Lake County, Illinois

2013 Albert Lake Summary Report

Prepared by the Environmental Services

LAKE COUNTY HEALTH DEPARTMENT

Population Health Environmental Services

Albert Lake

Albert Lake is located Ela Township and partially in the Village of Long Grove and Killdeer. The lake was created in the 1950's when a rock dam was constructed and flooded the surrounding area forming a shallow lake 18.7 acre lake. This dam failed and was replaced with the current dam by Hawthorne Developers. Albert Lake has a mean depth of 1.0 and maximum depth of 4.0 feet. The shoreline of the lake is approximately one mile long and dominated by a mix of wetland and woodland. The lake's main use appears to be aesthetics since the shallow morphology of the lake prevents recreational use activities such as boating, fishing and swimming. No gas motors are permitted on the lake. Albert Lake is part of the Buffalo Creek sub basin, which is within the Des Plaines River Watershed.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature, water clarity were measured from May-September 2013. The 2013 water quality sampling locations were different from 2001. The 2013 inlet sample was taken upstream from the previous location. The 2001 outlet sample was taken above the dam while the 2013 samples were taken below the dam near

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Lake Facts:

Major Watershed: Des Plaines

Sub-Watershed: Buffalo Creek sub basin

Location: T 43N, R 10-10E, S 26

Surface Area: 18.7 acres

Shoreline Length: 0.982 miles

Maximum Depth: 4 ft

Average Depth: 2 ft

Lake Volume: 18.7 acre-feet

Watershed Area: 1812 acres

Lake Type: Man-made impoundment.

Management Entity: Deerwood Estates Home Owners Association

Current Uses: Aesthetics

Access: Private

Deerwoods Drive. The data collected from the lake outlet will provide a representation of the in-lake water quality.

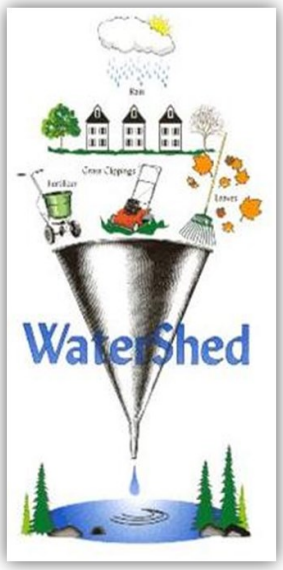
The phosphorus at the outlet in 2013 averaged 0.495 mg/L which is higher than the Illinois Environmental Protection Agency impairment rate of 0.050 mg/L. Excess phosphorus can lead to excess plant growth and algae blooms. Nitrogen is the other nutrient critical for algal growth. The average Total Kjeldahl nitrogen (TKN) concentration for Albert Lake outlet was 1.28 mg/L, which was higher than the county median of 1.170 mg/L and lower than the 2001 concentration by 46.3% (2.24 mg/L). A total nitrogen to total phosphorus (TN:TP) ratio of 22:1 indicates that phosphorus was the nutrient limiting aquatic plant and algae growth in Albert Lake.

By using phosphorous as an indicator, the trophic state index (TSIp) ranked Albert Lake as hypereutrophic with a TSIp value of 93.7. This means that the lake has excessively high nutrients. These lakes are often pea-soup green, with poor water clarity and are susceptible to winter fish kills. As a result, rough fish such as carp dominate Albert Lake. The 2013 average total suspended solids (TSS) concentration for Albert Lake was 10.01 mg/L, which was greater than the county median (8.0 mg/L).

Albert Lake has a large watershed that contributes to the high concentrations of chloride in the lake primarily from road salts. The conductivity of Albert Lake outlet was 0.8974 mS/cm which is higher than the county median (0.7875 mS/cm). This was a 5% decrease from the 2001 average (1.0363 mg/L). The chloride concentration in Albert Lake in 2013 was 137 mg/L which was higher than the county median of 145 mg/L.

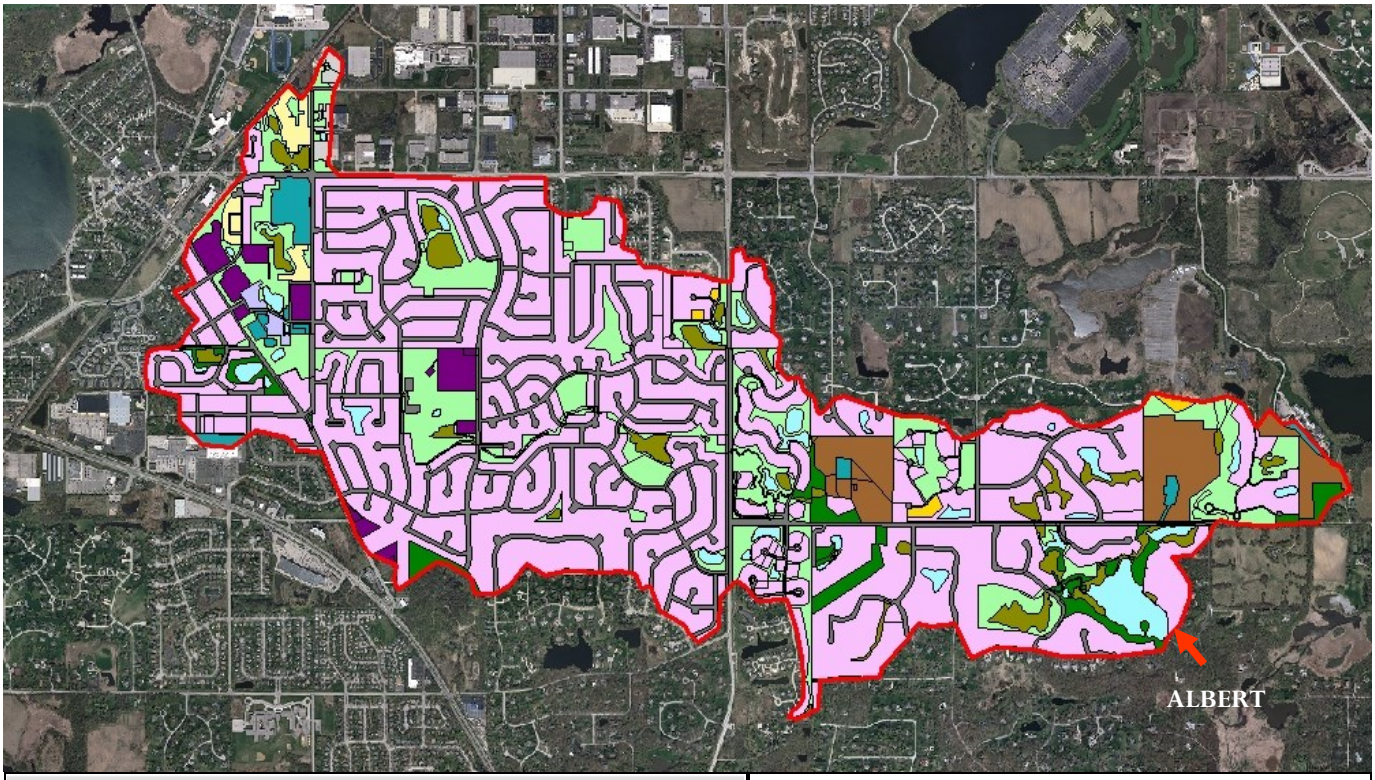
The plant community was assessed in September when most of the plants were likely to be present. Curlyleaf Pondweed which are usually gone by the end of July were still found in 17 sampling points. These are exotic and invasive species that tend to crowd out native species when left untreated. Aquatic plant populations in Albert Lake have increased. In 2001, only 7% of the sampled areas had plants while 100% of the area sampled in 2013 had plants. The density of plants had also increased with 15 of the 22 sites having 40-90% coverage. Flatstem pondweed is a new addition that was not observed in the 2001 aquatic plant survey. Curlyleaf pondweed was the only non-native invasive plant observed.

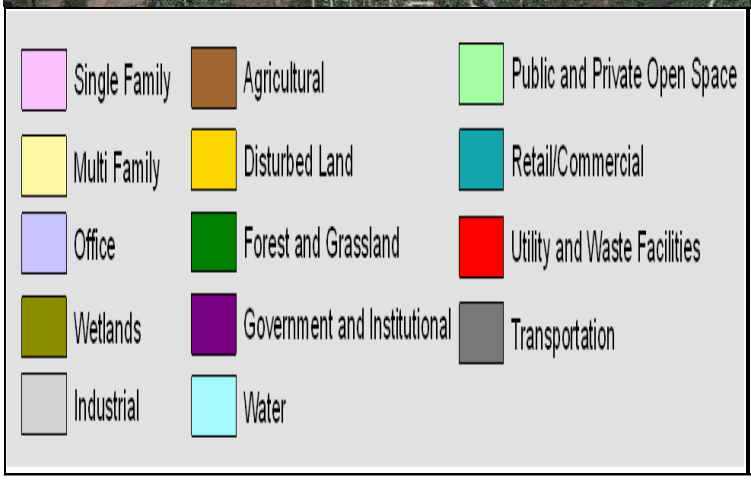
ALBERT LAKE WATERSHED

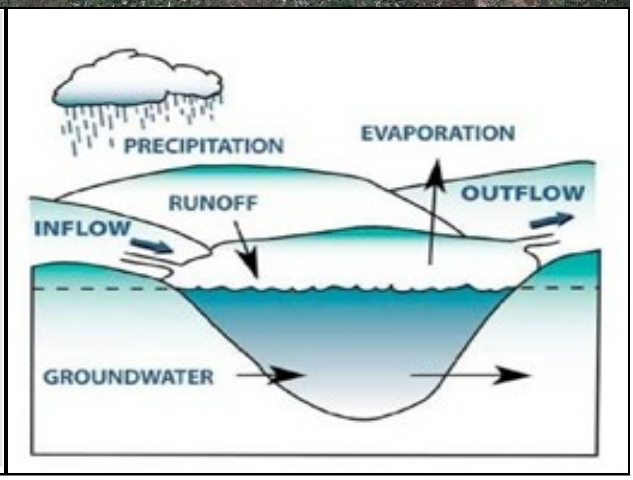


The lake is located in the Buffalo Creek sub basin, within the Des Plaines River watershed. A watershed is a drainage basin where water from rain or snow melt drains into a body of water, such as a river, lake, reservoir, wetland or storm drain. This watershed covers 1812 acres of which 993 acres are residential areas. The source of a lake's water supply is very important in determining its water quality and choosing management practices to protect the lake. Albert Lake receives water from Buffalo Creek as it enters the lake on the west side and also receives water through a creek that originates from a pond in the Tall Oaks Subdivision to the north. The retention time, the time it takes for water entering a lake to flow out again was calculated to be approximately 3.91 days. The two major sources of runoff for Albert Lake were single family (57.4%) and transportation runoff (15.7%). The impervious surfaces (parking lots, roads, buildings, compacted soil) do not allow rain to infiltrate into the ground. Land management practices of the large amount of residential area in the water shed impacts the lake. The developed area in the Albert Lake watershed is 86.5%. Controlling water that runs from the land's surface into the lake is important for drainage lakes.

ALBERT LAKE WATERSHED







ALBERT LAKE WATERSHED

The Albert Lake is on-line with Buffalo Creek and it is part of the Buffalo Creek sub basin which is within the Des Plaines River Watershed. It also receives water from a pond from the Tall Oaks Subdivision. Buffalo Creek winds through mostly residential areas before it enters Albert Lake from the west side of the lake. The water flows out of Albert Lake and into Buffalo Creek that eventually flowing into the Buffalo Creek Reservoir then into the Des Plains River.

The single family homes make up 57.4% of the watershed followed by transportation (16%), and Public and private open space (11.45%). The housing construction around the watershed has slowed considerably since 2001. The inflow of turbid waters are typically associated with low water clarity and high phosphorus concentration. The inflow sample collected in 2001 for TSS was 51 mg/L and in 2013 it was only 12 mg/L, which is a 76.5% reduction. The decrease in TSS led to an increase in water clarity and aquatic plant density in Albert Lake in 2013. The inflow of phosphorus also declined by 81% from 0.315 mg/L (2001) to 0.06 mg/L (2013). The retention time for Albert Lake is 3.91 days.

Lake Level

Permanent Staff Gage at Third Lake

Albert has a large watershed that covers 1812 acres, which helps replenish water lost through evaporation during the summer. It is recommended in the future that a staff gauge be installed and a staff gauge readings be taken weekly or bi-weekly if possible. This will give lake managers a much better idea of lake level fluctuations relative to rainfall events and can aid in future decisions regarding lake level. A staff gauge is a great tool for measuring water level in lakes, rivers, reservoirs. The data collected can be compiled to help understand the natural fluctuations of the lake. Large fluctuations in lake level can lead to shoreline erosion.

Water Quality & VLMP

Water clarity is an indicator of water quality related to chemical and physical properties. Measurements taken with a Sechhi disk indicate the light penetration into a body of water. Algae, microscopic animals, water color, eroded soil, and resuspension of bottom sediment are factors that interfere with light penetration and reduce water transparency. If light penetration is reduced significantly, macrophyte growth may be decreased which would in turn impact the organisms dependent upon them for food and cover. Participation in the Illinois Environmental Protection Agency's (IEPA) Volunteer Lake Monitoring Program (VLMP) would provide Albert Lake with a historical VLMP data that can be used to determine long term water quality trends and support current lake management decision making. Contact the LCHD for more information.

Volunteer Lake Monitor Program

Volunteers measure water clarity using the Secchi disk twice a month May through October. In 2013 there were **42 lakes** participating in Lake County.

If you would like more information please contact:

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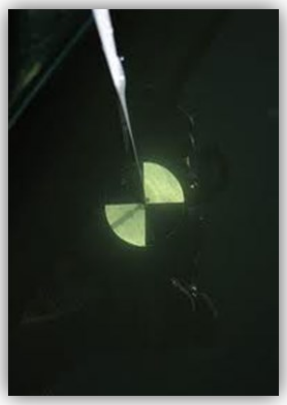
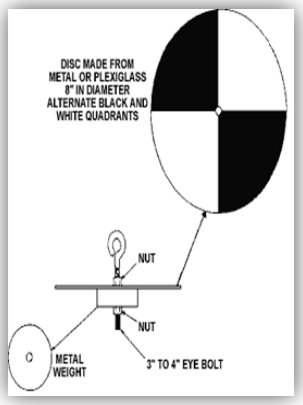




Total Suspended Solids

Turbidity is another measure of water clarity, which is caused by particles of matter rather than the dissolved organic compounds. Suspended particles dissipate light, which may limit the depth plants can grow. Reduced lake vegetation allows for algal blooms to proliferate due to the lack of competition for nutrients and light by plants.

The total suspended solid (TSS) parameter (turbidity) is composed of nonvolatile suspended compounds (NVSS), non-organic clay or sediment materials, and volatile suspended solids (TVS) (algae and other organic matter). High TSS values are typically correlated with poor water clarity and can be detrimental to many aspects of the lake ecosystem such as the plant and fish communities.

The 2013 TSS concentrations at the Albert Lake outlet averaged 10.0 mg/L which was above the county median of 8.0 mg/L and 86% lower than the 2001 average concentration of 75.1 mg/L. The high TSS concentration at the outlet in 2001 was a result of high carp densities in the lake and new housing construction with in the watershed. It should be noted that the 2001 sample was taken at outlet above the dam and the 2013 sample was taken at the outlet below the dam. The NVSS for the 2013 outlet sample was only 2.4 mg/L which means that a small amount of the suspended solids was sediment.

The 2013 inlet TSS concentration average was 15.3 mg/L which was a 70% decrease from the 2001 concentration of 50.8 mg/L. The high TSS (inlet) from 2001 coincided with new subdivisions being built along Buffalo Creek. Runoff from construction sites and disturbed land may have drained into the creek and eventually to Albert Lake.

There are no new construction occurring along Buffalo Creek upstream from Albert Lake which may be the reason why the TSS concentrations have dropped significantly. Construction sites and disturbed land along with wind and rain can add significant amount of sediment into the watershed. The NVSS for the 2013 inlet sample is 6.6 mg/L which means that less than half of the suspended solids are sediment. The outflow TSS concentration for 2013 was lower than the inflow concentration while this was not the case in 2001. A possible explanation is a decrease in carp population in Albert Lake along with an increase in aquatic plants have stabilized the lake sediment. Less carp means that there is less resuspension of sediments in the lake. This can eventually lead to a lake with better water clarity and a healthier aquatic plant population. With an average depth of 1 foot, wind and wave action can resuspend bottom lake sediments. A healthy aquatic plant population can stabilize lake sediment. Shoreline erosion and runoff contributes to the amount of TSS in the lake. Planting buffer strips along the shoreline will reduce sediments from entering the lake.

TSS

Total Suspended Solids

TSS are particles of algae or sediment suspended in the water column.

TVS

Total Volatile Solids

TVS represents the fraction of total solids that are organic in nature, such as algae cells

NVSS

Non-Volatile Suspended Solids

NVSS represents the non-organic clay and sediments that are suspended in the water column.

TDS

Total Dissolved Solids

TDS are the amount of dissolved substance such as salts or minerals in the water after evaporation.

Albert Lake Inlet

Albert Lake

Albert Lake Outlet

What Has Been Done to reduce phosphorus levels in albert lake

July 2010- The State of Illinois passed a law to reduce the amount of phosphorus content in dishwashing and laundry detergents.

July 2010- The State of Illinois passed another law restricting the use of lawn fertilizers containing phosphorus by commercial applicators.

Storm drains lead to the nearest lake, river, pond or wetland. They do not go to a treatment plant.

Salts dissolve and move downhill or into the nearest storm drain with storm-water and snowmelt runoff to the nearest lake, river or pond. They do not settle out; they remain in the water cycle virtually forever.

Nutrients

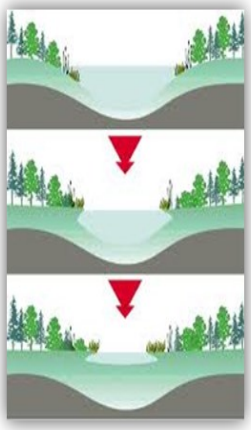
Organisms need nutrients to live or grow and are typically taken in from its environment. The primary nutrients needed for aquatic plants and algal growth are phosphorus and nitrogen. In most lakes, including Albert Lake, phosphorus is the limiting nutrient, which means everything that plants and algae need to grow is available in excess: sunlight, warm temperature, and nitrogen. Phosphorus has a direct effect on the amount of plant and algal growth in lakes. The 2013 average total phosphorus concentration at the inlet was 0.060 mg/L. The phosphorous concentration at the outlet of Albert Lake was 0.495 mg/L which indicates that water was picking up phosphorous as it passes through the lake. The source of this in-lake phosphorous is believed to be coming from resuspended sediments. Phosphorous bound to the sediments are likely released by the common carp's spawning and bottom-feeding activity which stirs up bottom lake sediments. Lakes with TP concentrations exceeding 0.05 mg/L can support high densities of algae and aquatic plants, which can reduce water clarity and dissolved oxygen levels and are considered impaired by the IEPA. Phosphorus originates from a variety of other sources, many of which are related to human activities which include: human and animal waste, soil erosion, detergents, septic systems, common carp, and runoff from farmland and lawns. A watershed plan should not ignore these sources of nutrients since everything flows downstream it affect Buffalo Creek Reservoir which eventually flows into the Des Plains River. Nitrogen is the other nutrient critical for algal growth. Total Kjeldahl nitrogen is a measure of organic nitrogen, and is typically bound up in algal and plant cells. The average 2013 TKN for Albert Lake inlet sample was 0.99 mg/L a 39% decrease from the 2001 concentration (1.28 mg/L) but below the county median. The average 2013 TKN at the outlet was 1.156 mg/L a 46.43% decrease from 2001 (2.24 mg/L).

Conductivity and Chloride

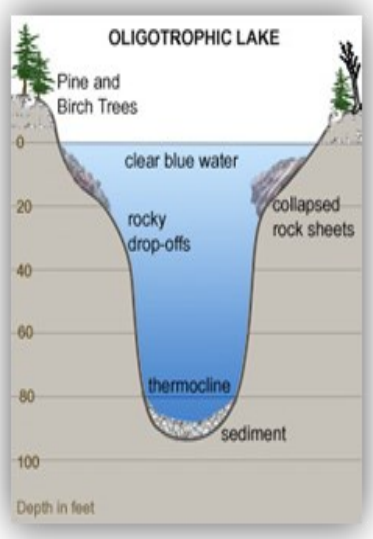
Conductivity is a measure of a waters ability to conduct electricity, which is a measure of the water's ionic activity and content. The higher the concentration of (dissolved) ions the higher the conductivity. Conductivity readings, which are influenced by chloride concentrations, have been increasing throughout the past decade in Lake County. Lakes with residential and/or urban land uses in their watershed often have higher conductivity readings and higher Cl^- concentrations because of the use of road salts. Storm water run-off from impervious surfaces such as roads and parking lots can deliver high concentrations of Cl^- to nearby water bodies. Road salt used in the winter road maintenance consists of the following ions: sodium chloride, calcium chloride, potassium chloride, magnesium chloride, or ferrocyanides which are detected when chlorides are analyzed. The 2013 average conductivity for Albert Lake outlet was 0.8974 mS/cm. This parameter was above the county median of 0.7875 mS/, a 34.16% decrease from the 2001 value of 1.0363 mS/cm. These values are influenced by the winter road maintenance of residential areas west of Albert Lake. The United States Environmental Protection Agency has determined that chloride concentrations higher than 230 mg/L can disrupt aquatic systems and prolonged exposure can harm 10% of aquatic species. Albert Lake's Cl- was 137 mg/L at the outlet Chlorides tend to accumulate within a watershed as these ions do not break down and are not utilized by plants or animals. High chloride concentrations may make it difficult for many of our native species to survive. However, many of our invasive species, such as Eurasian watermilfoil, Cattail and Common Reed, are tolerant to high chloride concentrations. Limiting the amount of salt laid down on the roads will help reduce the runoffs that enter the lake.

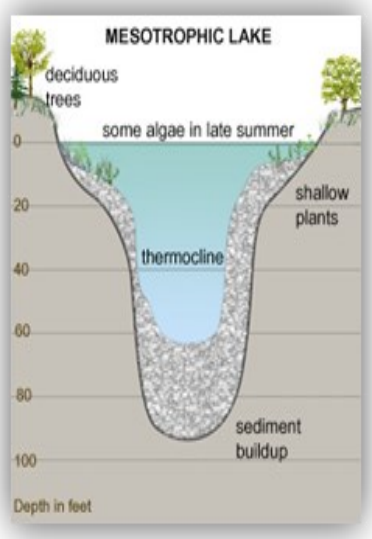
TROPHIC STATE INDEX

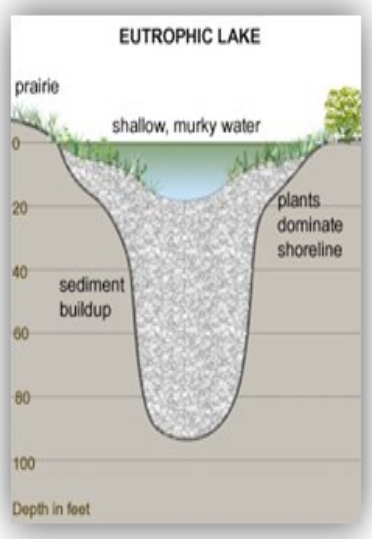
Another way to look at phosphorus levels and how they affect lake productivity is to use a Trophic State Index (TSI) based on phosphorus (TSIp). TSIp values are commonly used to classify and compare lake productivity levels (trophic state). A lakes response to additional phosphorus is an accelerated rate of eutrophication. Eutrophication is a natural process where lakes become increasingly enriched with nutrients. Lake start out with clear water and few aquatic plants and over time become more enriched with nutrients and vegetation until the lake becomes a wetland. This process takes thousands of years to take place. However, human activities that supply lakes with additional phosphorus that drives Eutrophication is speeding up this process significantly. The TSIp index classifies the lake into one of four categories: oligotrophic (nutrient-poor, biologically unproductive), mesotrophic (intermediate nutrient availability and biological productivity), and eutrophic (nutrient rich, highly productive), or hypereutrophic (extremely nutrient-rich, productive). In 2013, Albert Lake was eutrophic with a TSIp Value of 93.7, placing it 172th out of 175 lakes in the county. Lake Carina was 1st at 37.35



Eutrophication Process







Source: RMB Environmental

CARP (CYPRINUS CARPIO)

Common Carp

(Cyprinus Carpio)

Carp are considered to be one of the most damaging invasive fish species. Originally introduced to the Midwest waters in the 1800's as a food fish, carp can now be found in 48 States. In the U.S., the common carp is more abundant in manmade impoundments, lakes, and turbid sluggish streams and less abundant in clear waters or streams with a high gradient (Pflieger 1975; Trautman 1981; Ross 2001; Boschung and Mayden 2004). They are also highly tolerant of poor water quality.

The common carp has a dark copper-gold back with sides that are lighter, a yellowish belly and olive fins. They have 2 pairs of short barbells on their upper lip and their dorsal and anal fins have a leading spine that are serrated.

Carp spawn from early spring to late summer in water ranging from 15 – 28 C and prefer freshly flooded vegetation as spawning substrate. They prefer to spawn in shallow weedy areas in groups consisting of one female and several males. A single female can produce up to 100,000-500,000 which hatch in 5-8 days. The spawning ritual involves a lot of thrashing in shallow water contributing to turbidity problems.

They are omnivorous and feed over soft bottom substrate where they suck up silt and filter out crustaceans, insect larvae and other desirable food items. Carp are very active when feeding and can be observed around shallow areas where they uproot plants which increases turbidity and nutrient concentrations. Increase in nutrients causes algal blooms and reduction in light penetration that impacts aquatic plants.

There are several ways to control the carp population in a lake. The use of Rotenone (picicide) may be used to eradicate carp from a lake. However, it may be expensive because you may have to treat the entire creek to prevent carp from repopulating the lake. Rotenone is approved for use as a piscicide by the USEPA and has been used in the U.S. since the 1930's. It is also biodegradable and there is no bioaccumulation. Warm-blooded mammals have low toxicity because they have natural enzymes that would break down the toxin.

Treating the entire system would eradicate carp and allow aquatic plants to become established. Unfortunately, the concentration required to remove carp are high enough to kill native fish species. Native fish species can be restocked 30-50 days after treatment.

Introducing predator fish such as bass and northern pike may not be feasible because Albert is a very shallow lake and this increases the possibility of a winter kill. Removal of carp would increase lake clarity and allow aquatic plants to grow. This will help increase DO levels and reduce TP and TSS concentrations.

PROTECT YOUR WATERS

- Remove all plants, mud, fish, or animals before transporting equipment.
- Eliminate all water from equipment before transporting equipment.
- Dry anything that comes in contact with water (boat, trailers, equipment, clothing, etc.).
- Remove all mud and dirt since it might contain aquatic hitchhikers.
- Never release plants, fish or animals into a body of water unless they came out of that body of water.
- Do not release bait into the waters you are fishing.
- Do not release aquarium fish or aquatic pets in to the lake.

Blue-green Algae

Algae are important to the freshwater ecosystems, and most species of algae are not harmful. Algae blooms are often caused by blue-green algae, or "cyanobacteria", which are similar to bacteria in structure but utilize photosynthesis to grow. They have no nucleus and lack the photosynthetic pigments found in algae. They are usually too small to be seen individually, but can form visible colonies that can cover large areas of lakes. Certain species of blue-green algae can produce toxins that could pose a health risk to people and animals when they are exposed to them in large enough quantities.

Blooms can last for an extended period of time, which prevents sunlight from reaching underwater plants and algae that are important to the ecosystem.

The water can appear blue-green, bright green, brown, or red and may look like paint floating on the water.

Not all blue-green algae produce harmful toxins. The three types of cyanobacteria that are often associated with Harmful Algal Bloom (HAB) are the Anabaena, Aphanizomenon, and Microcystis. The presence of these cyanobacteria does not generally mean that the toxins are present in the water. The presence of toxins can only be verified through a sample analyzed in the lab.

Poisoning has caused the death of cows, dogs, and other animals. Most human cases occurred when people swim or ski in affected recreational water bodies during a bloom. Do not let pets drink the lake water.

If you suspect that you are experiencing symptoms related to exposure to blue-green algae such as stomach cramps, diarrhea, vomiting, headache, fever, muscle weakness, or difficulty breathing contact your doctor or the poison control center. For more information or to report a blue-green algae bloom, contact the Lake County Health Department Environmental Services (847) 377-8030.

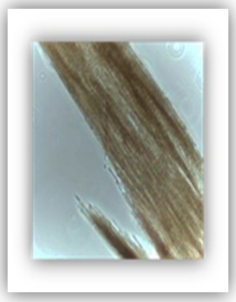
For More Information On Blue-green algae:
www.epa.state.il.us/water/surface-water/blue-green-algae.html

To report blue-green algae bloom:
Lake County Health Department

847-377-8030

Anabaena Sp.

Microcystis Sp.



Aphanizomenon Sp.

AQUATIC PLANTS

Sago Pondweed

Duckweed

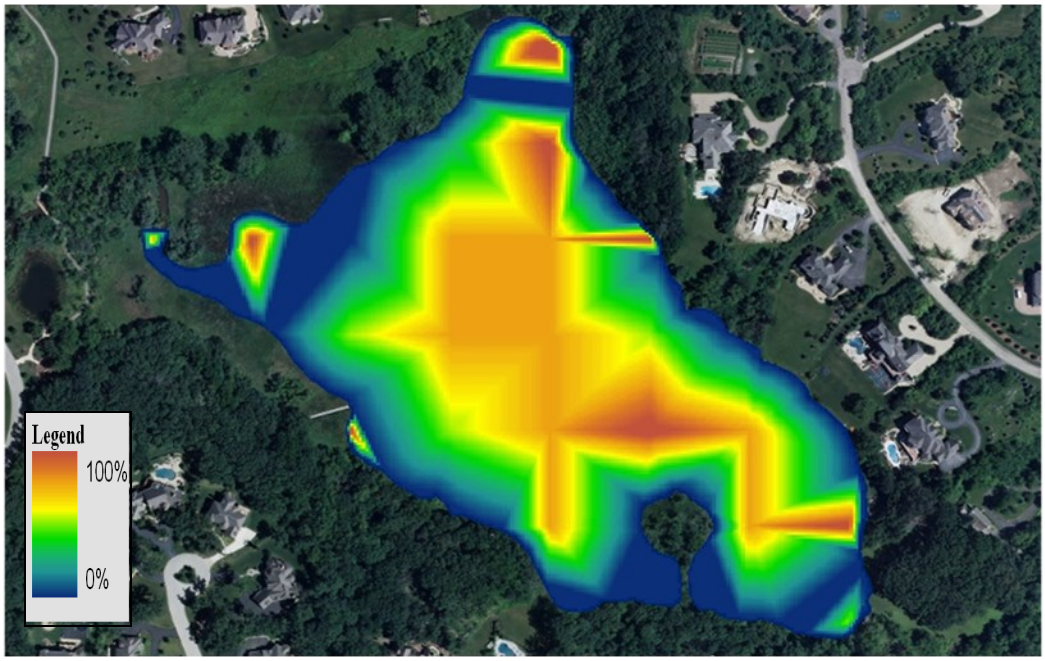
Flatstem Pondweed

An aquatic plant mapping survey provides information based on the species, density and distribution of plant communities in a particular lake. Water clarity and depth are the major limiting factors in determining the maximum depth at which aquatic plants will grow. In 2001 a few plants were found Albert Lake due to poor water clarity which may have been caused by carp activity. An aquatic plant sampling was conducted on Albert Lake on Sept 19, 2013. There were 22 points generated based on a computer grid system with points 60 meters apart. Aquatic plants occurred at all of the sites that included five aquatic plant species, including one exotic invasive species: Curlyleaf Pondweed. The overall area covered with plants increased from 7% of the sampling sites in 2001 to 100% in 2013. Plants were found at a maximum depth of 4.0 feet. The most commonly occurring species were Duckweed and Curlyleaf pondweed at 90.9% and 77.3%, respectively, followed by Coontail (50%), Sago Pondweed (40.2%), and Flatstem Pondweed (9.1%). Flat stem pondweed was not observed in during the 2001 survey. Small shallow lakes are susceptible to seasonal changes, aquatic plant population can improve with a reduction of carp which can lead to improved water clarity. Aquatic plants stabilize lake sediments and reduces the effects of wave driven resuspension of sediments. Aquatic plants play an important role in the lakes ecosystem by providing habitat for fish and shelter for aquatic organism. Plants provide oxygen, reduce nutrients such as phosphorus to prevent algae bloom, and help stabilize sediment. Non-native plants often crowd out native plants by growing earlier in the year or by forming canopies that block sunlight.

Removal of Curlyleaf Pondweed will allow native plants to become estalished. Treatment should be done prior to the formation of turions, which grow into new plants by early spring.

Rake Density (coverage)	# of Sites	% of Sites
No Plants	0	0
>0-10%	1	5
10-40%	5	23
40-60%	9	41
60-90%	6	27
>90%	1	5
Total Sites with Plants	22	100
Total # of Sites	22	100

DISTRIBUTION OF RAKE DENSITY ACROSS ALL SAMPLES SITES IN 2013



Curlyleaf pondweed

Curlyleaf Pondweed is a non-native aquatic plant that was first discovered in Illinois in the late 1920s. Curlyleaf pondweed is native to Asia, Europe, and Africa, Curlyleaf is now found across the North American in ponds, lakes, rivers and streams. The leaves are reddish green, stiff and wavy. It is approximately 2-3 inches long by ½ inch wide and arranged alternately around its stem. Native pondweeds have leaves with a parallel vein, while Curlyleaf have veins branching from mid-vein and small teeth like projections along the edge. Curlyleaf are rooted to the bottom of the lake and this allows the plant to grow in areas with moderate flow.

Curlyleaf has a distinct advantage over native aquatic plants because it starts growing before the ice has melted off the lake. This allows the invasive plant grow rapidly and form dense canopies by mid-spring which usually displaces native plant species. The next generation of Curlyleaf depends on the creation of vegetative propagules, called turions, which are produced at the late stages of the plant. Turions are hardened stem and leaf structure found at the tips of the plant which disperses and lay dormant on the bottom of the lake during summer. When the rest of the native aquatic plants recede and die off in the fall, the turions begin to germinate and continue to grow under the ice.

As Curlyleaf finally reach the end of its cycle by mid-July, large amount of vegetation begins to decay causing available oxygen to drop. The anoxic condition in the middle of the summer can lead to fish kills. Furthermore, the nutrients released by the decaying process may trigger an algae bloom which reduces the amount of sunlight needed by native plants to grow.

Control of Curlyleaf pondweed should take place prior to the formation of the turions. The treatment should be continued for several years since some of the turions may lay dormant for a few years. Early spring application of contact herbicides diquat and endothall can be effective in reducing the amount of Curlyleaf plant shoots. As a result, turion production is also reduced . Small populations of Curlyleaf can be manually removed with a rake or by hand pulling. All plant materials should be carefully removed as floating pieces of Curlyleaf that may contain turions can float away and colonize a different part of the lake.

CURLYLEAF PONDWEED

Scientific name:

Potamogeton crispus

Common name: Curly cabbage, crisp pondweed.

Origin: Eurasia, Africa, Australia

Characteristics: Grows rapidly after ice out. Turion producer. Plants die off by July.

CURLYLEAF PONDWEED WAS OBSERVED AT 77.3% OF THE SITES ON SEPTEMBER 17, 2013. THE MAXIMUM DEPTH THAT PLANTS WERE FOUND WAS 4 FEET.

Curlyleaf turion

PESTICIDE PERMIT REQUIREMENTS FOR PESTICIDE APPLICATION

FOR FULL DETAILS OF THE RULE SEE:

HTTP: / / WWW.EPA.STATE.IL.US/WATER/PERMITS/PESTICIDE/INDEX.HTML

A National Pesticide Elimination System (NPDES) permit is required when pesticides are applied to, over or near the waters of the State. This permit applies to all public waters that have an outflow to the State waters. A Notice of Intent (NOI) must be filled and submitted electronically to the Illinois Environmental Protection Agency (IEPA) at least 14 days prior to any application of pesticides.

- When is a NPDES permit needed?

Prior to any pesticide application made directly to, over or near waters of the state.

- Who should obtain NPDES permit coverage?

The individual pond owner who will apply the herbicide. If the pond owner hires a contract applicator either the contract applicator or the pond owner could apply for NPDES coverage.

- How do I apply for NPDES permit coverage?

File a Notice of Intent (NOI) with the IEPA. The form can be printed from the site listed above. Don't forget the 14 day public notice period and the information regarding the approval and notification process listed above, so plan ahead

- What does the permit cost?

Currently there is no fee however fees may be introduced at a later date.

- How long is the permit good for?

Five years from the date of issuance but not from the date of coverage.

- Is anything else needed besides the permit?

An Adverse Incident Report is needed if there are any adverse impacts related to the application such as spills or accidental overdosing. The incident must be reported to the Illinois Emergency Management Agency immediately and the report must follow within 15 days.

A Pesticide Discharge Management Plan (PDMP) is required if the annual threshold of 80 acres is past and if you do not meet any of the additional exemptions within the permit. The threshold is determined not only by the size of the pond or lake but by the number of treatments. For example, if a 10 acre pond is treated 9 times with different herbicides within a one-year period, it would be counted as 90 treatment acres and the 80 acre threshold limit would have been passed. This would trigger the need for a PDMP. If treated with the same herbicide 9 times, the additional treatments would not count toward the threshold.

- Additional things to remember

You are allowed to apply only a pesticide that is labeled for aquatic use. The General NPDES permit only applies to pesticide applications that will be made directly to or over waters of the State or at water's edge. Pesticide applications to dry ditches which discharge into waters of the State may also require General NPDES permit coverage.

You must file an updated NOI to modify your NPDES permit coverage to add additional use patterns or treatment areas at least 14 days prior to beginning the pesticide applications. The General NPDES permit coverage is good for 5 years from the issuance date on the permit.

Excerpt: Illinois DNR

Floristic Quality index

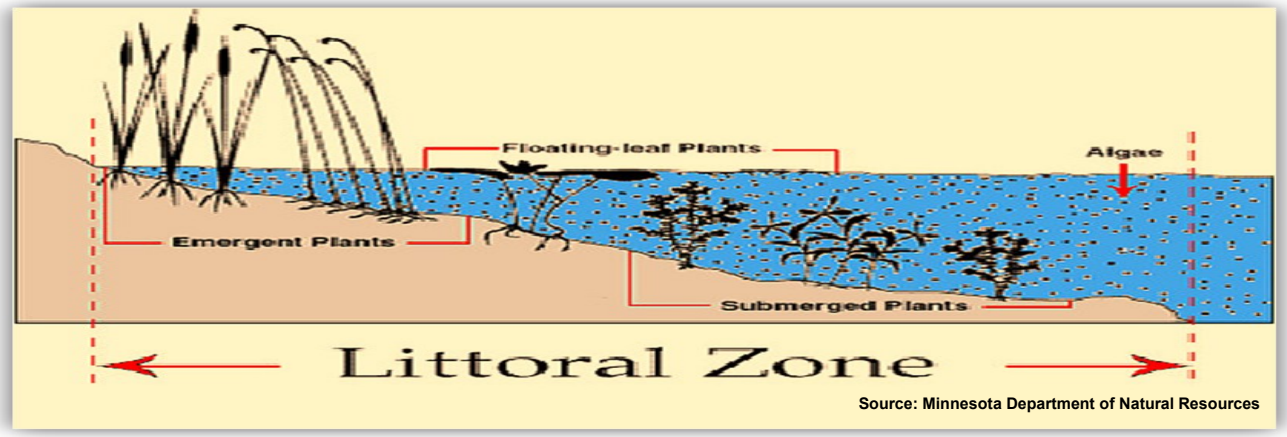
Lake County Average FQI = 13.8

Albert Lake FQI = 11.5

Rank = 95/162

Aquatic Plants Species Observed = 5

Floristic quality index (FQI; Swink and Wilhelm 1994) is an assessment tool designed to evaluate the closeness that the flora of an area is to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts. Each aquatic plant in a lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). This is done for every floating and submersed plant species found in the lake. These numbers are averaged and multiplied by the square root of the number of species present to calculate an FQI. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were counted in the FQI calculations for Lake County lakes. In 2013, Albert had an FQI of 11.5 ranking 95out of 162 in Lake County. The median FQI of lakes that we have studied from 2000-2013 is 13.8. Cedar Lake was first with an FQI of 38.0



Source: Minnesota Department of Natural Resources

In many lakes macrophytes contribute to the aesthetically pleasing appearance of the setting and are enjoyable in their own right. But even more important, they are an essential element in the life systems of most lakes. They perform a number of useful functions in maintaining the food chain of life in the lake.

- Macrophyte leaves and stems provide a habitat or home for small attached plants and animals. Some are microscopic in size and some are larger. These attached organisms are valuable as food for animals higher in the food chain, such as fish and birds.
- Many types of small organisms live in the sediment. There are insects that spend the immature stages of life in the sediments, leaving when they become adults. Decomposing plant life provides part of the food supply for these sediment dwelling organisms and the emerging insects, in turn, are food for fish.
- The submerged portions of macrophytes provide shelter and cover for small or young fish from larger fish that would feed on them.
- Types of plants that extend above the water can provide cover for waterfowl and their young, and many plants can serve directly as food for certain types of waterfowl.
- Aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available nutrients.

Excerpt: Department of Ecology, Washington state

"Vegetative buffer zones can play a key role in limiting negative water quality impacts from developed shoreland property"

The Western shoreline of Albert is lined with cattails. This prevents shoreline erosion and provides habitat for wildlife

Shoreline erosion

Erosion is a natural process primarily caused by water which results in the loss of material from the shoreline. Disturbed shorelines caused by human activity such as clearing of vegetation and beach rocks, and increasing runoff will accelerate erosion. Rain, melting snow and wave action are the main causes of erosion. Rain can loosen soil and wash it down gradient towards the lake. A shoreline assessment was conducted at Albert Lake on Sept. 19, 2013. Based on the 2013 assessment, there was a significant decrease in shoreline erosion with approximately 78% of the shoreline having no erosion. In 2001, Albert Lake had only 36.7% of the shore with no erosion. Overall, 19% had slight erosion, 2.9% had moderate, and 0% had severe erosion in 2013.

Creating a buffer helps prevent soil erosion as well as filter out pollutants and unwanted nutrients from entering the lake. Plant roots hold the soil particles in place so they are not easily washed away during a rain event, melting snow or wave action. Loose rocks and gravel placed on top of a filter fabric prevents soil from washing away before newly planted seed and vegetation has a chance to grow. Eroded materials cause turbidity, sedimentation, nutrients, and pollutants to enter a lake. Less runoff means less nutrients and other pollutants entering the lakes and streams. Excess nutrients are the primary cause of algal blooms and increased aquatic plant growth. Once in the lake, sediments, nutrients and pollutants are harder and more expensive to remove. Shore line buffer zone planted with native vegetation not only reduces runoff by increasing water infiltration into the ground, it also offers food and habitat for wildlife. Invasive plants such as purple loosestrife, buck thorn and reed canary grass can dominate areas along the shoreline. A monitoring program should be established in order to identify problem areas.

EROSION	2013	2001
None	78.0	36.7
Slight	19.0	53.8
Moderate	2.9	6.3
Severe	0	3.1
Total	100	100

SEDIMENT SAMPLE

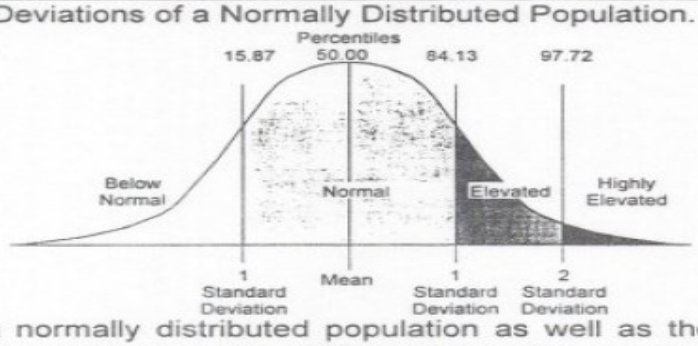
In 2013, LCHD-ES collected sediment samples for the Buffalo Creek Clean Watershed Partnership as part of an SMC watershed management board grant they received. A composite sample was taken from three locations in Albert Lake. The samples were analyzed for 136 parameters. Of the 136 parameters analyzed, 7 were above listed sediment quality guidelines. A table listing the full array of parameters tested and whether or not they exceeded limits is presented in Appendix A, Table X.

The sediment quality standards used to determine if the pollutants were above normal limits was McDonald et al., 2000 and Mitzelfelt, 1996. McDonald used two Standard Quality Guidelines (SQG). The thresh hold effect concentration (TEC) and the probable effect concentration (PEC). The TEC's were intended to identify contaminant concentrations below which harmful effects on sediment dwelling organisms were not expected (TELs; Smith et al. 1996; US EPA 1996a). The PEC's were intended to identify contaminant concentrations above which harmful effects on sediment-dwelling organisms were expected to occur frequently (MacDonald et al. 1996; Swaru 1999). Mitzelfelt either described the contaminant as elevated or highly elevated in the soils. These classifications were assigned by deviation from mean concentrations found from 273 samples of 63 Illinois lakes.

The sediments in Albert Lake whose values exceeded the SQG's did so above the TEC by McDonald's standards. Copper concentration was 36.8 mg/Kg-dry and Nickel concentration was 28.8 mg/Kg-dry which is above the minimum TEC of 31.6 mg/Kg-dry (Copper) and 22.7 mg/Kg-dry (Nickle). The Silver concentration is considered highly elevated with a concentration of 4.38 mg/Kg-dry based on Mitzelfelt. The concentration of Mercury was above the TEC , PEC and considered elevated under Mitzelfelt at 1.49 mg/Kg-dry. While mercury was found in the samples, it may be bound to the sediment and poses minimal risk . However this information may affect any sediment removal projects in the future. It is suspected that the source of at least some of the metals is the old sewage treatment plant that discharged into the creek above Albert Lake.

		Sample ID	MacDonald, et al. 2000		Mitzelfelt, 1996	
Analyte	Units	ALB 9/17/13 2:30 PM	TEC	PEC	Elevated	Highly Elevated
Copper	mg/Kg-dry	36.8	31.6	149	100 to <590	590 or greater
Nickel	mg/Kg-dry	28.8	22.7	48.6	31 to <43	43 or greater
Silver	mg/Kg-dry	4.38	NA	NA	0.1 to <1.0	1.0 or greater
Mercury	mg/Kg-dry	1.49	0.18	1.06	0.15 to <7.01	7.01 or greater

Figure 1. Standard Deviations of a Normally Distributed Population.



This figure shows a normally distributed population as well as the levels of standard deviation selected by Kelly and Hite (1981) to describe the sediment classification ranges. The percentiles are included to show how much of the population is below the given standard deviation. This information explains why the percentiles were selected for the new sediment classification. (Information from Harnett and Murphy (1980) p. 188.)

LakeCounty
Health Department and
Community Health Center

ENVIRONMENTAL SERVICES

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Population Health Services
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Phone: 847-377-8030
Fax: 847-984-5622

For more information visit us at:

http://www.lakecountyil.gov/Health/want/BeachLakeInfo.htm

Protecting the quality of our lakes is an increasing concern of Lake County residents. Each lake is a valuable resource that must be properly managed if it is to be enjoyed by future generations. To assist with this endeavor, Population Health Environmental Services provides technical expertise essential to the management and protection of Lake County surface waters.

Environmental Service's goal is to monitor the quality of the county's surface water in order to:

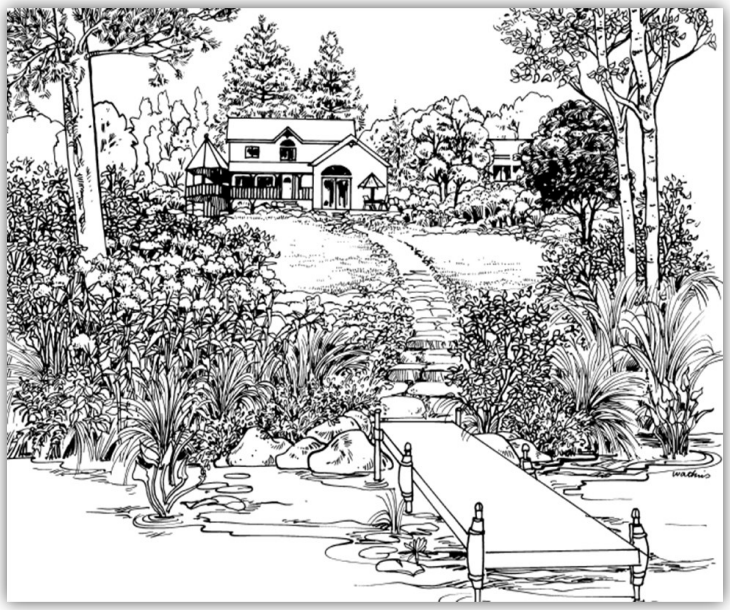
- Maintain or improve water quality and alleviate nuisance conditions
- Promote healthy and safe lake conditions
- Protect and improve ecological diversity

Services provided are either of a technical or educational nature and are provided by a professional staff of scientists to government agencies (county, township and municipal), lake property owners' associations and private individuals on all bodies of water within Lake County.

LAKE RECOMMENDATIONS

Albert's water quality has improved since 2001 with decreases in total phosphorus (TP) and total nitrogen (TN) which means that there are fewer nutrients available for algae-blooms to occur. The total suspended solids (TSS) also decreased. To improve the overall quality of Albert Lake, ES (Environmental Services) has the following recommendations:

- **Reduce or eliminate Common Carp**
- **Mitigate shorelines exhibiting erosion**
- **Encourage homeowners to incorporate native plants in their landscaping through**
  rain gardens or shoreline filter strips
- **Create a Curlyleaf Pondweed management plan in order to allow native plants to establish in the spring**
- **Participation in the Volunteer Lake Monitoring Program**
- **Install a staff gauge to monitor lake level fluctuations**
- **Assess current fish population**
- **Help reduce Cl^- by supporting wise use of road salt in the watershed**



Albert Landuse 2013

Land Use	Acreage	% of Total
Agricultural	77.32	4.3%
Disturbed Land	5.92	0.3%
Forest and Grassland	49.81	2.7%
Government and Institutional	31.49	1.7%
Industrial	22.95	1.3%
Multi Family	15.50	0.9%
Office	4.75	0.3%
Public and Private Open Space	197.88	10.9%
Retail/Commercial	24.92	1.4%
Single Family	992.74	54.8%
Transportation	271.33	15.0%
Water	56.94	3.1%
Wetlands	60.45	3.3%
Total Acres	**1812.00**	**100.0%**

Land Use	Acreage	Runoff Coeff.	Estimated Runoff, acft.	% Total of Estimated Runoff
Agricultural	77.32	0.05	10.6	0.6
Disturbed Land	5.92	0.05	0.8	0.0
Forest and Grassland	49.81	0.05	6.8	0.4
Government and Institutional	31.49	0.50	43.3	2.5
Industrial	22.95	0.80	50.5	2.9
Multi Family	15.50	0.50	21.3	1.2
Office	4.75	0.85	11.1	0.6
Public and Private Open Space	197.88	0.15	81.6	4.7
Retail/Commercial	24.92	0.85	58.3	3.3
Single Family	992.74	0.30	819.0	46.9
Transportation	271.33	0.85	634.2	36.3
Water	56.94	0.00	0.0	0.0
Wetlands	60.45	0.05	8.3	0.5
TOTAL	**1812.00**		**1745.9**	**100.0**

Lake volume	**18.70**	**acre-feet**
Retention Time (Years)= lake volume/runoff	**0.01**	**years**
Retention Time (Dayss)= lake volume/runoff	**3.91**	**days**

Albert Lake 2013 Multiparameter data

Location	Date	Temp	SpCond	Depth	pH	PAR2	DO %	DO
Inlet	5/14/2013	14.07	1.918	0.00	7.84		76.1	7.85
Outlet	5/14/2013	17.8	1.49	0.00	9		92.3	8.74
Inlet	6/11/2013	17.75	1.269	0.00	8.04		80	7.57
Outlet	6/11/2013	22.40	0.87	0.00	9.4		71.50	6.4
Inlet	7/9/2013	23.91	0.82	0.00	8.1		81.80	6.86
Outlet	7/9/2013	27.63	0.68	0.00	8.6		91.30	6.92
Inlet	8/13/2013	18.30	1.19	0.00	8.2		80.70	7.6
Outlet	8/13/2013	19.22	0.777	0.00	8.6		NA	NA
Inlet	9/10/2013	22.45	1.036	0.00	8.84		61.7	5.98
Outlet	9/11/2013	25.60	0.538	0.00	9.65		73.1	6.05

Water Quality Summary for Albert Lake Inflow 2013 and 2001.

Inflow	2013															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	Cl-	TSS	TS	TVS	SECCHI	COND	pH	DO
14-May	Surface	245	0.74	ND	0.07	0.026	0.008	1,012	210	6.0	844	177	NA	1.9180	7.8400	8.74
11-Jun	Surface	259	1.09	0.142	0.372	0.082	0.064	686	213	36.4	840	148	NA	1.2690	8.0400	7.57
9-Jul	Surface	202	0.99	ND	0.532	0.074	0.023	390	105	15.0	502	88	NA	0.6810	8.6100	8.86
13-Aug	Surface	225	1.09	ND	0.30	0.059	0.011	644	186	12.0	749	158	NA	1.1870	8.1700	7.60
10-Sep	Surface	234	1.03	0.120	0.082	0.058	0.022	568	143	7.1	661	105	NA	1.0360	8.8400	5.98
	Average	**233**	**0.99**	**NA**	**0.27**	**0.060**	**0.026**	**660**	**171**	**15.3**	**719**	**135**	**NA**	**1.2182**	**8.30**	**7.75**

Inflow	2001															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	Cl-	TSS	TS	TVS	SECCHI	COND	pH	DO
2-May	Surface	288	0.60	<0.1	0.16	0.079	0.012	1000	NA	31.3	987	259	1.02	1.5580	7.18	4.81
6-Jun	Surface	240	1.02	<0.1	0.525	0.079	0.019	634	NA	20.4	659	143	1.48	0.9853	7.36	8.42
11-Jul	Surface	224	1.57	0.230	0.051	0.301	0.121	686	NA	32.3	775	204	0.85	1.1270	7.26	1.93
8-Aug	Surface	248	1.83	<0.1	0.05	0.947	0.178	694	NA	124.0	867	210	0.49	1.2100	7.33	1.67
6-Sep	Surface	159	1.39	<0.1	0.465	0.167	0.028	432	NA	45.9	497	117	0.63	0.9202	7.27	4.44
	Average	**232**	**1.28**	**0.23k**	**0.25**	**0.315**	**0.0716**	**689.2**	**NA**	**50.8**	**757**	**187**	**0.89**	**1.1601**	**7.28**	**4.25**

Glossary

ALK = Alkalinity, mg/L $CaCO_3$	Cl^- = Chloride ions, mg/L
TKN = Total Kjeldahl nitrogen, mg/L	TSS = Total suspended solids, mg/L
NH_3-N = Ammonia nitrogen, mg/L	TS = Total solids, mg/L
NO_3-N = Nitrate + Nitrite nitrogen, mg/L	TVS = Total volatile solids, mg/L
TP = Total phosphorus, mg/L	SECCHI = Secchi Disk Depth, ft.
SRP = Soluble reactive phosphorus, mg/L	COND = Conductivity, milliSiemens/cm
TDS = Total dissolved solids, mg/L	DO = Dissolved oxygen, mg/L

Note: "k" denotes that the actual value is known to be less than the value presented.

NA = Not Applicable

* = Prior to 2006 only Nitrate was analyzed

Water Quality Summary for Albert Lake Outflow 2013 and 2001.

Outflow	2013															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	Cl-	TSS	TS	TVS	SECCHI	COND	pH	DO
14-May	Surface	152	0.97	ND	ND	0.108	0.048	797	178	14.0	640	130	NA	1.4900	9.0000	8.74
11-Jun	Surface	157	1.00	ND	ND	0.307	0.251	483	172	8.9	569	108	NA	0.8660	9.4000	6.40
9-Jul	Surface	171	1.04	ND	ND	0.762	0.617	458	83.3	10.0	416	89	NA	0.8160	8.1200	6.86
13-Aug	Surface	196	1.31	ND	0.14	0.591	0.495	438	124	4.5	483	96	NA	0.7770	8.6000	6.92
10-Sep	Surface	213	1.70	ND	0.1	0.706	0.566	318	125	13.0	506	90	NA	0.5380	9.6500	6.05
	Average	**178**	**1.20**	**NA**	**NA**	**0.495**	**0.395**	**499**	**136**	**10.1**	**523**	**103**	**NA**	**0.8974**	**8.95**	**6.99**

Outflow	2001															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	TDS	Cl-	TSS	TS	TVS	SECCHI	COND	pH	DO
2-May	Surface	229	0.59	<0.1	<0.05	0.185	0.022	846	NA	42.7	873	206	0.79	1.3480	7.81	7.31
6-Jun	Surface	215	1.66	<0.1	0.157	0.167	0.005	566	NA	71.3	635	154	0.59	0.9037	7.51	8.32
11-Jul	Surface	241	2.07	<0.1	0.051	1.160	0.616	684	NA	92.0	785	196	0.85	1.0690	7.67	2.97
8-Aug	Surface	218	4.58	<0.1	<0.05	3.880	0.754	584	NA	81.7	693	195	0.49	0.9632	7.54	2.92
6-Sep	Surface	206	2.28	<0.1	<0.05	0.555	0.11	540	NA	87.6	634	153	0.49	0.8976	7.46	2.84
	Average	**222**	**2.24**	**0.10k**	**0.104k**	**1.189**	**0.3014**	**644**	**NA**	**75.1**	**724**	**181**	**0.64**	**1.0363**	**7.60**	**4.87**

Glossary

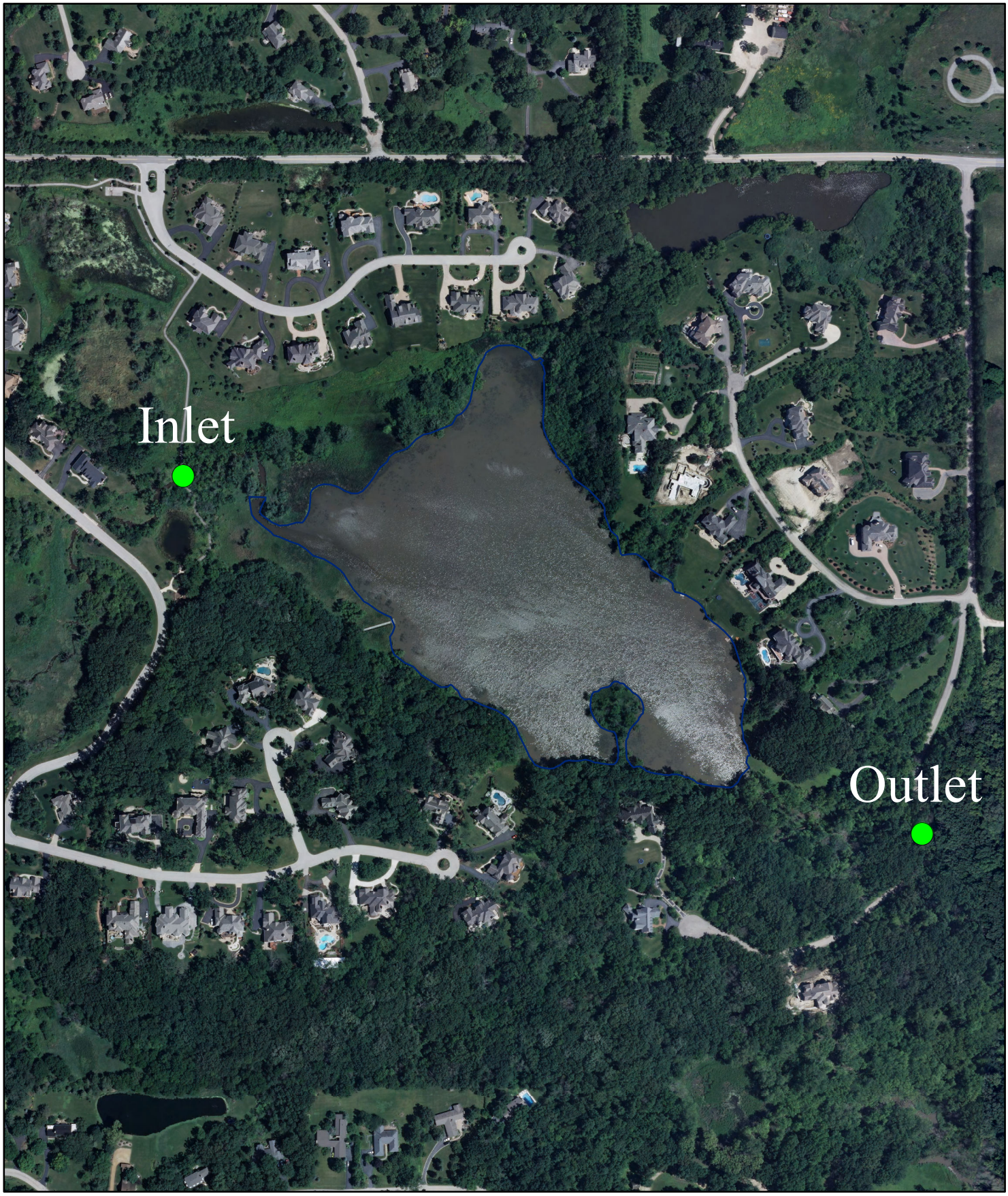
ALK = Alkalinity, mg/L $CaCO_3$	Cl^- = Chloride ions, mg/L
TKN = Total Kjeldahl nitrogen, mg/L	TSS = Total suspended solids, mg/L
NH_3-N = Ammonia nitrogen, mg/L	TS = Total solids, mg/L
NO_3-N = Nitrate + Nitrite nitrogen, mg/L	TVS = Total volatile solids, mg/L
TP = Total phosphorus, mg/L	SECCHI = Secchi Disk Depth, ft.
SRP = Soluble reactive phosphorus, mg/L	COND = Conductivity, milliSiemens/cm
TDS = Total dissolved solids, mg/L	DO = Dissolved oxygen, mg/L

Note: "k" denotes that the actual value is known to be less than the value presented.

NA = Not Applicable

* = Prior to 2006 only Nitrate was analyzed

Albert Lake 2013 Sampling Points



LakeCounty
Health Department and
Community Health Center

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0 250 500 750 1,000
Feet

Environmental Services
Product Number 12.2013
Revised 12/2013

Results of Sediment Analysis from Albert Lake, 2013.
(Results provided by Cardno JF New, November 2013)

Cardno JF New	November 25, 2013					
		Sample ID	MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	ALB 9/17/13 2:30 PM	TEC	PEC	Elevated	Highly Elevated
Nitrogen, Kjeldahl, Total	mg/Kg-dry	1260			5357-<11700	11700 or greater
Arsenic	mg/Kg-dry	<7.69	9.79	33	14 to <95.5	95.5 or greater
Cadmium	mg/Kg-dry	1.23	0.99	4.98	5 to <14	14 or greater
Chromium	mg/Kg-dry	12.9	43.4	111	24 to <49	49 or greater
Copper	mg/Kg-dry	36.8	31.6	149	100 to <590	590 or greater
Lead	mg/Kg-dry	21.4	35.8	128	59 to<339	339 or greater
Nickel	mg/Kg-dry	28.8	22.7	48.6	31 to <43	43 or greater
Phosphorus	mg/Kg-dry	1080			1115 to<2179	2179 or greater
Silver	mg/Kg-dry	4.38			0.1 to <1.0	1.0 or greater
Zinc	mg/Kg-dry	105	121	459	145 to <1100	1100 or greater
Mercury	mg/Kg-dry	1.49	0.18	1.06	0.15 to <7.01	7.01 or greater
4,4´-DDD	µg/Kg-dry	< 15.2				
4,4´-DDE	µg/Kg-dry	< 15.2				
4,4´-DDT	µg/Kg-dry	< 15.2			5 to <12	12 or greater
Aldrin	µg/Kg-dry	< 15.2			1 to <1.2	1.2 or greater
alpha-BHC	µg/Kg-dry	< 15.2			na	1 or greater
beta-BHC	µg/Kg-dry	< 15.2				
Chlordane	µg/Kg-dry	< 15.2	3.24	17.6	5 to 12	12 or greater
delta-BHC	µg/Kg-dry	< 15.2				
Dieldrin	µg/Kg-dry	< 15.2	1.9	61.8	3.4 to <15	15 or greater
Endosulfan I	µg/Kg-dry	< 15.2				
Endosulfan II	µg/Kg-dry	< 15.2				
Endosulfan sulfate	µg/Kg-dry	< 15.2				
Endrin	µg/Kg-dry	< 15.2	2.22	207	n/a	1 or greater
Endrin aldehyde	µg/Kg-dry	< 15.2				
gamma-BHC	µg/Kg-dry	< 15.2	2.37	4.99	n/a	1 or greater

Cardno JF New	November 25, 2013					
		Sample ID	MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	ALB 9/17/13 2:30 PM	TEC	PEC	Elevated	Highly Elevated
Heptachlor	µg/Kg-dry	< 15.2			n/a	1 or greater
Heptachlor epoxide	µg/Kg-dry	< 15.2	2.47	16	1 to <1.6	1.6 or greater
Methoxychlor	µg/Kg-dry	< 15.2			n/a	5 or greater
Toxaphene	µg/Kg-dry	< 303				
Aroclor 1016	mg/Kg-dry	< 0.0759				
Aroclor 1221	mg/Kg-dry	< 0.152				
Aroclor 1232	mg/Kg-dry	< 0.0759				
Aroclor 1242	mg/Kg-dry	< 0.0759				
Aroclor 1248	mg/Kg-dry	< 0.0759				
Aroclor 1254	mg/Kg-dry	< 0.0759				
Aroclor 1260	mg/Kg-dry	< 0.0759				
1,1,1-Trichloroethane	µg/Kg-dry	< 6.7				
1,1,2-Trichloroethane	µg/Kg-dry	< 6.7				
1,1-Dichloroethane	µg/Kg-dry	< 6.7				
1,1-Dichloroethene	µg/Kg-dry	< 6.7				
1,2-Dibromo-3-chloropropane	µg/Kg-dry	< 6.7				
1,2-Dibromoethane	µg/Kg-dry	< 6.7				
1,2-Dichloroethane	µg/Kg-dry	< 6.7				
1,2-Dichloropropane	µg/Kg-dry	< 6.7				
1-Butanol	µg/Kg-dry	< 664				
Acetone	µg/Kg-dry	< 196				
Benzene	µg/Kg-dry	< 6.7				
Bromodichloromethane	µg/Kg-dry	< 6.7				
Bromoform	µg/Kg-dry	< 6.7				
Bromomethane	µg/Kg-dry	< 22.7				
Carbon disulfide	µg/Kg-dry	< 6.7				
Carbon tetrachloride	µg/Kg-dry	< 6.7				
Chlorobenzene	µg/Kg-dry	< 6.7				

Cardno JF New	November 25, 2013					
		Sample ID	MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	ALB 9/17/13 2:30 PM	TEC	PEC	Elevated	Highly Elevated
Chloroform	µg/Kg-dry	< 6.7				
cis-1,2-Dichloroethene	µg/Kg-dry	< 6.7				
cis-1,3-Dichloropropene	µg/Kg-dry	< 6.7				
Dibromochloromethane	µg/Kg-dry	< 6.7				
Ethylbenzene	µg/Kg-dry	< 6.7				
m,p-Xylene	µg/Kg-dry	< 7.8				
Tetrachloroethene	µg/Kg-dry	< 6.7				
Toluene	µg/Kg-dry	< 6.7				
trans-1,2-Dichloroethene	µg/Kg-dry	< 7.32				
trans-1,3-Dichloropropene	µg/Kg-dry	< 6.7				
Trichloroethene	µg/Kg-dry	< 6.7				
Vinyl acetate	µg/Kg-dry	< 93.2				
Vinyl chloride	µg/Kg-dry	< 6.7				
1,2,4-Trichlorobenzene	µg/Kg-dry	< 11.2				
1,2-Dichlorobenzene	µg/Kg-dry	< 12				
1,3-Dichlorobenzene	µg/Kg-dry	< 11.2				
1,4-Dichlorobenzene	µg/Kg-dry	< 11.2				
2,4,5-Trichlorophenol	µg/Kg-dry	< 279				
2,4,6-Trichlorophenol	µg/Kg-dry	< 279				
2,4-Dichlorophenol	µg/Kg-dry	< 65.4				
2,4-Dimethylphenol	µg/Kg-dry	< 56.9				
2,4-Dinitrophenol	µg/Kg-dry	< 1840				
2,4-Dinitrotoluene	µg/Kg-dry	< 279				
2,6-Dinitrotoluene	µg/Kg-dry	< 279				
2-Chloronaphthalene	µg/Kg-dry	< 11.2				
2-Chlorophenol	µg/Kg-dry	< 67.6				

Cardno JF New	November 25, 2013					
		Sample ID	MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	ALB 9/17/13 2:30 PM	TEC	PEC	Elevated	Highly Elevated
2-Nitrophenol	µg/Kg-dry	< 279				
3,3´-Dichlorobenzidine	µg/Kg-dry	< 279				
4,6-Dinitro-2-methylphenol	µg/Kg-dry	< 3370				
4-Bromophenyl phenyl ether	µg/Kg-dry	< 100				
4-Chloro-3-methylphenol	µg/Kg-dry	< 279				
4-Chloroaniline	µg/Kg-dry	< 279				
4-Chlorophenyl phenyl ether	µg/Kg-dry	< 95.9				
4-Nitrophenol	µg/Kg-dry	< 2560				
Acenaphthene	µg/Kg-dry	< 11.2				
Acenaphthylene	µg/Kg-dry	< 85.3				
Anthracene	µg/Kg-dry	< 55.8	57.2	845		
Azobenzene as 1,2-Diphenylhydrazine	µg/Kg-dry	< 85.2				
Benz(a)anthracene	µg/Kg-dry	45	108	1050		
Benzidine	µg/Kg-dry	< 2660				
Benzo(a)pyrene	µg/Kg-dry	< 68.6	150	1450		
Benzo(b)fluoranthene	µg/Kg-dry	120				
Benzo(g,h,i)perylene	µg/Kg-dry	64				
Benzo(k)fluoranthene	µg/Kg-dry	41				
Bis(2-chloroethoxy)methane	µg/Kg-dry	< 11.2				
Bis(2-chloroethyl)ether	µg/Kg-dry	< 11.2				
Bis(2-chloroisopropyl)ether	µg/Kg-dry	< 11.2				
Bis(2-ethylhexyl)phthalate	µg/Kg-dry	77				
Butyl benzyl phthalate	µg/Kg-dry	< 55.8				
Carbazole	µg/Kg-dry	< 93.8				
Chrysene	µg/Kg-dry	< 94.3	166	1290		
Di-n-butyl phthalate	µg/Kg-dry	< 79.4				
Di-n-octyl phthalate	µg/Kg-dry	< 55.8				
Dibenz(a,h)anthracene	µg/Kg-dry	< 85.7	33	NR		

Cardno JF New	November 25, 2013					
		Sample ID	MacDonald, 2000		Mitzelfelt, 1996	
Analyte	Units	ALB 9/17/13 2:30 PM	TEC	PEC	Elevated	Highly Elevated
Diethyl phthalate	µg/Kg-dry	< 109				
Dimethyl phthalate	µg/Kg-dry	< 94.9				
Fluoranthene	µg/Kg-dry	140	423	2230		
Fluorene	µg/Kg-dry	< 94.6	77.4	536		
Hexachlorobenzene	µg/Kg-dry	< 104				
Hexachlorobutadiene	µg/Kg-dry	< 84.3				
Hexachlorocyclopentadiene	µg/Kg-dry	< 279				
Hexachloroethane	µg/Kg-dry	< 64.5				
Indeno(1,2,3-cd)pyrene	µg/Kg-dry	84				
Isophorone	µg/Kg-dry	< 65.5				
m,p-Cresol	µg/Kg-dry	< 63				
N-Nitrosodi-n-propylamine	µg/Kg-dry	< 17.5				
N-Nitrosodimethylamine	µg/Kg-dry	< 75				
N-Nitrosodiphenylamine	µg/Kg-dry	< 279				
Naphthalene	µg/Kg-dry	< 77.4	176	561		
Nitrobenzene	µg/Kg-dry	< 133				
o-Cresol	µg/Kg-dry	< 74.2				
Pentachlorophenol	µg/Kg-dry	< 112				
Phenanthrene	µg/Kg-dry	< 99.1	204	1170		
Phenol	µg/Kg-dry	< 69.7				
Pyrene	µg/Kg-dry	110	195	1520		
2,4,5-TP (Silvex)	µg/Kg-dry	< 178				
2,4-D	µg/Kg-dry	< 213				
Cyanide	mg/Kg-dry	<1.63			n/a	n/a
Percent Moisture	% (Percent)	67.7				

Lake County average Floristic Quality Index (FQI) ranking 2000-2013.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
1	Cedar Lake	38.0	36.6
2	East Loon Lake	34.7	36.1
3	Cranberry Lake	29.7	29.7
4	Deep Lake	29.7	31.2
5	Bangs Lake	29.6	26.0
6	Little Silver Lake	29.6	31.6
7	Round Lake Marsh North	29.1	29.9
8	West Loon Lake	27.1	29.5
9	Sullivan Lake	26.9	28.5
10	Third Lake	25.1	22.5
11	Fourth Lake	24.7	27.1
12	Indpendence Grove	24.6	27.5
13	Sterling Lake	24.5	26.9
14	Sun Lake	24.3	26.1
15	Lake Zurich	24.3	27.1
16	Redwing Slough	24.0	25.8
17	Schreiber Lake	23.9	24.8
18	Lakewood Marsh	23.8	24.7
19	Deer Lake	23.5	24.4
20	Round Lake	23.5	25.9
21	Honey Lake	23.3	25.1
22	Lake of the Hollow	23.0	24.8
23	Wooster Lake	22.8	21.1
24	Cross Lake	22.4	24.2
25	Countryside Glen Lake	21.9	22.8
26	Davis Lake	21.4	21.4
27	Butler Lake	21.4	23.1
28	Lake Barrington	21.2	21.2
29	Duck Lake	21.1	22.9
30	Timber Lake (North)	20.9	23.4
31	ADID 203	20.5	20.5
32	Broberg Marsh	20.5	21.4
33	McGreal Lake	20.2	22.1
34	Lake Kathryn	19.6	20.7
35	Fish Lake	19.3	21.2
36	Redhead Lake	19.3	21.2
37	Druce Lake	19.1	21.8
38	Turner Lake	18.6	21.2
39	Salem Lake	18.5	20.2
40	Lake Helen	18.0	18.0
41	Old Oak Lake	18.0	19.1
42	Potomac Lake	17.8	17.8
43	Long Lake	17.7	15.8
44	Hendrick Lake	17.7	17.7
45	Rollins Savannah 2	17.7	17.7
46	Grandwood Park Lake	17.2	19.0
47	Seven Acre Lake	17.0	15.5
48	Lake Miltmore	16.8	18.7
49	McDonald Lake 1	16.7	17.7
50	Highland Lake	16.7	18.9
51	Bresen Lake	16.6	17.8
52	Almond Marsh	16.3	17.3
53	Owens Lake	16.3	17.3
54	Windward Lake	16.3	17.6

Lake County average Floristic Quality Index (FQI) ranking 2000-2013.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
55	Grays Lake	16.1	16.1
56	White Lake	16.0	17.0
57	Dog Bone Lake	15.7	15.7
58	Osprey Lake	15.5	17.3
59	Heron Pond	15.1	15.1
60	North Churchill Lake	15.0	15.0
61	Hastings Lake	15.0	17.0
62	Lake Tranquility (S1)	15.0	17.0
63	Forest Lake	14.8	15.9
64	Dog Training Pond	14.7	15.9
65	Island Lake	14.7	16.6
66	Grand Ave Marsh	14.3	16.3
67	Nippersink Lake	14.3	16.3
68	Taylor Lake	14.3	16.3
69	Manning's Slough	14.1	16.3
70	Tower Lake	14.0	14.0
71	Dugdale Lake	14.0	15.1
72	Eagle Lake (S1)	14.0	15.1
73	Crooked Lake	14.0	16.0
74	Longview Meadow Lake	13.9	13.9
75	Bishop Lake	13.4	15.0
76	Ames Pit	13.4	15.5
77	Mary Lee Lake	13.1	15.1
78	Old School Lake	13.1	15.1
79	Dunn's Lake	12.7	13.9
80	Summerhill Estates Lake	12.7	13.9
81	Buffalo Creek Reservoir 1	12.5	11.4
82	Buffalo Creek Reservoir 2	12.5	11.4
83	McDonald Lake 2	12.5	12.5
84	Rollins Savannah 1	12.5	12.5
85	Stone Quarry Lake	12.5	12.5
86	Kemper Lake 1	12.2	13.4
87	Pond-A-Rudy	12.1	12.1
88	Stockholm Lake	12.1	13.5
89	Lake Carina	12.1	14.3
90	Lake Leo	12.1	14.3
91	Lambs Farm Lake	12.1	14.3
92	Grassy Lake	12.0	12.0
93	Lake Matthews	12.0	12.0
94	Flint Lake Oulet	11.8	13.0
95	Albert Lake	11.5	10.3
96	Rivershire Pond 2	11.5	13.3
97	Antioch Lake	11.3	13.4
98	Hook Lake	11.3	13.4
99	Briarcrest Pond	11.2	12.5
100	Lake Naomi	11.2	12.5
101	Pulaski Pond	11.2	12.5
102	Lake Napa Suwe	11.0	11.0
103	Redwing Marsh	11.0	11.0
104	West Meadow Lake	11.0	11.0
105	Lake Minear	11.0	13.9
106	Nielsen Pond	10.7	12.0
107	Lake Holloway	10.6	10.6
108	Sylvan Lake	10.6	10.6
109	Crooked Lake	10.2	12.5
110	Gages Lake	10.2	12.5

Lake County average Floristic Quality Index (FQI) ranking 2000-2013.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
111	College Trail Lake	10.0	10.0
112	Valley Lake	9.9	9.9
113	Werhane Lake	9.8	12.0
114	Loch Lomond	9.4	12.1
115	Columbus Park Lake	9.2	9.2
116	Lake Lakeland Estates	9.2	9.2
117	Waterford Lake	9.2	9.2
118	Lake Fairfield	9.0	10.4
119	Lake Louise	9.0	10.4
120	Fischer Lake	9.0	11.0
121	Lake Fariview	8.5	6.9
122	Timber Lake (South)	8.5	6.9
123	East Meadow Lake	8.5	8.5
124	South Churchill Lake	8.5	8.5
125	Kemper Lake 2	8.5	9.8
126	Lake Christa	8.5	9.8
127	Lake Farmington	8.5	9.8
128	Lucy Lake	8.5	9.8
129	Bittersweet Golf Course #13	8.1	8.1
130	Lake Linden	8.0	8.0
131	Sand Lake	8.0	10.4
132	Countryside Lake	7.7	11.5
133	Fairfield Marsh	7.5	8.7
134	Lake Eleanor	7.5	8.7
135	Banana Pond	7.5	9.2
136	Slocum Lake	7.1	5.8
137	Lucky Lake	7.0	7.0
138	North Tower Lake	7.0	7.0
139	Lake Forest Pond	6.9	8.5
140	Ozaukee Lake	6.7	8.7
141	Leisure Lake	6.4	9.0
142	Peterson Pond	6.0	8.5
143	Little Bear Lake	5.8	7.5
144	Deer Lake Meadow Lake	5.2	6.4
145	ADID 127	5.0	5.0
146	Island Lake	5.0	5.0
147	Liberty Lake	5.0	5.0
148	Oak Hills Lake	5.0	5.0
149	Slough Lake	5.0	5.0
150	International Mining and Chemical Lake	5.0	7.1
151	Diamond Lake	3.7	5.5
152	Lake Charles	3.7	5.5
153	Big Bear Lake	3.5	5.0
154	Sand Pond (IDNR)	3.5	5.0
155	Harvey Lake	3.3	5.0
156	Half Day Pit	2.9	5.0
157	Lochanora Lake	2.5	5.0
158	Echo Lake	0.0	0.0
159	Hidden Lake	0.0	0.0
160	St. Mary's Lake	0.0	0.0
161	Willow Lake	0.0	0.0
162	Woodland Lake	0.0	0.0
	Mean	**13.8**	**14.8**
	Median	**12.5**	**13.9**

APPENDIX A. METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES

Water Sampling and Laboratory Analyses

Two water samples were collected once a month from May through September. Sample locations were at the deepest point in the lake (see sample site map), three feet below the surface, and 3 feet above the bottom. Samples were collected with a horizontal Van Dorn water sampler. Approximately three liters of water were collected for each sample for all lab analyses. After collection, all samples were placed in a cooler with ice until delivered to the Lake County Health Department lab, where they were refrigerated. Analytical methods for the parameters are listed in Table A1. Except nitrate nitrogen, all methods are from the Eighteenth Edition of Standard Methods, (eds. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1992). Methodology for nitrate nitrogen was taken from the 14th edition of Standard Methods. Dissolved oxygen, temperature, conductivity and pH were measured at the deep hole with a Hydrolab DataSonde® 4a. Photosynthetic Active Radiation (PAR) was recorded using a LI-COR® 192 Spherical Sensor attached to the Hydrolab DataSonde® 4a. Readings were taken at the surface and then every two feet until reaching the bottom.

Plant Sampling

In order to randomly sample each lake, mapping software (ArcMap 9.3) overlaid a grid pattern onto an aerial photo of Lake County and placed points 60 or 30 meters apart, depending on lake size. Plants were sampled using a garden rake fitted with hardware cloth. The hardware cloth surrounded the rake tines and is tapered two feet up the handle. A rope was tied to the end of the handle for retrieval. At designated sampling sites, the rake was tossed into the water, and using the attached rope, was dragged across the bottom, toward the boat. After pulling the rake into the boat, plant coverage was assessed for overall abundance. Then plants were individually identified and placed in categories based on coverage. Plants that were not found on the rake but were seen in the immediate vicinity of the boat at the time of sampling were also recorded. Plants difficult to identify in the field were placed in plastic bags and identified with plant keys after returning to the office. The depth of each sampling location was measured either by a hand-held depth meter, or by pushing the rake straight down and measuring the depth along the rope or rake handle. One-foot increments were marked along the rope and rake handle to aid in depth estimation.

Shoreline Assessment

In previous years a complete assessment of the shoreline was done. However, this year we did a visual estimate to determine changes in the shoreline. The degree of shoreline erosion was categorically defined as none, slight, moderate, or severe. Below are brief descriptions of each category.

> None – Includes man-made erosion control such as beach, rip-rap and sea wall.
>
> Slight – Minimal or no observable erosion; generally considered stable; no erosion control practices will be recommended with the possible exception of small problem areas noted within an area otherwise designated as “slight”.

Moderate – Recession is characterized by past or recently eroded banks; area may exhibit some exposed roots, fallen vegetation or minor slumping of soil material; erosion control practices may be recommended although the section is not deemed to warrant immediate remedial action.

Severe – Recession is characterized by eroding of exposed soil on nearly vertical banks, exposed roots, fallen vegetation or extensive slumping of bank material, undercutting, washouts or fence posts exhibiting realignment; erosion control practices are recommended and immediate remedial action may be warranted.

Wildlife Assessment

Species of wildlife were noted during visits to each lake. When possible, wildlife was identified to species by sight or sound. However, due to time constraints, collection of quantitative information was not possible. Thus, all data should be considered anecdotal.
Some of the species on the list may have only been seen once, or were spotted during their migration through the area.

Table A1. Analytical methods used for water quality parameters.

Parameter	***Method***
Temperature	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Dissolved oxygen	Hydrolab DataSonde ®4a or YSI 6600 Sonde®
Nitrate and Nitrite nitrogen	USEPA 353.2 rev. 2.0 EPA-600/R-93/100 Detection Limit = 0.05 mg/L
Ammonia nitrogen	SM 18th ed. Electrode method, #4500 NH_3-F Detection Limit = 0.1 mg/L
Total Kjeldahl nitrogen	SM 18th ed, 4500-N_{org} C Semi-Micro Kjeldahl, plus 4500 NH_3-F Detection Limit = 0.5 mg/L
pH	Hydrolab DataSonde® 4a, or YSI 6600 Sonde® Electrometric method
Total solids	SM 18th ed, Method #2540B
Total suspended solids	SM 18th ed, Method #2540D Detection Limit = 0.5 mg/L
Chloride	SM 18th ed, Method #4500C1-D
Total volatile solids	SM 18th ed, Method #2540E, from total solids
Alkalinity	SM 18th ed, Method #2320B, patentiometric titration curve method
Conductivity	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Total phosphorus	SM 18th ed, Methods #4500-P B 5 and #4500-P E Detection Limit = 0.01 mg/L
Soluble reactive phosphorus	SM 18th ed, Methods #4500-P B 1 and #4500-P E Detection Limit = 0.005 mg/L
Clarity	Secchi disk
Color	Illinois EPA Volunteer Lake Monitoring Color Chart
Photosynthetic Active Radiation (PAR)	Hydrolab DataSonde® 4a or YSI 6600 Sonde®, LI-COR® 192 Spherical Sensor

APPENDIX C. INTERPRETING YOUR LAKE'S WATER QUALITY DATA

Lakes possess a unique set of physical and chemical characteristics that will change over time. These in-lake water quality characteristics, or parameters, are used to describe and measure the quality of lakes, and they relate to one another in very distinct ways. As a result, it is virtually impossible to change any one component in or around a lake without affecting several other components, and it is important to understand how these components are linked.

The following pages will discuss the different water quality parameters measured by Lake County Health Department staff, how these parameters relate to each other, and why the measurement of each parameter is important. The median values (the middle number of the data set, where half of the numbers have greater values, and half have lesser values) of data collected from Lake County lakes from 2000-2009 will be used in the following discussion.

Temperature and Dissolved Oxygen:

Water temperature fluctuations will occur in response to changes in air temperatures, and can have dramatic impacts on several parameters in the lake. In the spring and fall, lakes tend to have uniform, well-mixed conditions throughout the water column (surface to the lake bottom). However, during the summer, deeper lakes will separate into distinct water layers. As surface water temperatures increase with increasing air temperatures, a large density difference will form between the heated surface water and colder bottom water. Once this difference is large enough, these two water layers will separate and generally will not mix again until the fall. At this time the lake is thermally stratified. The warm upper water layer is called the ***epilimnion***, while the cold bottom water layer is called the ***hypolimnion***. In some shallow lakes, stratification and destratification can occur several times during the summer. If this occurs the lake is described as polymictic. Thermal stratification also occurs to a lesser extent during the winter, when warmer bottom water becomes separated from ice-forming water at the surface until mixing occurs during spring ice-out.

Monthly temperature profiles were established on each lake by measuring water temperature every foot (lakes $\leq$ 15 feet deep) or every two feet (lakes > 15 feet deep) from the lake surface to the lake bottom. These profiles are important in understanding the distribution of chemical/biological characteristics and because increasing water temperature and the establishment of thermal stratification have a direct impact on dissolved oxygen (DO) concentrations in the water column. If a lake is shallow and easily mixed by wind, the DO concentration is usually consistent throughout the water column. However, shallow lakes are typically dominated by either plants or algae, and increasing water temperatures during the summer speeds up the rates of photosynthesis and decomposition in surface waters. When many of the plants or algae die at the end of the growing season, their decomposition results in heavy oxygen consumption and can lead to an oxygen crash. In deeper, thermally stratified lakes, oxygen production is greatest in the top portion of the lake, where sunlight drives photosynthesis, and oxygen consumption is greatest near the bottom of a lake, where sunken organic matter accumulates and decomposes. The oxygen difference between the top and bottom water layers can be dramatic, with plenty of oxygen near the surface, but practically none near the bottom. The oxygen profiles measured during the water quality study can illustrate if

this is occurring. This is important because the absence of oxygen (anoxia) near the lake bottom can have adverse effects in eutrophic lakes resulting in the chemical release of phosphorus from lake sediment and the production of hydrogen sulfide (rotten egg smell) and other gases in the bottom waters. Low oxygen conditions in the upper water of a lake can also be problematic since all aquatic organisms need oxygen to live. Some oxygen may be present in the water, but at too low a concentration to sustain aquatic life. Oxygen is needed by all plants, virtually all algae and for many chemical reactions that are important in lake functioning. Most adult sport-fish such as largemouth bass and bluegill require at least 3 mg/L of DO in the water to survive. However, their offspring require at least 5 mg/L DO as they are more sensitive to DO stress. When DO concentrations drop below 3 mg/L, rough fish such as carp and green sunfish are favored and over time will become the dominant fish species.

External pollution in the form of oxygen-demanding organic matter (i.e., sewage, lawn clippings, soil from shoreline erosion, and agricultural runoff) or nutrients that stimulate the growth of excessive organic matter (i.e., algae and plants) can reduce average DO concentrations in the lake by increasing oxygen consumption. This can have a detrimental impact on the fish community, which may be squeezed into a very small volume of water as a result of high temperatures in the epilimnion and low DO levels in the hypolimnion.

Nutrients:

Phosphorus:
For most Lake County lakes, phosphorus is the nutrient that limits plant and algae growth. This means that any addition of phosphorus to a lake will typically result in algae blooms or high plant densities during the summer. The source of phosphorus to a lake can be external or internal (or both). External sources of phosphorus enter a lake through point (i.e., storm pipes and wastewater discharge) and non-point runoff (i.e., overland water flow). This runoff can pick up large amounts of phosphorus from agricultural fields, septic systems or impervious surfaces before it empties into the lake.

Internal sources of phosphorus originate within the lake and are typically linked to the lake sediment. In lakes with high oxygen levels (oxic), phosphorus can be released from the sediment through plants or sediment resuspension. Plants take up sediment-bound phosphorus through their roots, releasing it in small amounts to the water column throughout their life cycles, and in large amounts once they die and begin to decompose. Sediment resuspension can occur through biological or mechanical means. Bottom-feeding fish, such as common carp and black bullhead can release phosphorus by stirring up bottom sediment during feeding activities and can add phosphorus to a lake through their fecal matter. Sediment resuspension, and subsequent phosphorus release, can also occur via wind/wave action or through the use of artificial aerators, especially in shallow lakes. In lakes that thermally stratify, internal phosphorus release can occur from the sediment through chemical means. Once oxygen is depleted (anoxia) in the hypolimnion, chemical reactions occur in which phosphorus bound to iron complexes in the sediment becomes soluble and is released into the water column. This phosphorus is trapped in the hypolimnion and is unavailable to algae until fall turnover, and can cause algae blooms once

it moves into the sunlit surface water at that time. Accordingly, many of the lakes in Lake County are plagued by dense algae blooms and excessive, exotic plant coverage, which negatively affect DO levels, fish communities and water clarity.

Lakes with an average phosphorus concentration greater than 0.05 mg/L are considered nutrient rich. The median near surface total phosphorus (TP) concentration in Lake County lakes from 2000-2009 was 0.063 mg/L and ranged from a non-detectable minimum of <0.010 mg/L on five lakes to a maximum of 3.880 mg/L on Albert Lake. The median anoxic TP concentration in Lake County lakes from 2000-2009 was 0.167 mg/L and ranged from a minimum of 0.012 mg/L in Independence Grove Lake to a maximum of 3.880 mg/L in Taylor Lake.

The analysis of phosphorus also included soluble reactive phosphorus (SRP), a dissolved form of phosphorus that is readily available for plant and algae growth. SRP is not discussed in great detail in most of the water quality reports because SRP concentrations vary throughout the season depending on how plants and algae absorb and release it. It gives an indication of how much phosphorus is available for uptake, but, because it does not take all forms of phosphorus into account, it does not indicate how much phosphorus is truly present in the water column. TP is considered a better indicator of a lake's nutrient status because its concentrations remain more stable than soluble reactive phosphorus. However, elevated SRP levels are a strong indicator of nutrient problems in a lake.

Nitrogen:
Nitrogen is also an important nutrient for plant and algae growth. Sources of nitrogen to a lake vary widely, ranging from fertilizer and animal wastes, to human waste from sewage treatment plants or failing septic systems, to groundwater, air and rainfall. As a result, it is very difficult to control or reduce nitrogen inputs to a lake. Different forms of nitrogen are present in a lake under different oxic conditions. NH_4^+ (ammonium) is released from decomposing organic material under anoxic conditions and accumulates in the hypolimnion of thermally stratified lakes. If NH_4^+ comes into contact with oxygen, it is immediately converted to NO_2 (nitrite) which is then oxidized to NO_3^- (nitrate). Therefore, in a thermally stratified lake, levels of NH_4^+ would only be elevated in the hypolimnion and levels of NO_3^- would only be elevated in the epilimnion. Both NH_4^+ and NO_3^- can be used as a nitrogen source by aquatic plants and algae. Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen plus ammonium. Adding the concentrations of TKN and nitrate together gives an indication of the amount of total nitrogen present in the water column. If inorganic nitrogen (NO_3^-, NO_2^-, NH_4^+) concentrations exceed 0.3 mg/L in spring, sufficient nitrogen is available to support summer algae blooms. However, low nitrogen levels do not guarantee limited algae growth the way low phosphorus levels do. Nitrogen gas in the air can dissolve in lake water and blue-green algae can "fix" atmospheric nitrogen, converting it into a usable form. Since other types of algae do not have the ability to do this, nuisance blue-green algae blooms are typically associated with lakes that are nitrogen limited (i.e., have low nitrogen levels).

The ratio of TKN plus nitrate nitrogen to total phosphorus (TN:TP) can indicate whether plant/algae growth in a lake is limited by nitrogen or phosphorus. Ratios of less than 10:1

suggest a system limited by nitrogen, while lakes with ratios greater than 20:1 are limited by phosphorus. It is important to know if a lake is limited by nitrogen or phosphorus because any addition of the limiting nutrient to the lake will, likely, result in algae blooms or an increase in plant density.

Solids:

Although several forms of solids (total solids, total suspended solids, total volatile solids, total dissolved solids) were measured each month by the Lakes Management Staff, total suspended solids (TSS) and total volatile solids (TVS) have the most impact on other variables and on the lake as a whole. TSS are particles of algae or sediment suspended in the water column. High TSS concentrations can result from algae blooms, sediment resuspension, and/or the inflow of turbid water, and are typically associated with low water clarity and high phosphorus concentrations in many lakes in Lake County. Low water clarity and high phosphorus concentrations, in turn, exacerbate the high TSS problem by leading to reduced plant density (which stabilize lake sediment) and increased occurrence of algae blooms. The median TSS value in epilimnetic waters in Lake County was 7.9 mg/L, ranging from below the 0.1 mg/L detection limit to 165 mg/L in Fairfield Marsh.

TVS represents the fraction of total solids that are organic in nature, such as algae cells, tiny pieces of plant material, and/or tiny animals (zooplankton) in the water column. High TVS values indicate that a large portion of the suspended solids may be made up of algae cells. This is important in determining possible sources of phosphorus to a lake. If much of the suspended material in the water column is determined to be resuspended sediment that is releasing phosphorus, this problem would be addressed differently than if the suspended material was made up of algae cells that were releasing phosphorus. The median TVS value was 132.8 mg/L, ranging from 34.0 mg/L in Pulaski Pond to 298.0 mg/L in Fairfield Marsh.

Total dissolved solids (TDS) are the amount of dissolved substances, such as salts or minerals, remaining in water after evaporation. These dissolved solids are discussed in further detail in the *Alkalinity* and *Conductivity* sections of this document. TDS concentrations were measured in Lake County lakes prior to 2004, but was discontinued due to the strong correlation of TDS to conductivity and chloride concentrations.

Water Clarity:

Water clarity (transparency) is not a chemical property of lake water, but is often an indicator of a lake's overall water quality. It is affected by a lake's water color, which is a reflection of the amount of total suspended solids and dissolved organic chemicals. Thus, transparency is a measure of particle concentration and is measured with a Secchi disk. Generally, the lower the clarity or Secchi depth, the poorer the water quality. A decrease in Secchi depth during the summer occurs as the result of an increase in suspended solids (algae or sediment) in the water column. Aquatic plants play an important role in the level of water clarity and can, in turn, be negatively affected by low clarity levels. Plants increase clarity by competing with algae for

resources and by stabilizing sediments to prevent sediment resuspension. A lake with a healthy plant community will almost always have higher water clarity than a lake without plants. Additionally, if the plants in a lake are removed (through herbicide treatment or the stocking of grass carp), the lake will probably become dominated by algae and Secchi depth will decrease. This makes it very difficult for plants to become re-established due to the lack of available sunlight and the lake will, most likely, remain turbid. Turbidity will be accelerated if the lake is very shallow and/or common carp are present. Shallow lakes are more susceptible to sediment resuspension through wind/wave action and are more likely to experience clarity problems if plants are not present to stabilize bottom sediment.

Common Carp are prolific fish that feed on invertebrates in the sediment. Their feeding activities stir up bottom sediment and can dramatically decrease water clarity in shallow lakes. As mentioned above, lakes with low water clarity are, generally, considered to have poor water quality. This is because the causes and effects of low clarity negatively impact the plant and fish communities, as well as the levels of phosphorus in a lake. The detrimental impacts of low Secchi depth to plants has already been discussed. Fish populations will suffer as water clarity decreases due to a lack of food and decreased ability to successfully hunt for prey. Bluegills are planktivorous fish and feed on invertebrates that inhabit aquatic plants. If low clarity results in the disappearance of plants, this food source will disappear too. Largemouth Bass and Northern Pike are piscivorous fish that feed on other fish and hunt by sight. As the water clarity decreases, these fish species find it more difficult to see and ambush prey and may decline in size as a result. This could eventually lead to an imbalance in the fish community. Phosphorus release from resuspended sediment could increase as water clarity and plant density decrease. This would then result in increased algae blooms, further reducing Secchi depth and aggravating all problems just discussed. The average Secchi depth for Lake County lakes is 3.12 feet. From 2000-2009, Ozaukee Lake had the lowest Secchi depths (0.25 feet) and West Loon Lake had the highest (24.77 feet). As an example of the difference in Secchi depth based on plant coverage, South Churchill Lake, which had no plant coverage and large numbers of Common Carp in 2003 had an average Secchi depth of 0.73 feet (over four times lower than the county average), while Deep Lake, which had a diverse plant community and few carp had an average 2003 Secchi depth of 12.48 feet (almost four times higher than the county average).

Another measure of clarity is the use of a light meter. The light meter measures the amount of light at the surface of the lake and the amount of light at each depth in the water column. The amount of attenuation and absorption (decreases) of light by the water column are major factors controlling temperature and potential photosynthesis. Light intensity at the lake surface varies seasonally and with cloud cover, and decreases with depth. The deeper into the water column light penetrates, the deeper potential plant growth. The maximum depth at which algae and plants can grow underwater is usually at the depth where the amount of light available is reduced to 0.5%-1% of the amount of light available at the lake surface. This is called the euphotic (sunlit) zone. A general rule of thumb in Lake County is that the 1% light level is about 1 to 3 times the Secchi disk depth.

Alkalinity, Conductivity, Chloride, pH:

Alkalinity:

Alkalinity is the measurement of the amount of acid necessary to neutralize carbonate ($CO_3^{=}$) and bicarbonate (HCO_3^{-}) ions in the water, and represents the buffering capacity of a body of water. The alkalinity of lake water depends on the types of minerals in the surrounding soils and in the bedrock. It also depends on how often the lake water comes in contact with these minerals. If a lake gets groundwater from aquifers containing limestone minerals such as calcium carbonate ($CaCO_3$) or dolomite ($CaMgCO_3$), alkalinity will be high. The median alkalinity in Lake County lakes (162 mg/L) is considered moderately hard according to the hardness classification scale of Brown, Skougstad and Fishman (1970). Because hard water (alkaline) lakes often have watersheds with fertile soils that add nutrients to the water, they usually produce more fish and aquatic plants than soft water lakes. Since the majority of Lake County lakes have a high alkalinity they are able to buffer the adverse effects of acid rain.

Conductivity and Chloride:

Conductivity is the inverse measure of the resistance of lake water to an electric flow. This means that the higher the conductivity, the more easily an electric current is able to flow through water. Since electric currents travel along ions in water, the more chemical ions or dissolved salts a body of water contains, the higher the conductivity will be. Accordingly, conductivity has been correlated to total dissolved solids and chloride ions. The amount of dissolved solids or conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Many Lake County lakes have elevated conductivity levels in May, but not during any other month. This was because chloride, in the form of road salt, was washing into the lakes with spring rains, increasing conductivity. Most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanide salts. Beginning in 2004, chloride concentrations are one of the parameters measured during the lake studies. Increased chloride concentrations may have a negative impact on aquatic organisms. Conductivity changes occur seasonally and with depth. For example, in stratified lakes the conductivity normally increases in the hypolimnion as bacterial decomposition converts organic materials to bicarbonate and carbonate ions depending on the pH of the water. These newly created ions increase the conductivity and total dissolved solids. Over the long term, conductivity is a good indicator of potential watershed or lake problems if an increasing trend is noted over a period of years. It is also important to know the conductivity of the water when fishery assessments are conducted, as electroshocking requires a high enough conductivity to properly stun the fish, but not too high as to cause injury or death.

pH:
pH is the measurement of hydrogen ion (H^+) activity in water. The pH of pure water is neutral at 7 and is considered acidic at levels below 7 and basic at levels above 7. Low pH levels of 4-5 are toxic to most aquatic life, while high pH levels (9-10) are not only toxic to aquatic life but may also result in the release of phosphorus from lake sediment. The presence of high plant densities can increase pH levels through photosynthesis, and lakes dominated by a large amount of plants or algae can experience large fluctuations in pH levels from day to night, depending on the rates of photosynthesis and respiration. Few, if any pH problems exist in Lake County lakes. Typically, the flooded gravel mines in the county are more acidic than the glacial lakes as they have less biological activity, but do not usually drop below pH levels of 7. The median near surface pH value of Lake County lakes was 8.34, with a minimum of 7.07 in Bittersweet #13 Lake and a maximum of 10.40 in Summerhill Estates Lake.

Eutrophication and Trophic State Index:

The word *eutrophication* comes from a Greek word meaning "well nourished." This also describes the process in which a lake becomes enriched with nutrients. Over time, this is a lake's natural aging process, as it slowly fills in with eroded materials from the surrounding watershed and with decaying plants. If no human impacts disturb the watershed or the lake, natural eutrophication can take thousands of years. However, human activities on a lake or in the watershed accelerate this process by resulting in rapid soil erosion and heavy phosphorus inputs. This accelerated aging process on a lake is referred to as cultural eutrophication. The term trophic state refers to the amount of nutrient enrichment within a lake system. *Oligotrophic* lakes are usually deep and clear with low nutrient levels, little plant growth and a limited fishery. *Mesotrophic* lakes are more biologically productive than oligotrophic lakes and have moderate nutrient levels and more plant growth. A lake labeled as *eutrophic* is high in nutrients and can support high plant densities and large fish populations. Water clarity is typically poorer than oligotrophic or mesotrophic lakes and dissolved oxygen problems may be present. A *hypereutrophic* lake has excessive nutrients, resulting in nuisance plant or algae growth. These lakes are often pea-soup green, with poor water clarity. Low dissolved oxygen may also be a problem, with fish kills occurring in shallow, hypereutrophic lakes more often than less enriched lakes. As a result, rough fish (tolerant of low dissolved oxygen levels) dominate the fish community of many hypereutrophic lakes. The categorization of a lake into a certain trophic state should not be viewed as a "good to bad" categorization, as most lake residents rate their lake based on desired usage. For example, a fisherman would consider a plant-dominated, clear lake to be desirable, while a water-skier might prefer a turbid lake devoid of plants. Most lakes in Lake County are eutrophic or hypereutrophic. This is primarily as a result of cultural eutrophication. However, due to the fertile soil in this area, many lakes (especially man-made) may have started out under eutrophic conditions and will never attain even mesotrophic conditions, regardless of any amount of money put into the management options. This is not an excuse to allow a lake to continue to deteriorate, but may serve as a reality check for lake owners attempting to create unrealistic conditions in their lakes.

The Trophic State Index (TSI) is an index which attaches a score to a lake based on its average

total phosphorus concentration, its average Secchi depth (water transparency) and/or its average chlorophyll *a* concentration (which represent algae biomass). It is based on the principle that as phosphorus levels increase, chlorophyll *a* concentrations increase and Secchi depth decreases. The higher the TSI score, the more nutrient-rich a lake is, and once a score is obtained, the lake can then be designated as oligotrophic, mesotrophic or eutrophic. Table 1 (below) illustrates the Trophic State Index using phosphorus concentration and Secchi depth.

Table 1. Trophic State Index (TSI).

Trophic State	TSI score	Total Phosphorus (mg/L)	Secchi Depth (feet)
Oligotrophic	<40	≤ 0.012	>13.12
Mesotrophic	≥40<50	>0.012 ≤ 0.024	≥6.56<13.12
Eutrophic	≥50<70	>0.024 ≤ 0.096	≥1.64<6.56
Hypereutrophic	≥70	>0.096	< 1.64

Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
1	Lake Carina	0.0100	37.35
2	Sterling Lake	0.0100	37.35
3	Indpendence Grove	0.0130	41.14
4	Lake Zurich	0.0135	41.68
5	Druce Lake	0.0140	42.00
6	Windward Lake	0.0160	44.13
7	Sand Pond (IDNR)	0.0165	44.57
8	West Loon	0.0170	45.00
9	Pulaski Pond	0.0180	45.83
10	Banana Pond	0.0200	47.35
11	Cedar Lake	0.0200	47.35
12	Gages Lake	0.0200	47.35
13	Lake Kathryn	0.0200	47.35
14	Lake Minear	0.0200	47.35
15	Highland Lake	0.0202	47.49
16	Lake Miltmore	0.0210	48.00
17	Timber Lake (North)	0.0210	48.05
18	Cross Lake	0.0220	48.72
19	Dog Training Pond	0.0220	48.72
20	Sun Lake	0.0220	48.72
21	Deep Lake	0.0230	49.36
22	Lake of the Hollow	0.0230	49.36
23	Round Lake	0.0230	49.36
24	Stone Quarry Lake	0.0230	49.36
25	Bangs Lake	0.0240	50.00
26	Little Silver Lake	0.0250	50.57
27	Lake Leo	0.0260	51.13
28	Cranberry Lake	0.0270	51.68
29	Dugdale Lake	0.0270	51.68
30	Peterson Pond	0.0270	51.68
31	Fourth Lake	0.0360	53.00
32	Lake Fairfield	0.0300	53.20
33	Third Lake	0.0300	53.20
34	Lake Catherine	0.0310	53.67
35	Lambs Farm Lake	0.0310	53.67
36	Old School Lake	0.0310	53.67
37	Grays Lake	0.0310	54.00
38	Harvey Lake	0.0320	54.50
39	Hendrick Lake	0.0340	55.00
40	Honey Lake	0.0340	55.00
41	Sand Lake	0.0380	56.00
42	Sullivan Lake	0.0370	56.22
43	Channel Lake	0.0380	56.60
44	Ames Pit	0.0390	56.98
45	Diamond Lake	0.0390	56.98
46	East Loon	0.0400	57.34

Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
47	Schreiber Lake	0.0400	57.34
48	Waterford Lake	0.0400	57.34
49	Hook Lake	0.0410	57.70
50	Duck Lake	0.0430	58.39
51	Nielsen Pond	0.0450	59.04
52	Seven Acre Lake	0.0460	59.36
53	Turner Lake	0.0460	59.36
54	Willow Lake	0.0460	59.36
55	East Meadow Lake	0.0480	59.97
56	Lucky Lake	0.0480	59.97
57	Old Oak Lake	0.0490	60.27
58	College Trail Lake	0.0500	60.56
59	Hastings Lake	0.0520	61.13
60	Butler Lake	0.0530	61.40
61	West Meadow Lake	0.0530	61.40
62	Lucy Lake	0.0550	61.94
63	Lake Linden	0.0570	62.45
64	Lake Christa	0.0580	62.70
65	Owens Lake	0.0580	62.70
66	Briarcrest Pond	0.0580	63.00
67	Lake Barrington	0.0600	63.10
68	Lake Lakeland Estates	0.0620	63.66
69	Lake Naomi	0.0620	63.66
70	Lake Tranquility (S1)	0.0620	63.66
71	Liberty Lake	0.0630	63.89
72	North Tower Lake	0.0630	63.89
73	Werhane Lake	0.0630	63.89
74	Countryside Glen Lake	0.0640	64.12
75	Countryside Lake	0.0660	65.00
76	Davis Lake	0.0650	64.34
77	Leisure Lake	0.0650	64.34
78	St. Mary's Lake	0.0670	64.78
79	Little Bear Lake	0.0680	65.00
80	Buffalo Creek Reservoir 1	0.0680	65.00
81	Mary Lee Lake	0.0680	65.00
82	Wooster Lake	0.0700	65.41
83	Crooked Lake	0.0710	66.00
84	Timber Lake (South)	0.0720	65.82
85	Lake Helen	0.0720	65.82
86	Grandwood Park Lake	0.0720	65.82
87	ADID 203	0.0730	66.02
88	Bluff Lake	0.0730	66.02
89	Long Lake	0.0730	66.02
90	Spring Lake	0.0730	66.02
91	Broberg Marsh	0.0780	66.97
92	Woodland Lake	0.0800	68.00

Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
93	Redwing Slough	0.0822	67.73
94	Tower Lake	0.0830	67.87
95	Petite Lake	0.0830	67.87
96	Lake Marie	0.0850	68.21
97	Potomac Lake	0.0850	68.21
98	White Lake	0.0862	68.42
99	Grand Ave Marsh	0.0870	68.55
100	North Churchill Lake	0.0870	68.55
101	McDonald Lake 1	0.0880	68.71
102	Lake Fairview	0.0890	68.00
103	Rivershire Pond 2	0.0900	69.04
104	South Churchill Lake	0.0900	69.04
105	McGreal Lake	0.0910	69.20
106	Lake Charles	0.0930	69.40
107	Deer Lake	0.0940	69.66
108	Dunn's Lake	0.0950	69.82
109	Eagle Lake (S1)	0.0950	69.82
110	International Mine and Chemical Lake	0.0950	69.82
111	Valley Lake	0.0950	69.82
112	Big Bear Lake	0.0960	69.97
113	Buffalo Creek Reservoir 2	0.0960	69.97
114	Fish Lake	0.0960	69.97
115	Lochanora Lake	0.0960	69.97
116	Nippersink Lake	0.1000	70.56
117	Sylvan Lake	0.1000	70.56
118	Longview Meadow Lake	0.1020	70.84
119	Lake Forest Pond	0.1070	71.53
120	Bittersweet Golf Course #13	0.1100	71.93
121	Fox Lake	0.1100	71.93
122	Kemper 2	0.1100	71.93
123	Middlefork Savannah Outlet 1	0.1120	72.00
124	Osprey Lake	0.1110	72.06
125	Bresen Lake	0.1130	72.32
126	Round Lake Marsh North	0.1130	72.32
127	Deer Lake Meadow Lake	0.1160	72.70
128	Taylor Lake	0.1180	72.94
129	Island Lake	0.1210	73.00
130	Columbus Park Lake	0.1230	73.54
131	Lake Nipperink	0.1240	73.66
132	Echo Lake	0.1250	73.77
133	Grass Lake	0.1290	74.23
134	Lake Holloway	0.1320	74.56
135	Redhead Lake	0.1410	75.51
136	Antioch Lake	0.1450	75.91
137	Slocum Lake	0.1500	77.00
138	Lakewood Marsh	0.1510	76.50

Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
139	Pond-A-Rudy	0.1510	76.50
140	Lake Matthews	0.1520	76.59
141	Forest Lake	0.1540	76.78
142	Middlefork Savannah Outlet 2	0.1590	77.00
143	Pistakee Lake	0.1590	77.24
144	Grassy Lake	0.1610	77.42
145	Salem Lake	0.1650	77.78
146	Half Day Pit	0.1690	78.12
147	Lake Eleanor	0.1810	79.11
148	Lake Farmington	0.1850	79.43
149	Lake Louise	0.1850	79.43
150	ADID 127	0.1890	79.74
151	Lake Napa Suwe	0.1940	80.00
152	Patski Pond	0.1970	80.33
153	Dog Bone Lake	0.1990	80.48
154	Summerhill Estates Lake	0.1990	80.48
155	Redwing Marsh	0.2070	81.05
156	Stockholm Lake	0.2082	81.13
157	Bishop Lake	0.2160	81.66
158	Ozaukee Lake	0.2200	81.93
159	Kemper 1	0.2220	82.08
160	Hidden Lake	0.2240	82.19
161	McDonald Lake 2	0.2250	82.28
162	Fischer Lake	0.2280	82.44
163	Oak Hills Lake	0.2790	85.35
164	Loch Lomond	0.2950	86.16
165	Heron Pond	0.2990	86.35
166	Rollins Savannah 1	0.3070	87.00
167	Fairfield Marsh	0.3260	87.60
168	ADID 182	0.3280	87.69
169	Manning's Slough	0.3820	90.22
170	Slough Lake	0.3860	90.03
171	Rasmussen Lake	0.4860	93.36
172	Albert Lake, Site II, outflow	0.4950	93.67
173	Flint Lake Outlet	0.5000	93.76
174	Rollins Savannah 2	0.5870	96.00
175	Almond Marsh	1.9510	113.00

2000 - 2013 Water Quality Parameters, Statistics Summary

	ALKoxic <=3ft00-2013	
Average	**164**	
Median	**159**	
Minimum	**65**	**IMC**
Maximum	**330**	**Flint Lake**
STD	**42**	
n =	**863**	

	ALKanoxic 2000-2013	
Average	**198**	
Median	**187**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**53**	
n =	**231**	

	Condoxic <=3ft00-2013	
Average	**0.8667**	
Median	**0.7875**	
Minimum	**0.2260**	**Schreiber Lake**
Maximum	**6.8920**	**IMC**
STD	**0.5239**	
n =	**860**	

	Condanoxic 2000-2013	
Average	**1.0056**	
Median	**0.8360**	
Minimum	**0.3210**	**Lake Kathyrn, Schreiber Lake**
Maximum	**7.4080**	**IMC**
STD	**0.8091**	
n =	**231**	

	NO3-N, Nitrate+Nitrite,oxic <=3ft00-2013	
Average	**0.454**	
Median	**0.145**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.016**	
n =	**863**	

*ND = Many lakes had non-detects (74.5%)
Only compare lakes with detectable concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

	NH3-Nanoxic 2000-2013	
Average	**2.211**	
Median	**1.530**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.425**	
n =	**231**	

*ND = 29.1% Non-detects from 32 different lakes

	pHoxic <=3ft00-2013	
Average	**8.35**	
Median	**8.34**	
Minimum	**7.06**	**Deer Lake**
Maximum	**10.40**	**Summerhill Estates**
STD	**0.46**	
n =	**860**	

	pHanoxic 2000-2013	
Average	**7.27**	
Median	**7.24**	
Minimum	**6.24**	**Cranberry Lake, Banana Pond**
Maximum	**9.16**	**White Lake**
STD	**0.45**	
n =	**231**	

	All Secchi 2000-2013	
Average	**4.35**	
Median	**3.00**	
Minimum	**0.18**	**McDonald 2/Ozaukee/Rollins 2**
Maximum	**29.23**	**Bangs Lake**
STD	**3.63**	
n =	**783**	

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2000 - 2013 Water Quality Parameters, Statistics Summary (continued)

	TKNoxic <=3ft00-2013	
Average	**1.525**	
Median	**1.170**	
Minimum	**<0.1**	***ND**
Maximum	**41.200**	**Almond Marsh**
STD	**1.726**	
n =	**863**	

*ND = 3.5% Non-detects from 14 different lakes

	TKNanoxic 2000-2013	
Average	**2.891**	
Median	**2.210**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.372**	
n =	**231**	

*ND = 3.5% Non-detects from 4 different lakes

	TPoxic <=3ft00-2013	
Average	**0.114**	
Median	**0.067**	
Minimum	**<0.01**	***ND**
Maximum	**7.270**	**Almond Marsh**
STD	**0.276**	
n =	**863**	

*ND = 1.8% Non-detects from 6 different lakes

	TPanoxic 2000-2013	
Average	**0.323**	
Median	**0.180**	
Minimum	**0.012**	**Independence Grove, W. Loon**
Maximum	**3.800**	**Taylor Lake**
STD	**0.410**	
n =	**231**	

	TSSall <=3ft00-2013	
Average	**15.8**	
Median	**8.0**	
Minimum	**<1**	***ND**
Maximum	**220.0**	**Rollins 2**
STD	**22.5**	
n =	**848**	

*ND = 1.3% Non-detects from 8 different lakes

	TVSoxic <=3ft00-2013	
Average	**124.7**	
Median	**119.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**1090.0**	**Almond Marsh**
STD	**50.7**	
n =	**818**	

No 2002 IEPA Chain Lakes

	TDSoxic <=3ft00-2004	
Average	**470**	
Median	**454**	
Minimum	**150**	**Lake Kathryn, White**
Maximum	**1340**	**IMC**
STD	**169**	
n =	**745**	

No 2002 IEPA Chain Lakes.

	CLanoxic 2000-2013	
Average	**195**	
Median	**135**	
Minimum	**3.5**	**Schreiber Lake**
Maximum	**2390**	**IMC**
STD	**310**	
n =	**178**	

	CLoxic 2000-2013	
Average	**179**	
Median	**145**	
Minimum	**2.7**	**Schreiber Lake**
Maximum	**2760**	**IMC**
STD	**200**	
n =	**723**	

LakeCounty
Health Department and
Community Health Center

Anoxic conditions are defined <=1 mg/l D.O.
pH Units are equal to the -Log of [H] ion activity
Conductivity units are in MilliSiemens/cm
Secchi Disk depth units are in feet
All others are in mg/L

Minimums and maximums are based on data from all lakes from 2000-2013 (n=4476).

Average, median and STD are based on data from the most recent water quality sampling year for each lake.

LCHD Environmental Services ~ 1/21/2014