytoplankton. Diatom communities are a popular tool for monitoring environmental conditions, past and present, and are commonly used in studies of water quality; often the brown stuff attached to rock surfaces.

Drainage Lakes:

Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter retention times than seepage lakes. Watershed protection is usually needed to manage lake water quality.

Erosion:

The lowering of the land surface by weathering, corrosion, and transportation, under the influence of gravity, wind, and running water.

Eutrophic:

Eutrophic lakes are high in nutrients and support a large biomass (all the plants and animals living in a lake). They are usually either weedy or subject to frequent algae blooms, or both. Eutrophic lakes often support large fish populations, but are also susceptible to oxygen depletion. Small, shallow, eutrophic lakes are especially vulnerable to winterkill which can reduce the number and variety of fish. Rough fish are commonly found in eutrophic lakes.

Eutrophication:

The process by which lakes and streams are enriched by nutrients, and the resulting increase in plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).

Fen:

A fen is a type of wetland fed by surface and/or groundwater. Fens are characterized by their water chemistry, which is neutral or alkaline, unlike bogs, which are generally acid.

*Terms in bold, see glossary pp 12-16

Floristic Quality Index (FQI):

The FQI is a standardized method for evaluating natural plant communities by multiplying the average coefficient of conservatism (c-value) for all species by the square root of the total number of species found at that lake; an additional point is added to the index for each state-listed special concern species, two points added for a threatened species, and three points added for an endangered species. A higher floristic quality index, such as FQI=60, indicates a higher floristic quality and biological integrity and a lower level of disturbance impacts. A lower floristic quality index, such as FQI=20, indicates a lower floristic quality and biological integrity and a higher level of disturbance impacts.

Groundwater:

Water found below the land surface in pore spaces between soil particles or in cracks in rock. It moves slowly from higher to lower areas on the landscape and may provide water to a lake.

Groundwater Drainage Lake:

Often referred to a spring-fed lake, has large amounts of groundwater as its source, and a surface outlet. Areas of high groundwater inflow may be visible as springs or sand boils. Groundwater drainage lakes often have intermediate retention times with water quality dependent on groundwater quality.

Hardness, Hard Water:

The quantity of multivalent cations (cations with more than one +), primarily calcium (Ca⁺⁺) and magnesium (Mg⁺⁺) in the water expressed as milligrams per liter of CaCO₃. Amount of hardness relates to the presence of soluble minerals, especially limestone, in the lake watershed. Soft water has 60 mg/L CaCO₃ or less, moderately hard water has 61-120 mg/L CaCO₃, hard water has 121-180 mg/L CaCO₃, and very hard water has more than 180 mg/L CaCO₃.

Impoundment:

Manmade lake or reservoir usually characterized by stream inflow and always by a stream outlet. Because of nutrient and soil loss from upstream land use practices, impoundments ordinarily have higher nutrient concentrations and faster sedimentation rates than natural lakes. Their retention times are relatively short.

Littoral:

The shallow water zone near the shoreline that is home to most aquatic plants.

Macrophytes:

see "Rooted aquatic plants."

Macrophytic Algae:

Algae that resemble true plants in that they appear to have stems and leaves, and are attached to the bottom.

Marl:

White to gray accumulation on lake bottoms caused by precipitation of calcium carbonate (CaCO₃) in hard water lakes. Marl may contain many snail and clam shells, which are also calcium carbonate. While it gradually fills in lakes, marl also precipitates phosphorus, resulting in low algae populations and good water clarity. In the past, marl was recovered and used to lime agricultural fields.

Mesotrophic:

Mesotrophic lakes lie between the oligotrophic and eutrophic trophic stages. In late summer, they lose oxygen at depth, limiting cold water fish and causing phosphorus release from sediments.

mg/L:

see "Concentration units"

*Terms in bold, see glossary pp 12-16

Nitrate (NO₃⁻):

An inorganic form of nitrogen important for plant growth. Nitrogen is in this stable form when oxygen is present. Nitrate often contaminates groundwater when water originates from manure pits, fertilized fields, lawns or septic systems. High levels of nitrate-nitrogen (over 10 mg/L) are dangerous to infants and expectant mothers. A concentration of nitrate-nitrogen (NO₃-N) plus ammonium-nitrogen (NH₄-N) of 0.3 mg/L in spring will support summer algae blooms if enough phosphorus is present.

Nitrite (NO₂⁻):

A form of nitrogen that rapidly converts to nitrate (NO₃⁻) and is usually included in the NO₃⁻ analysis.

Nitrogen:

A chemical element that is an essential plant nutrient and may occur in the form of nitrate, nitrite, ammonium, or organic nitrogen in lakes.

Oligotrophic:

A trophic state in which lakes are generally clear, deep and free of weeds or large algae blooms. Though beautiful, they are low in nutrients and do not support large fish populations. However, oligotrophic lakes often develop a food chain capable of sustaining a very desirable fishery of large game fish.

Phosphorus:

Key nutrient influencing plant growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus is the amount of phosphorus in solution that is available to plants. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form.

Photosynthesis:

The process by which green plants convert carbon dioxide (CO₂) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Potassium:

A chemical element that is an essential plant nutrient and may enter lakes from runoff of agricultural fertilizers and animal wastes.

Retention Time: (Turnover Rate or Flushing Rate)

The average length of time water resides in a lake, ranging from several days in small impoundments to many years in large seepage lakes. Retention time is important in determining the impact of nutrient inputs. Long retention times result in recycling and greater nutrient retention in most lakes. Calculate retention time by dividing the volume of water passing through the lake per year by the lake volume.

Rip Rap (Rip-Rap):

Hard rock, commonly granite or concrete rubble recycled from construction sites, used inland on lakes, rivers, coastlines, and other waterways to prevent bank erosion. Generally rip rap is not considered good management in lakes, due to its inability to provide adequate habitat, and is no longer commonly used.

Rooted Aquatic Plants: (Macrophytes)

Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

*Terms in bold, see glossary pp 12-16

Secchi Disc (Secchi Disk):

An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity (light penetration). The disc is lowered into water until it disappears from view. It is then raised until just visible. An average of the two depths, taken from the shaded side of the boat, is recorded as the Secchi disc reading. For best results, the readings should be taken on sunny, calm days.

Sedimentation:

Accumulated organic and inorganic matter on the lake bottom. Sediment includes decaying algae and weeds, marl, and soil and organic matter eroded from the lake's watershed.

Seepage Lakes:

Lakes without a significant inlet or outlet, fed by rainfall and groundwater. Seepage lakes lose water through evaporation and groundwater moving on a down gradient. Lakes with little groundwater inflow tend to be naturally acidic and most susceptible to the effects of acid rain. Seepage lakes often have long retention times, and lake levels fluctuate with local groundwater levels. Water quality is affected by groundwater quality and the use of land on the shoreline.

Sodium:

A chemical element that may enter lakes from runoff of road salt, fertilizers, and human and animal wastes.

Stratification, Stratified:

The layering of water due to differences in density. Water's greatest density occurs at 39°F (4°C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to a depth of about 20 ft. The narrow transition zone between the epilimnion and cold bottom water (hypolimnion) is called the metalimnion or thermocline.

Sulfate (SO₄⁻):

The most common form of sulfur in natural waters. The amounts relate primarily to soil minerals in the watershed. Sulfate (SO₄⁻) can be reduced to sulfide (S⁻) and hydrogen sulfide (H₂S) under low or zero oxygen conditions. Hydrogen sulfide smells like rotten eggs and harms fish. Sulfate input from acid rain is a major indicator of sulfur dioxide (SO₂) air pollution. Sulfate concentration is used as a chemical fingerprint to distinguish acid lakes acidified by acid rain from those acidified by organic acids from bogs.

Substrate:

The material found at the bottom of a lake, such as silt, mud, sand, clay, marl, gravel, etc.

Suspended Solids:

A measure of the particulate matter in a water sample, expressed in milligrams per liter. When measured on inflowing streams, it can be used to estimate the sedimentation rate of lakes or impoundments.

Turbidity:

The "cloudiness" or "murkiness" of water, caused by total suspended solids.

Vascular Plants:

Vascular plants are those plants that have tissues for conducting water, minerals, and food through the plant. Vascular plants include the ferns, clubmosses, flowering plants, and conifers.

Watershed:

The total land area that drains either surface water or groundwater toward a lake.

*Terms in bold, see glossary pp 12-16