## Fountain Lake

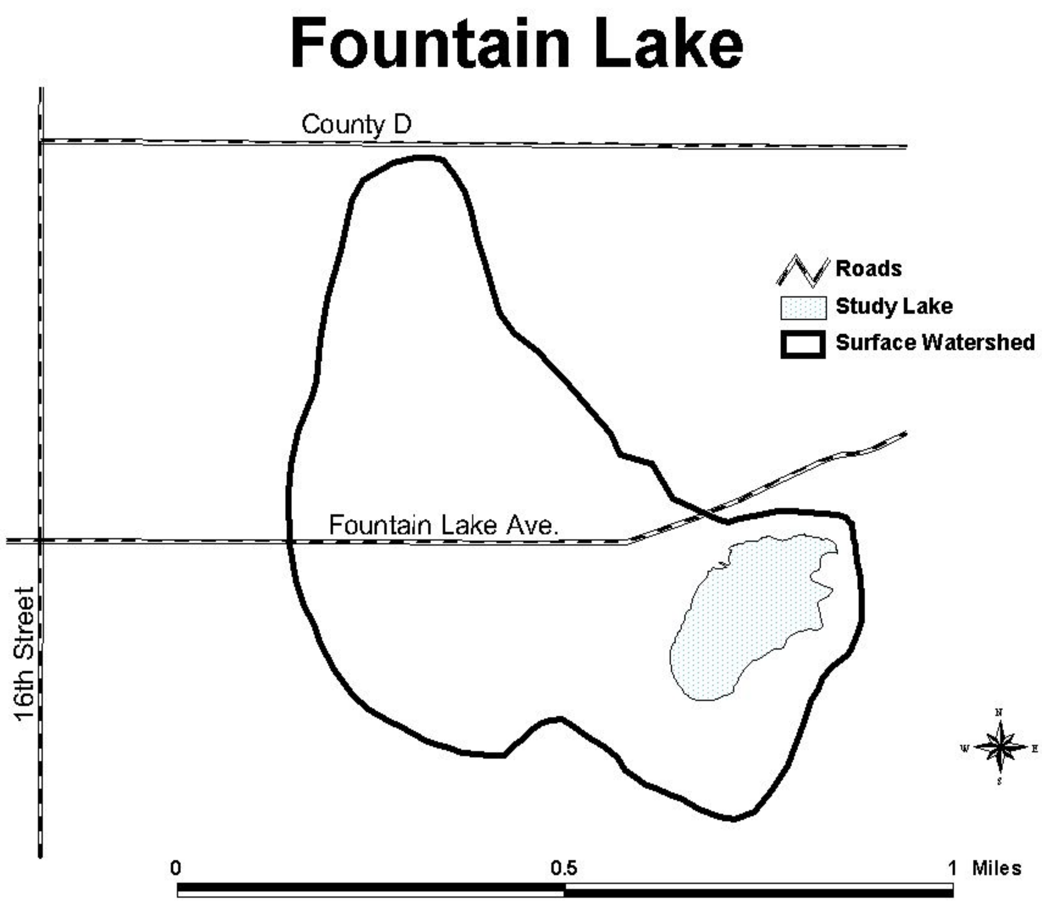
### Introduction

Fountain Lake is a 16 acre, **hard water drainage lake** located in Town of Belmont, northeast of Almond and southwest of Hartman Creek State Park. It has a maximum depth of 23 feet and a **marl** bottom with small sandy patches. It's volume is estimated to be 114.5 acre feet. The **retention time** is estimated to be 0.1 years. The 0.7 mile shoreline is undeveloped and well forested. There is a small inlet feeding Fountain Lake on the northwest side and an outlet (Emmons Creek) with a small dam that maintains the water level at the northeast side of the lake. The sportfish in the lake includes largemouth bass, bluegill, and yellow perch.

### Land Use and Watershed

The surface **watershed** for Fountain Lake is 212 acres (Figure 1). Forested areas make up the majority of the land use in this area (55%), followed by shrub vegetation (20%), (Figure 2). Forested areas have increased dramatically since 1948, correlating with a decrease in the amount of shrub vegetation. Non-irrigated agriculture has decreased from 1948 levels and has remained a minor land use in the **watershed**. Other land uses have remained relatively stable (Figure 3).

**Figure 1. Fountain Lake surface watershed boundary.**




*Terms in bold, see glossary pp 19-24

**Figure 2. Land Use in the Fountain Lake surface watershed 2002.**

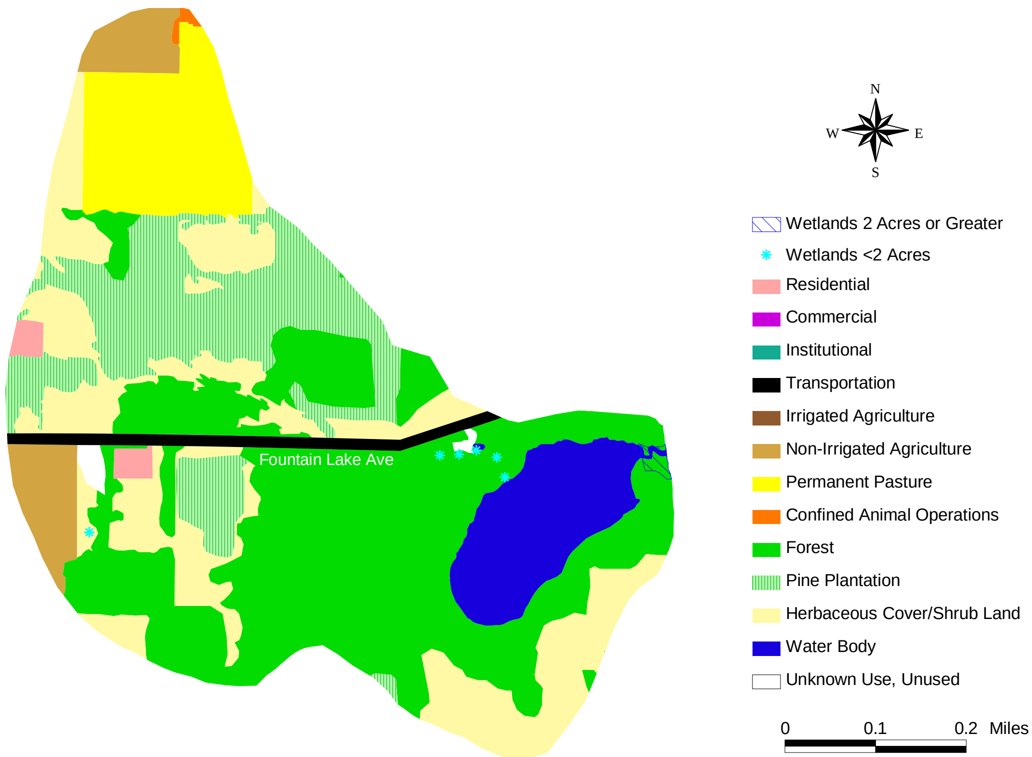
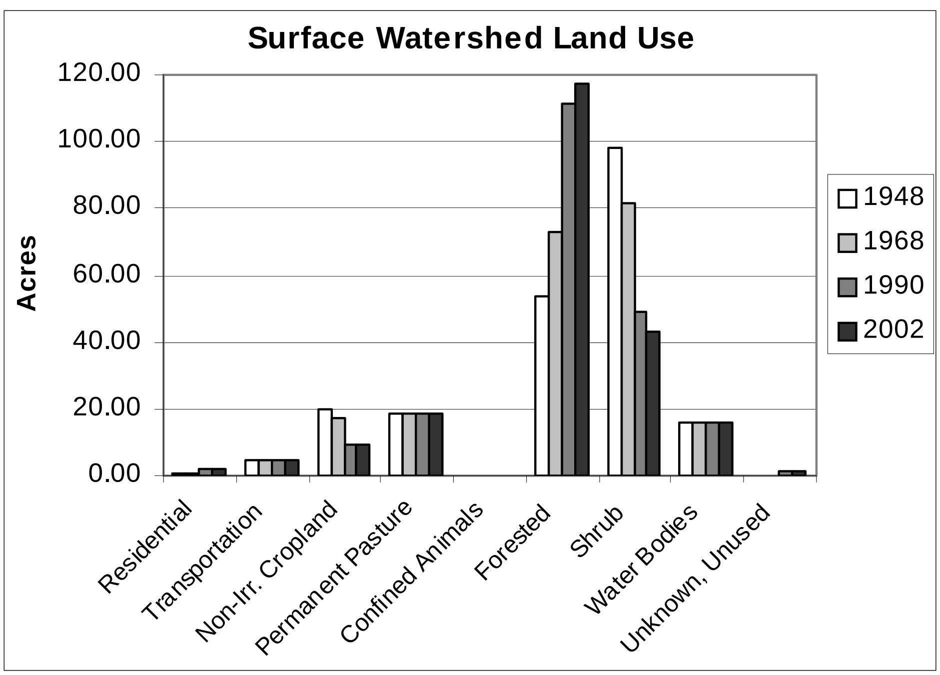



**Figure 3. Land Use in the Fountain Lake surface watershed 1948-2002.**




*Terms in bold, see glossary pp 19-24

The **groundwater watershed** of Fountain Lake is 870 acres (Figure 4). The dominant land use in this area is forest (48%), followed by non-irrigated cropland (18%) and shrub vegetation (15%)(Figure 5). Non-irrigated agriculture has declined sharply since 1948, while forested areas have been increasing. Acres of shrub cover were increasing from 1948 to 1990, but recently decreased slightly. Irrigated cropland appeared sometime after 1990 and remains only six percent of the land use (Figure 6). There is no indication that there are any potentially failing septic systems or former landfill sites present in either the surface **watershed** or the **groundwater watershed**.

**Figure 4. Fountain Lake groundwater watershed boundary.**

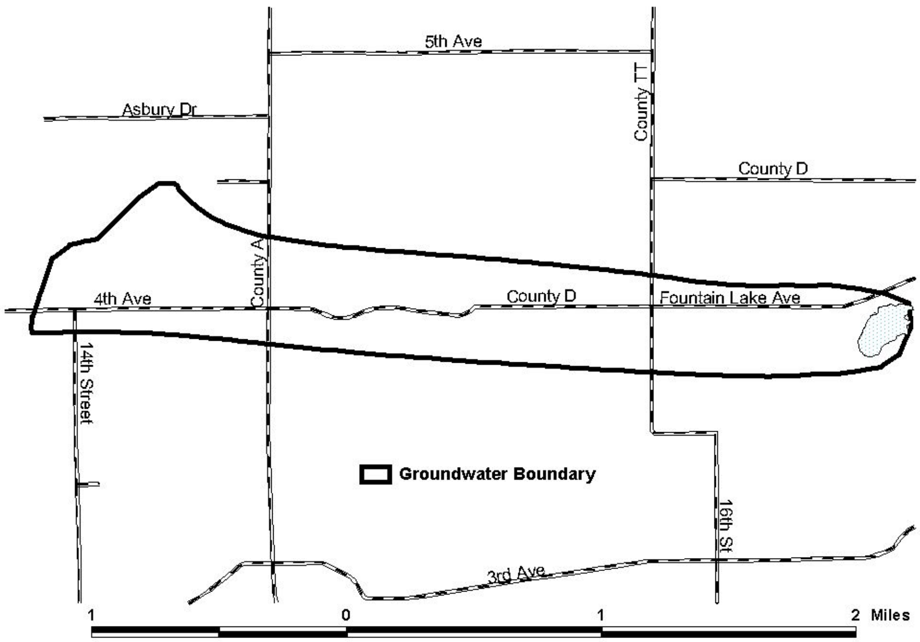
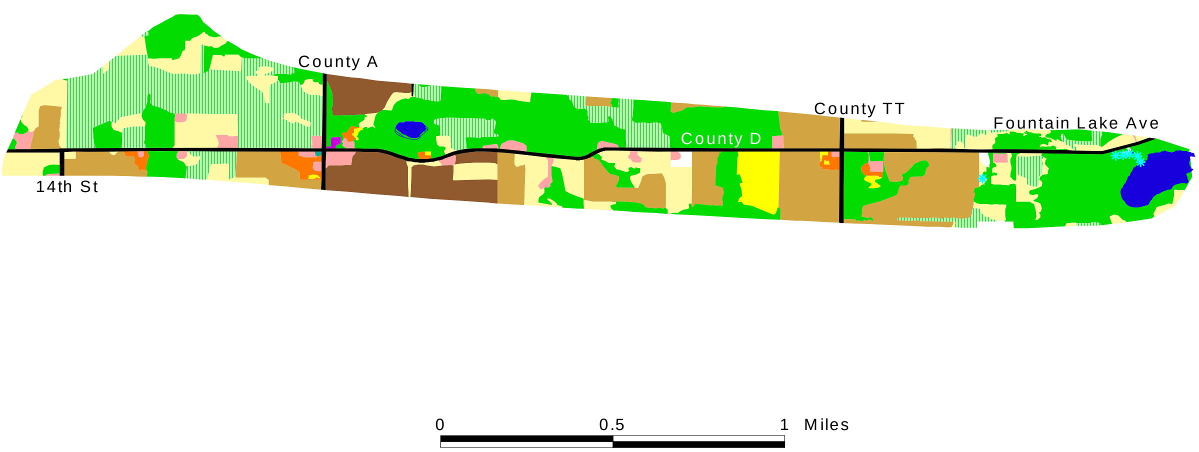
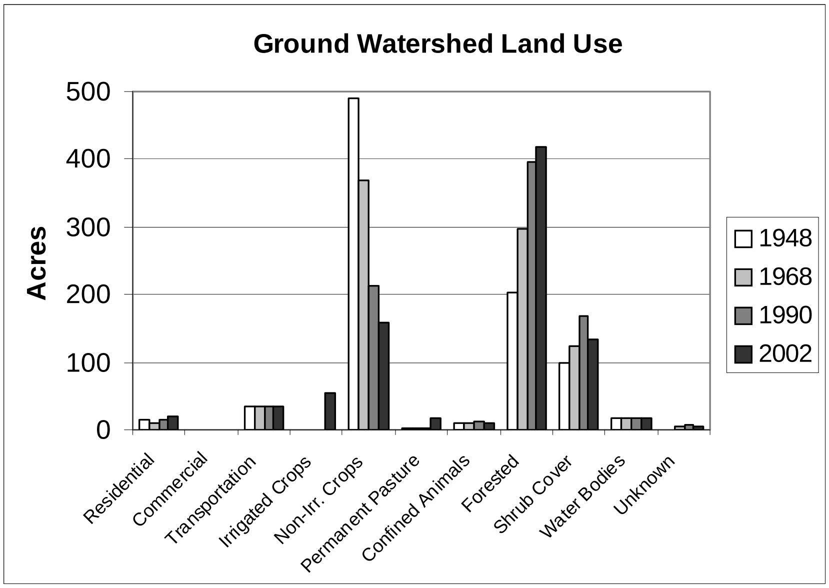



**Figure 5. Land use in the Fountain Lake groundwater watershed 2002.**




*Terms in bold, see glossary pp 19-24

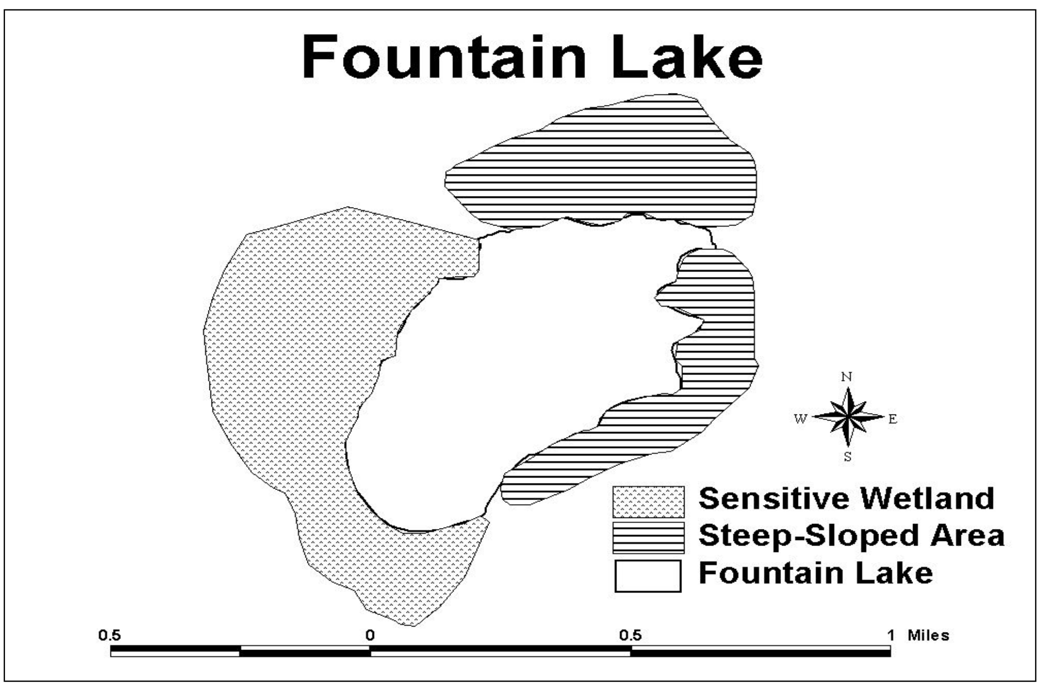
**Figure 6. Land use in the Fountain Lake groundwater watershed 1948-2002.**




## 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. Fountain Lake sits adjacent to a wetland to the west and steep slopes along the northern and eastern shores. The lack of development gives it great scenic value and provides excellent habitat (Figure 7).

**Figure 7. Upland sensitive areas near Fountain Lake.**




*Terms in bold, see glossary pp 19-24

**Birds**

Lakeshore development can negatively or positively affect habitat quality of birds depending on the ecological requirements of each species. Development can play a important role in providing resources unavailable to certain species in a more natural environment, yet eliminate other species' needs altogether, especially at the most extreme levels of development.

Of the 28 most common species, eastern phoebe (*Sayornus phoebe*), American goldfinch (*Carduelis tristis*), American robin (*Turdus migratorius*), mourning dove (*Zenaida macroura*), and downy woodpecker (*Picoides pubescens*) showed the greatest tendency to be found in developed areas. These species may be taking advantage of different resources available in the urban environment, such as birdfeeders (as in the case of the American goldfinch and downy woodpecker), open foraging areas (American robin and mourning dove), or nest sites (eastern phoebe).

At undeveloped sites, least flycatcher (*Empidonax minimus*), great crested flycatcher (*Myiarchus crinitus*), red-eyed vireo (*Vireo olivaceus*), black-capped chickadee (*Poecile atricapillus*), blue jay (*Cyaanocitta cristata*), red-bellied woodpecker (*Melanerpes carolinus*), eastern wood-pewee (*Contopus virens*), indigo bunting (*Passerina cyanea*), and common yellowthroat (*Geothylypis trichas*) were the most common. A majority of these species are insectivores and are likely to feed in more forested environments.

**Table 1. Bird species identified near Fountain Lake.**

| Common Name | Number Observed | Food | Foraging | Nest Type | Nest Location |
|---|---|---|---|---|---|
| American Robin | 3 | insects | ground gleaner | cup | deciduous |
| Black-capped Chickadee | 4 | insects | foliage gleaner | cavity | deciduous |
| Blue Jay | 1 | omnivore | ground gleaner | cup | coniferous |
| Catbird | 1 | insects | ground gleaner | cup | shrub |
| Cedar Waxwing | 3 | fruit | foliage gleaner | cup | deciduous |
| Chipping Sparrow | 1 | insects | ground gleaner | cup | coniferous |
| Common Yellowthroat | 2 | insects | foliage gleaner | cup | shrub |
| Least Flycatcher | 3 | insects | hover gleaner | cup | deciduous |
| Ovenbird | 1 | insects | hawker | cup | bridge |
| Red-eyed Vireo | 5 | insects | hover gleaner | cup | shrub |
| Red-winged Blackbird | 5 | insects | ground gleaner | cup | reed |
| Scarlet Tanager | 1 | insects | hover gleaner | saucer | deciduous |
| Song Sparrow | 1 | insects | ground gleaner | cup | ground |
| White-breasted Nuthatch | 2 | insects | bark gleaner | cavity | deciduous |
| **Total** | **33** | | | | |

**Shoreline Vegetation, Reptiles, and Amphibians**

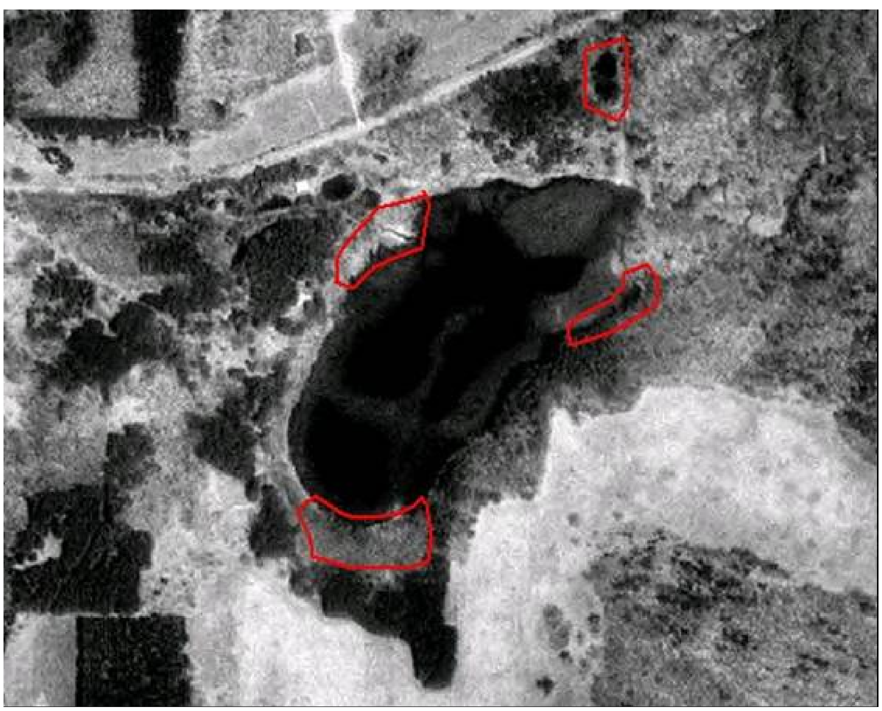
Amphibians (frogs and toads) were included in this survey because with their permeable skin and biphasic lifecycle (meaning that the young live in the water while adults can survive on land) they are considered excellent indicators of overall ecosystem health. Furthermore, both turtles

*Terms in bold, see glossary pp 19-24

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 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 anurans are intimately associated with lakes and the associated habitats of a **watershed**.

Four frog species were identified during the survey of Fountain Lake: spring peeper (*Pseudacris crucifer*), American toad (*Bufo americanus*), green frog (*Rana clamitans*), and wood frog (*Rana sylvatica)*. The primary amphibian habitat is located in a small pond to the north of the lake and on the south side of lake (sensitive areas are identified in Figure 8). Some of the key features of this habitat include areas of marsh with large amounts of submergent, emergent, and floating-leaf vegetation as well as downed trees. The good news is that there is minimal shoreline alteration on Fountain Lake, which provides numerous areas of ideal amphibian and reptile habitat. The bad news is that there is a small amount of recreational use on the lake which may affect amphibian populations. During the reptile survey Fountain Lake was found to contain one species of turtle (snapping turtle [*Chelydra serpentina*]).

**Figure 8. Regions of primary amphibian habitat around Fountain Lake.**

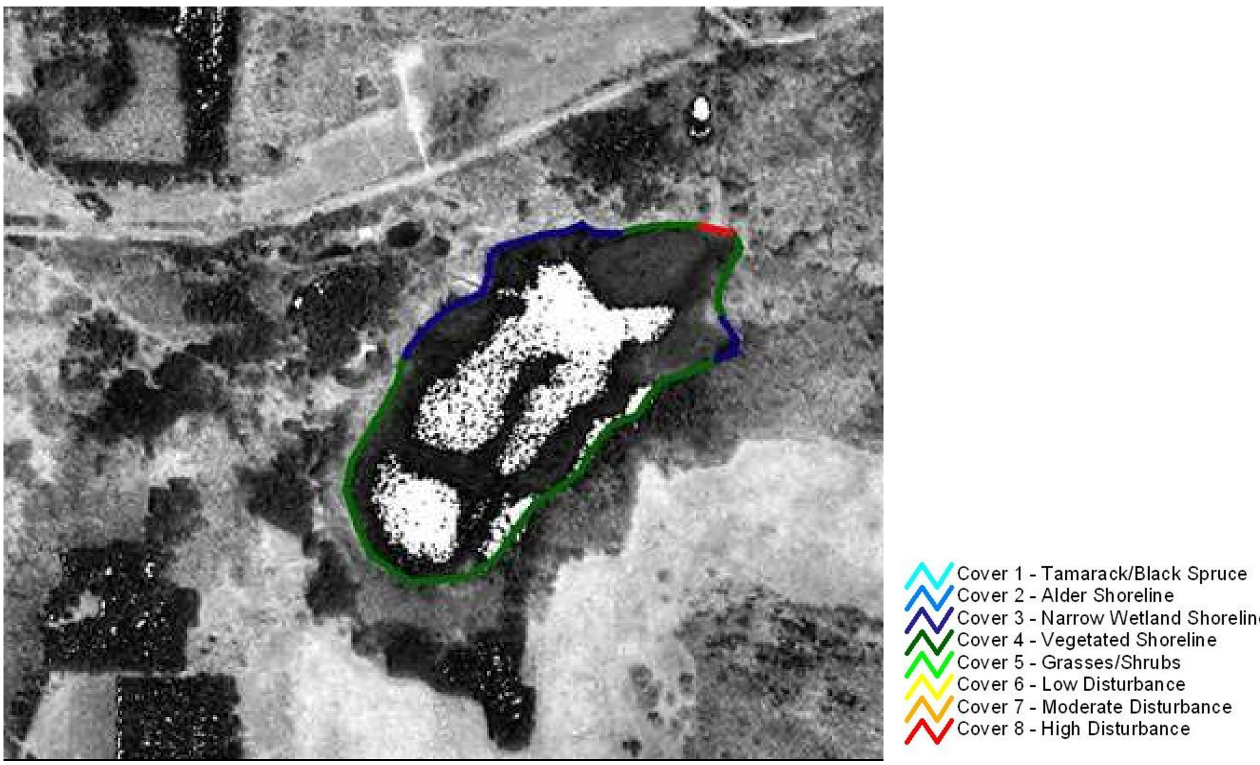


*Terms in bold, see glossary pp 19-24

About 62% of the Fountain Lake shoreline is vegetated shoreline. Vegetated shoreline is characterized as being upland areas with dense vegetation comprised of tall grasses or shrubs that lacks a rocky component. It is represented by dark green in Figure 9. Another 36.1% of the shoreline is composed of narrow wetland shore. Narrow wetlands are characterized as being wetland areas that extend less than 5 meters onto the shore and have an adjacent undeveloped upland area.

Around Fountain Lake, 2.1% of the lake's shoreline is considered to be highly disturbed. An area that exhibits high vegetation disturbance is defined as a beach, **rip rap**, sea wall or where the shore is mowed to the water line.

**Figure 9. Shoreline vegetation around Fountain Lake.**




## Aquatic Plants

There are 53 species of aquatic and wetland **macrophytes** (52 species of **vascular plants** and one species of **macrophytic algae**) that have been found in Fountain Lake or on the wet parts of the shore. This is above average for Portage County lakes. The average **coefficient of conservatism** (c-value) for the 52 species of **vascular plants** is 4.8 which is slightly above average. The **floristic quality index** is 35.9 (34.9 plus one point for a special concern species) which is also above average for the Portage County lakes.

The flora of Fountain Lake is fairly typical of a **hard water** lake. Stonewort (*Chara* spp.) is the most abundant submersed **macrophyte**, with sago pondweed (*Stuckenia pectinata*), bush-pondweed (*Najas flexilis*), common water-milfoil (*Myriophyllum sibiricum*), and Illinois

*Terms in bold, see glossary pp 19-24

pondweed common (*Potamogeton illinoensis*). Much of the shore holds native vegetation, although cattails (*Typha* spp.) and reed canary-grass (*Phalaris arundinacea*) seem to be increasing. Slim-stem reedgrass (*Calamagrostis stricta*), a special concern species, has not been relocated in recent years, but it is a fairly inconspicuous grass, and may have been overlooked. Maintaining native vegetation on the shore is probably the best way to guard against further spread of these invaders. Because the lake could probably support a large population of Eurasian water-milfoil (*Myriophyllum spicatum)*, special care is needed to prevent this plant from becoming established.

**The Fishery**

A total of 19 species of fish have been reported from Fountain Lake since 1952 (Table 2). Fountain Lake is a natural lake, but was deepened and enlarged with the addition of a small concrete dam across the outlet in 1938. Because it is located at the headwaters of Emmons Creek, a cold water stream, it was stocked with salmonids beginning in 1955. According to WDNR records, stocking stopped in 1964 because of poor angler success. Trout have not been recorded there since 1966. The lake is relatively shallow at 24 feet and may not provide well-oxygenated cold water necessary for salmonid survival. Alternatively, the fish may have simply moved over the dam to more favorable habitat downstream. The sport fish population in this lake is largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), and yellow perch (*Perca flavescens*). The lake had the best population of rock bass (*Ambloplites rupestris)* of the ten lakes sampled in this study. Nine species of fish were collected from Fountain Lake in 2002-2003. The most recent survey prior to this study was conducted in 2001 with essentially the same species collected as in the present study. There were no newly documented species. Ten species or 59% of the total known fauna, more than any other lake, was lost or not observed in the 2002-2003 survey. This large percentage loss of species may in part be the result of the addition of the small dam which would effectively block upstream movement of stream species that would only occasionally be found in the lake environment. This could explain the loss of the banded darter (*Etheostoma zonale*), a stream fish, which could only be sustained in a lake environment if a population had access to riverine spawning habitat. Other species not found include black crappie (*Pomoxis nigromaculatus*), black bullhead (*Ictalurus melas*), white sucker (*Catostomus commersoni*), golden shiner (*Notemigonus crysoleucas*), and central mudminnow (*Umbra limi*) which are all common inhabitants of central Wisconsin waters. Another species not found in 2002-2003, the northern pike (*Esox lucius*), was previously known by only one individual and it is unlikely the lake would support a self sustaining population of this species.

*Terms in bold, see glossary pp 19-24

**Table 2. Species occurrence in Fountain Lake from the 2002/2003 study and WDNR records.**

***Note: "S" indicates WDNR stocking record.***

| | |
|---|---|
| **Brown Trout** | 1966. |
| **Rainbow Trout** | 1952. **S**; 1964-1955. |
| **Bluegill** | 2002, 2001, 1983, 1975, 1966, 1959, 1952. |
| **Green Sunfish** | 2002, 2001, 1983, 1975. |
| **Rock Bass** | 2002, 2001, 1983, 1975, 1966, 1959. |
| **Largemouth Bass** | 2002, 2001, 1983, 1975, 1966, 1959. |
| **Black Crappie** | 1983, 1975, 1966. |
| **Walleye** | 1983, 1975. |
| **Yellow Perch** | 2002, 1983, 1975, 1966, 1959. |
| **Iowa Darter** | 2002, 2001. |
| **Banded Darter** | 1959. |
| **Northern Pike** | 1983, 1975. |
| **Black Bullhead** | 1983. |
| **White Sucker** | 1975, 1959. |
| **Bluntnose Minnow** | 2002, 2001, 1959. |
| **Golden Shiner** | 1975. |
| **Blacknose Shiner** | 2002, 2001, 1975. |
| **Brook Stickleback** | 2002, 2001, 1959. |
| **Central Mudminnow** | 2001, 1975, 1959. |

**Bottom Substrate, Vegetative Structure, and Critical Habitat**

Bottom **substrate** in Fountain Lake is mostly **marl** with some small areas of sand and gravel (Figure 10). Suitable **substrate** is present for spawning of most sport fish species present in the lake as indicated by abundant young of year for all species except yellow perch. Fountain Lake is dominated by Chara, which blankets much of the lake bottom and provides substantial cover for small fish. Pondweed and pond-lily beds provide a diversity of submerged and floating cover for larger fish. Much of the southern shoreline is forested and several areas of partially submersed standing timber were noted. Because this lake has not been developed, it would serve as a good example for shoreline restoration efforts in other area lakes that have undergone more extensive shoreline disturbance.

*Terms in bold, see glossary pp 19-24

**Figure 10. Littoral bottom map of Fountain Lake 6/21/03.**

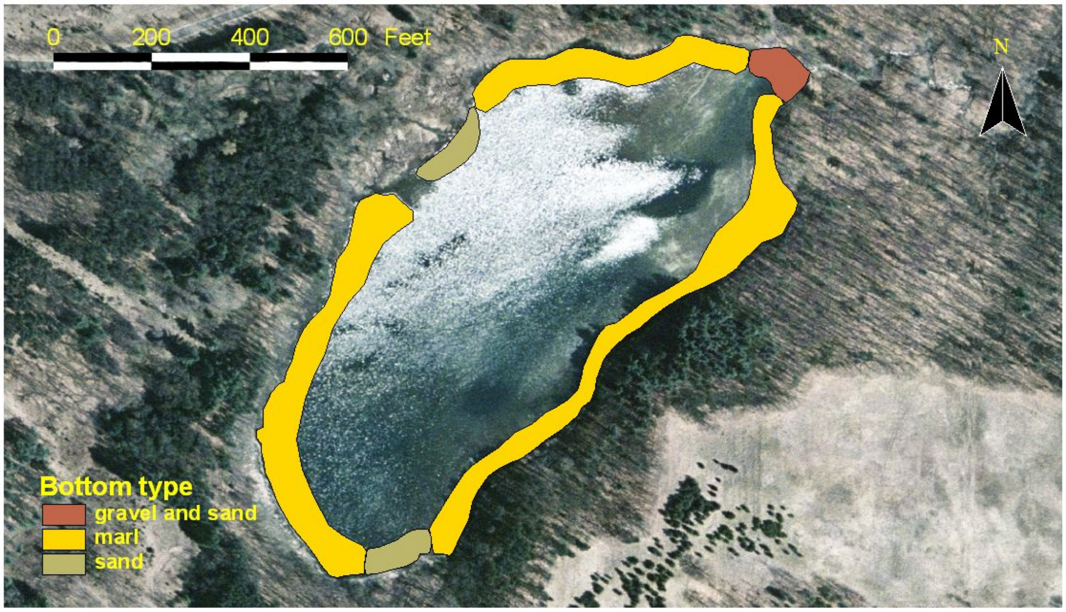
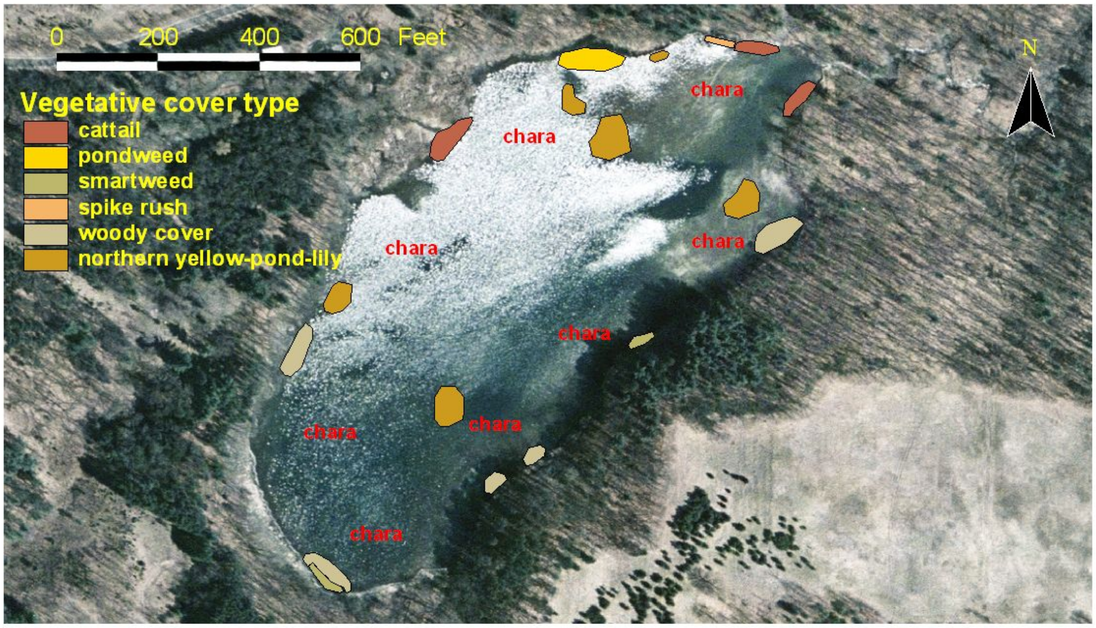



**Figure 11. Vegetative cover map of Fountain Lake 6/21/03.**




## 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. Temperature profiles that were measured with depth in Fountain Lake show that the lake water mixes from top to bottom in the spring and fall, which is typical for most lakes in Wisconsin.

*Terms in bold, see glossary pp 19-24

During parts of the summer and winter it becomes slightly **stratified**, but this is not negatively effecting dissolved oxygen concentrations, which were sufficient (greater than 5 mg/L) throughout most of the water column (Figure 12 and Figure 13).

**Figure 12. Profile of temperature in Fountain Lake 2002-2004.**

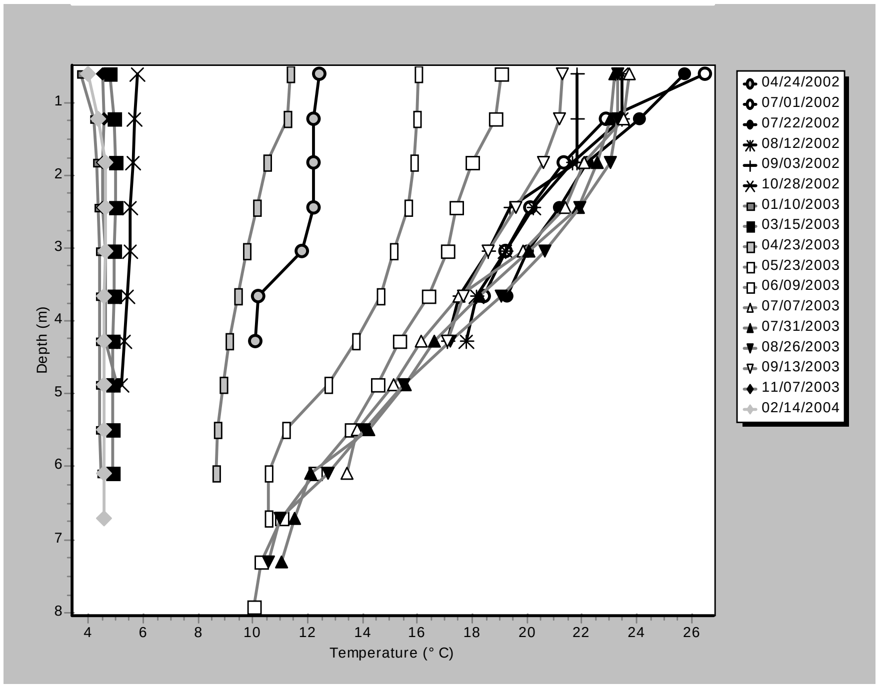
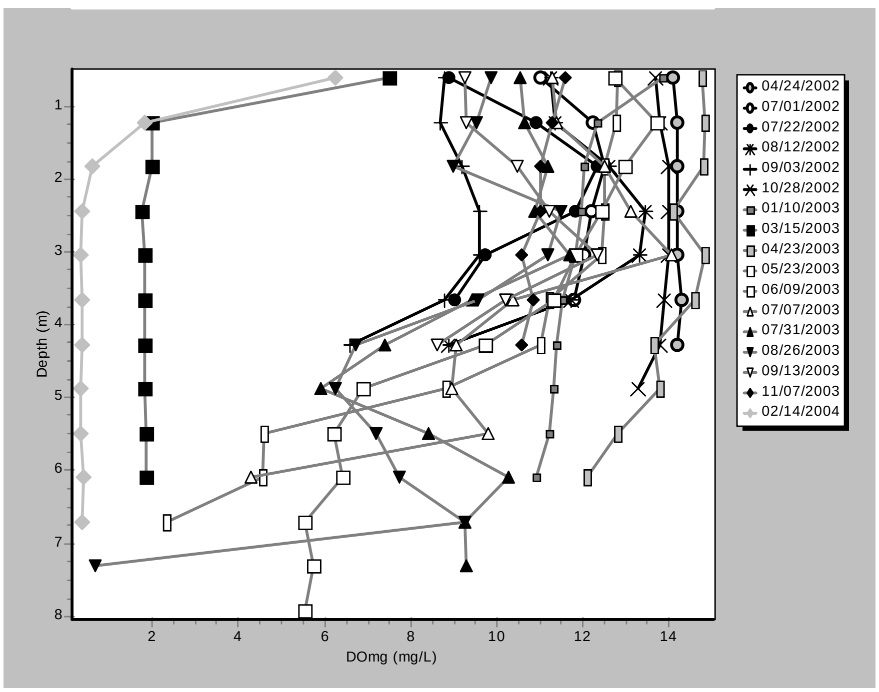


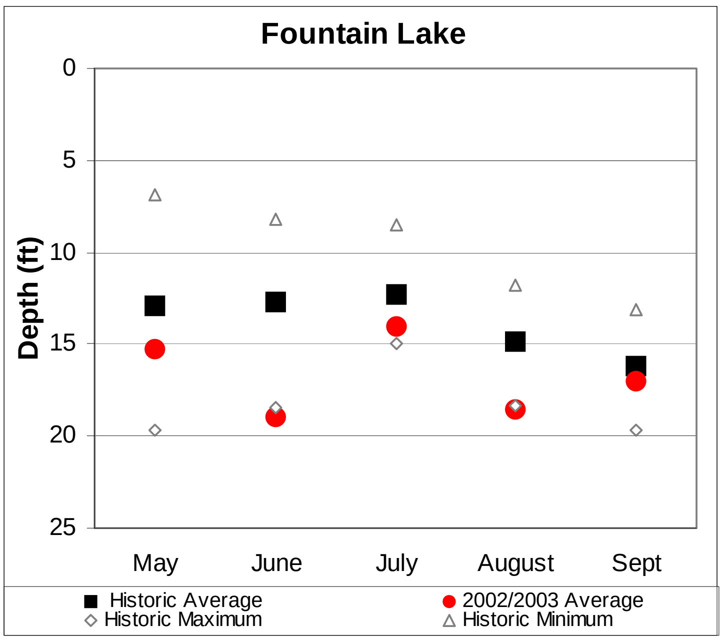

**Figure 13. Profile of dissolved oxygen in Fountain Lake 2002-2004.**




*Terms in bold, see glossary pp 19-24

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***). In Fountain Lake measures of **color**, **turbidity**, and **chlorophyll *a*** were all low, resulting in good to very good water **clarity** (Figure 14). The average Secchi disc depth reading for similar lakes in the county is 10 feet. The water **clarity** of Fountain Lake during the 2002-03 sampling period consistently exceeded this depth. The months of June and August show the best water **clarity**. Fluctuations in water **clarity** throughout the summer are normal as **algae** populations and **sedimentation** increase and decrease.

**Figure 14. Monthly average water clarity measurements in Fountain Lake 2002-2003 and historic average, maximum and minimums.**




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). **Nitrate** concentrations in Fountain Lake are elevated and high enough to produce **algae** blooms throughout the summer, however since the **phosphorus** concentrations are low throughout the year, nuisance **algae** blooms were not observed (Table 3). Common sources of **nitrogen** include fertilizers, animal waste, and septic systems. Typically **nitrate** moves to a lake via **groundwater**.

**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. In Fountain Lake **chloride** and **sodium** were somewhat elevated (Table 4). 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**. **Atrazine** was found in low concentrations in the lake water (0.06 µg/L), however some toxicity studies have indicated that reproductive system abnormalities can occur in frogs at

*Terms in bold, see glossary pp 19-24

these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Fountain Lake.

**Table 3. 2002-2003 water quality seasonal averages in Fountain Lake.**

| **Fountain Lake** | RP (ug/L) | TP (ug/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* | 2.3 | 23.7 | 1.50 | 1.04 | 0.05 | 172.0 | 186.0 | 96.0 | 6 | 1.0 | 0.0 |
| *Summer Averages* | 6.7 | 17.0 | 1.26 | 0.63 | 0.10 | 176.0 | 175.5 | 79.0 | 7 | 1.9 | 2.7 |
| *Fall Averages* | 7.0 | 24.0 | 1.76 | 1.26 | 0.17 | 184.0 | 201.5 | 106.5 | 8 | 1.0 | |
| *Winter Averages* | 4.8 | 13.0 | 1.49 | 1.14 | 0.18 | | | | | | |
| *2002-2004 Averages* | 5.3 | 18.5 | 1.47 | 0.97 | 0.12 | 177.3 | 187.7 | 93.8 | 7 | 1.3 | 2.5 |

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

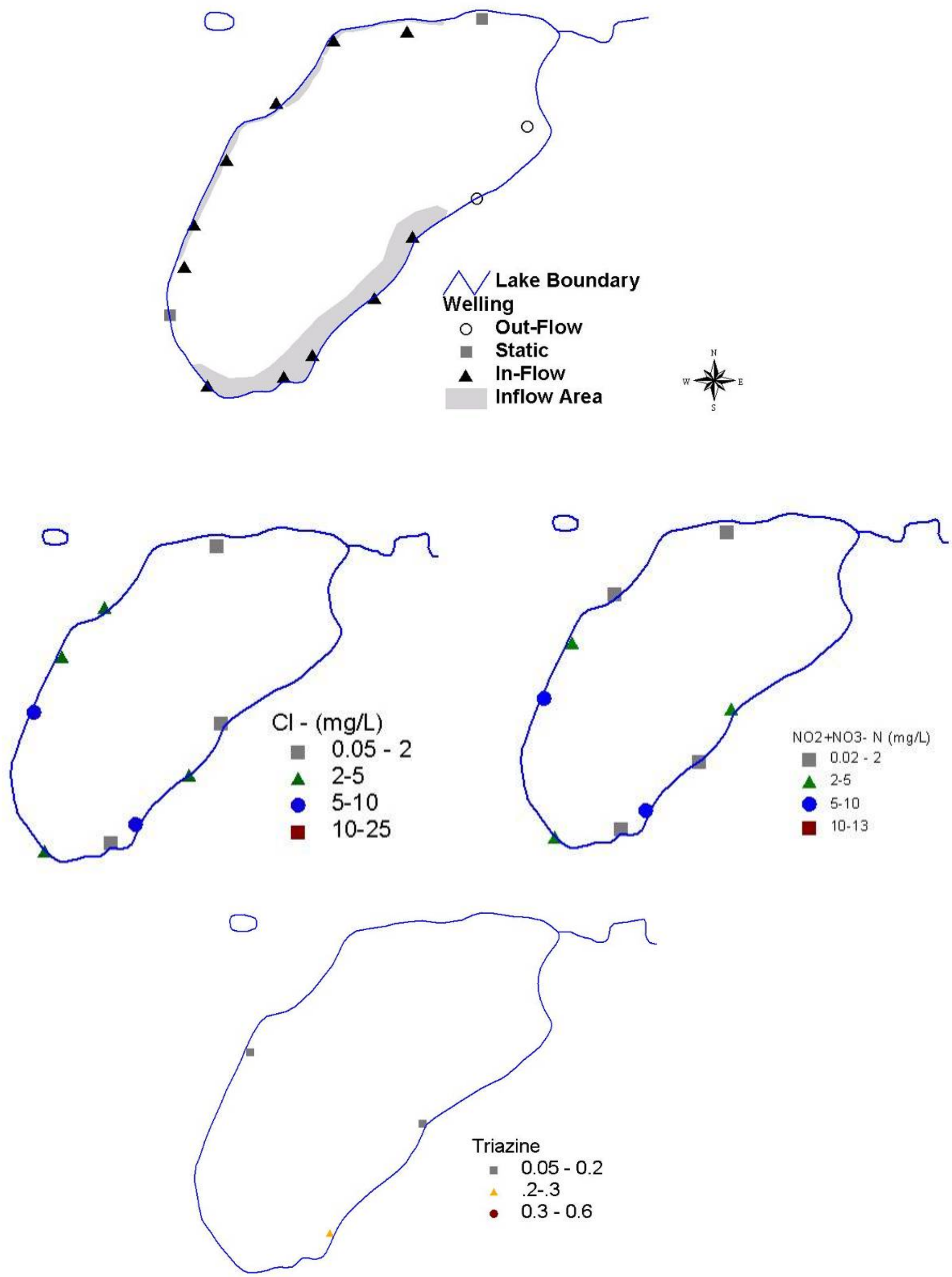
**Table 4. 2002-2003 Fountain Lake average water chemistry and reference value.**

| **Fountain Lake** | *Low* | *Medium* | *High* | **Reference Values** | *Low* | *Medium* | *High* |
|---|---|---|---|---|---|---|---|
| *Sulfate* | 9.20 | | | *Sulfate* | <10 | 10-20 | >20 |
| *Chloride* | | 3.17 | | *Chloride* | <3 | 3-10 | >10 |
| *Potassium* | 1.03 | | | *Potassium** | <2.16 | 2.16-4.30 | >4.30 |
| *Sodium* | | 2.57 | | *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.*

Fifteen mini wells were placed in the lakebed around Fountain Lake to determine areas of **groundwater** inflow/no flow/outflow. **Groundwater** was flowing into the lake at 73% of the sites indicating that **groundwater** is a major contributor of water and water quality to Fountain Lake. Samples were collected for lab analysis from nine sites. Concentrations of reactive **phosphorus** and **ammonium** were low. Sixty-seven percent of the samples had elevated **chloride** concentrations (0.5 – 10 **mg/L**), and 50% of the samples had elevated **nitrate** (0.2 – 6.7 **mg/L**). The sites with elevated **chloride** corresponded with the sites with elevated **nitrate**. All three samples that were analyzed for **atrazine** had detectible concentrations (Figure 15).

**Figure 15. Locations in Fountain Lake showing groundwater inflow/no flow/outflow from mini-piezometer measurements and winter observations, chloride, nitrate, and triazine concentrations.**




*Terms in bold, see glossary pp 19-24

**Algal Community**

The algal community in Fountain Lake was very diverse. The dominant group was the green **algae** (Chlorophyta, 33% of all cells counted). The **blue-green algae** (Cyanobacteria, 23% of all cells counted) and the yellow-green **algae** and **diatoms** (Ochrophyta, 30% of all cells counted) were subdominant phyla (Table 5). These three phyla represented 86% of all cells counted during the 2003 sampling season. In the 3493 cells counted during this period there were 5 genera of Cyanobacteria, 20 genera of Chlorophyta, 15 genera of Ochrophyta (including 13 **diatom** genera), 3 genera of Euglenophyta (2 species of each genus), 4 genera of Dinophyta (5 species), and 2 genera of Cryptophyta identified. In May the green **algae** (Chlorophyta) and the yellow-greens and **diatoms** (Ochrophyta) were nearly equal co-dominants (36% and 30% respectively) with the cyanophytes a distant third (18%). By the June sample period these three phyla were of near equal abundance (26-32%/phylum). The greens and blue-greens were near codominants in August (36% and 30% respectively with the ochrophytes a distant third (19%). In September, like June, the three phyla were nearly equal (28-33%/phylum). In November the ochrophytes dominated (39% of all cells counted) with the chlorophytes a bit less common (30% of all cells counted) and the cyanophytes making up 19% of all cells counted. The other three phyla (Euglenophyta, Dinophyta, Cryptophyta) made up only 14% of all cells counted across the 2003 samples and one of these phyla was never more than 8% of all cells counted in a single sample (Figure 16).

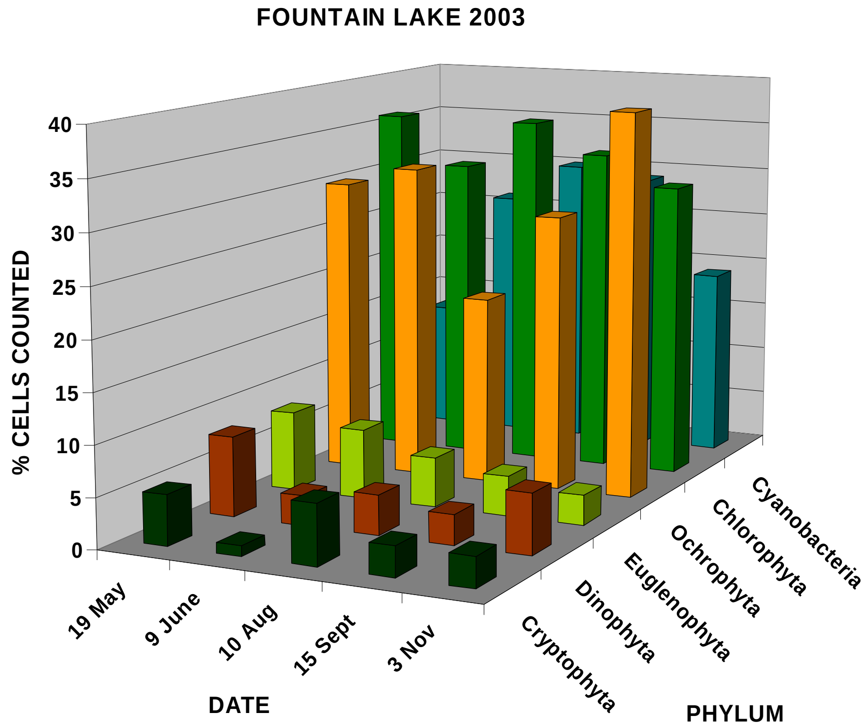
**Table 5. Algal phyla and mean seasonal composition in Fountain Lake from May to November 2003.**

FOUNTAIN LAKE

| PHYLUM | % CELLS COUNTED BY PHYLUM AND DATE | | | | | **MEAN** |
|---|---|---|---|---|---|---|
| | 19 May | 9 June | 10 Aug | 15 Sept | 3 Nov | |
| Cyanobacteria | 13 | 26 | 30 | 29 | 19 | 23 |
| Chlorophyta | 36 | 31 | 36 | 33 | 30 | 33 |
| Ochrophyta | 30 | 32 | 19 | 28 | 39 | 30 |
| Euglenophyta | 8 | 7 | 5 | 4 | 3 | 5 |
| Dinophyta | 8 | 3 | 4 | 3 | 6 | 5 |
| Cryptophyta | 5 | 1 | 6 | 3 | 3 | 4 |

*Terms in bold, see glossary pp 19-24

**Figure 16. Algal community composition by date in Fountain Lake from May to November 2003 (total phylum cells counted divided by total cells counted).**




At the genus level of abundance there was also much diversity in the algae of Fountain Lake (Figure 17).Cyanophytes, chlorophytes, and ochrophytes filled all 15 of the most abundant slots. The small, nonmotile, unicellular green algal genus *Ankistrodesmus*; the large nonmotile coenobic colonial genus *Scendesmus*; and the unicellular desmid *Staurastrum* occupied five of the 15 top slots with each of them dominating one sample period (May, August, September, respectively). **Diatoms** filled the other two top slots and 6 of the 15 top spots. The elongate unicellular **diatom** genus *Synedra* and the oval, raphid **diatom** species *Cocconeis* each made three appearances in the top 15 list and each was the dominant taxa during one sampling period. Cyanobacterial genera took the other four spaces in the top 15 but never more than third most abundant. The small colonial genus *Coelosphaerium* and two filamentous genera (unbranched, heterocystous *Anabaena* and unbranched, nonheterocystous *Oscillatoria*) were the most common blue-green algae (Table 6).

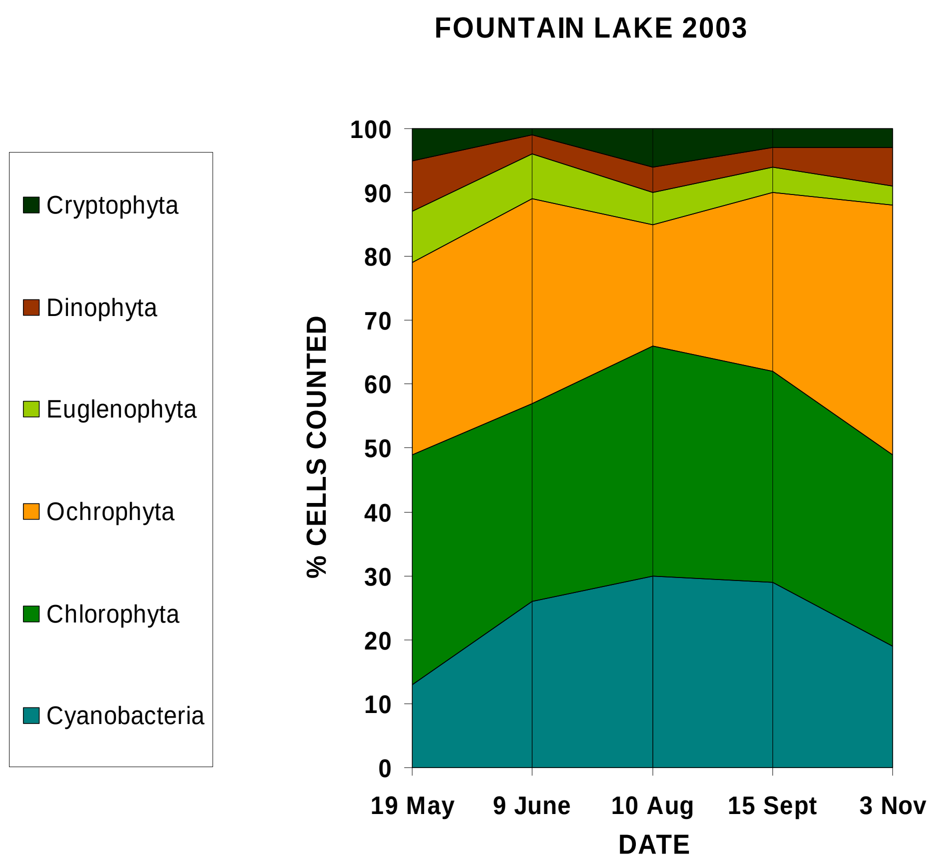
The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Fountain Lake presents a picture of an **oligotrophic** lake. The 53 genera identified during the sample periods were relatively common and none of those that reached numerical dominance in the sample counts are associated with toxins or health issues (with the possible exception of the cyanophyte *Anabaena* that can produce toxins). The water **clarity** in Fountain Lake was good to very good during all algal sampling periods, also indicative of an **oligotrophic** lake.

*Terms in bold, see glossary pp 19-24

**Table 6. Most common algal genera by date in Fountain Lake from May to November 2003.**

| DATE | TOP THREE TAXA (MOST ABUNDANT, LEFT TO RIGHT) | | |
|---|---|---|---|
| 19 May | *Ankistrodesmus* | *Synedra 2* | *Cocconeis* |
| 9 June | *Synedra 2* | *Ankistrodesmus* | *Coelosphaerium* |
| 10 August | *Scenedesmus* | *Synedra 2* | *Coelosphaerium* |
| 15 September | *Staurastrum* | *Cocconeis* | *Anabaena* |
| 3 November | *Cocconeis* | *Staurastrum* | *Oscillatoria* |

**Figure 17. Algal community composition by phylum in Fountain Lake from May to November 2003.**




*Terms in bold, see glossary pp 19-24

**Fountain Lake Study Highlights**

- Fountain Lake sits adjacent to a wetland to the west and steep slopes along the northern and eastern shores. The lack of development gives it great scenic value and provides excellent habitat.
- About 62% of the Fountain Lake shoreline is vegetated shoreline, 36% is narrow wetlands and 2% of the lake's shoreline is considered to be highly disturbed.
- Some of the key features of this habitat include areas of marsh with large amounts of submergent, emergent, and floating-leaf vegetation as well as downed trees. The good news is that there is minimal shoreline alteration on Fountain Lake, which provides numerous areas of ideal amphibian and reptile habitat. There is a small amount of recreational use on the lake which may affect amphibian populations.
- The flora of Fountain Lake is fairly typical of a **hard water** lake. Stonewort is the most abundant submersed **macrophyte**, with sago pondweed, bush-pondweed, common water-milfoil, and Illinois pondweed common. Much of the shore holds native vegetation, although cattails and reed canary-grass seem to be increasing. Slim-stem reedgrass, a special concern species, has not been relocated in recent years, but it is a fairly imconspicuous grass, and may have been overlooked. Maintaining native vegetation on the shore is probably the best way to guard against further spread of these invaders. Because the lake could probably support a large population of Eurasian water-milfoil, special care is needed to prevent this plant from becoming established.
- The sport fish population in this lake is largemouth bass, bluegill and yellow perch. The lake had the best population of rock bass of the ten lakes sampled in this study. Nine species of fish were collected from Fountain Lake in 2002-2003. Ten species or 59% of the total known fauna, more than any other lake, was lost or not observed in the 2002-2003 survey. This large percentage loss of species may in part be the result of the addition of the small dam which would effectively block upstream movement of stream species that would only occasionally be found in the lake environment. This could explain the loss of the banded darter, a stream fish, which could only be sustained in a lake environment if a population had access to riverine spawning habitat. Other species not found include black crappie, black bullhead, white sucker, golden shiner and central mudminnow which are all common inhabitants of central Wisconsin waters.
- Suitable **substrate** is present for spawning of most sport fish species present in the lake as indicated by abundant young of year for all species except yellow perch. Fountain Lake is dominated by Chara which blankets much of the lake bottom and provides substantial cover for small fish. Pondweed and pond-lily beds provide a diversity of submerged and floating cover for larger fish. Much of the southern shoreline is forested and several areas of partially submersed standing timber were noted. Because this lake has not been developed, it would serve as a good example for shoreline restoration efforts in other area lakes that have undergone more extensive shoreline disturbance.

*Terms in bold, see glossary pp 19-24

- **Nitrate** concentrations in Fountain Lake are elevated and high enough to produce **algae** blooms throughout the summer, however since the **phosphorus** concentrations are low throughout the year, nuisance **algae** blooms were not observed. **Atrazine** was found in low concentrations in the lake water (0.06), 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 Fountain Lake.
- **Groundwater** was flowing into the lake at 73% of the sites indicating that **groundwater** is a major contributor of water and water quality in Fountain Lake. Sixty-seven percent of the samples had elevated **chloride** concentrations, and 50% of the samples had elevated **nitrate**. All three samples that were analyzed for triazine (atrazine) had detectible concentrations.
- The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Fountain Lake presents a picture of an **oligotrophic** lake. The **algae** species were relatively common and none of those that reached numerical dominance in the sample counts are associated with toxins or health issues (with the possible exception of the cyanophyte *Anabaena* that can produce toxins). The water **clarity** in Fountain Lake was good to very good during all algal sampling periods, also indicative of an **oligotrophic** lake.

## 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 $CaCO_3$.

**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 ($NO_3$) 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 ($NH_4^+$) form, but at high pH values the toxic ammonium hydroxide ($NH_4OH$) occurs. The water quality standard for fish and aquatic life is 0.02 mg/L of $NH_4OH$. At a pH of 7 and a temperature of 68$^o$ F (20$^o$ 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.

*Terms in bold, see glossary pp 19-24

**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 ($N_2$) from the air to provide their own nutrient.

**Chloride (Cl-):**

Chlorine in the chloride ion ($Cl^-$) form has very different properties from chlorine gas ($Cl_2$), 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.

**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 Basin:**

The total land area that drains toward the lake.

**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.

**Endocrine:**

An integrated system of small organs that involve the release of extracellular signaling molecules known as hormones. The endocrine system is instrumental in regulating metabolism, growth, development and puberty, tissue function, and also plays a part in determining mood.

**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.

**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 $CaCO_3$. Amount of hardness relates to the presence of soluble minerals, especially limestone, in the lake watershed. Moderately hard water has 61-120 mg/L $CaCO_3$, hard water has 121-180 mg/L $CaCO_3$, and very hard water has more than180 mg/L $CaCO_3$.

*Terms in bold, see glossary pp 19-24

**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 ($CaCO_3$) 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"

**Nitrate ($NO_3^-$):**

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 ($NO_3$-N) plus ammonium-nitrogen ($NH_4$-N) of 0.3 mg/L in spring will support summer algae blooms if enough phosphorus is present.

**Nitrite ($NO_2^-$):**

A form of nitrogen that rapidly converts to nitrate ($NO_3^-$) and is usually included in the $NO_3^-$ 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.

*Terms in bold, see glossary pp 19-24

**Photosynthesis:**

The process by which green plants convert carbon dioxide ($CO_2$) 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.

**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.

**Soft Water:**

Water with less than 60 mg/L CaCO3 (see Hard water).

**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 ($SO_4^{--}$):**

The most common form of sulfur in natural waters. The amounts relate primarily to soil minerals in the watershed. Sulfate ($SO_4^{--}$) can be reduced to sulfide ($S^{--}$) and hydrogen sulfide ($H_2S$) 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 ($SO_2$) 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.