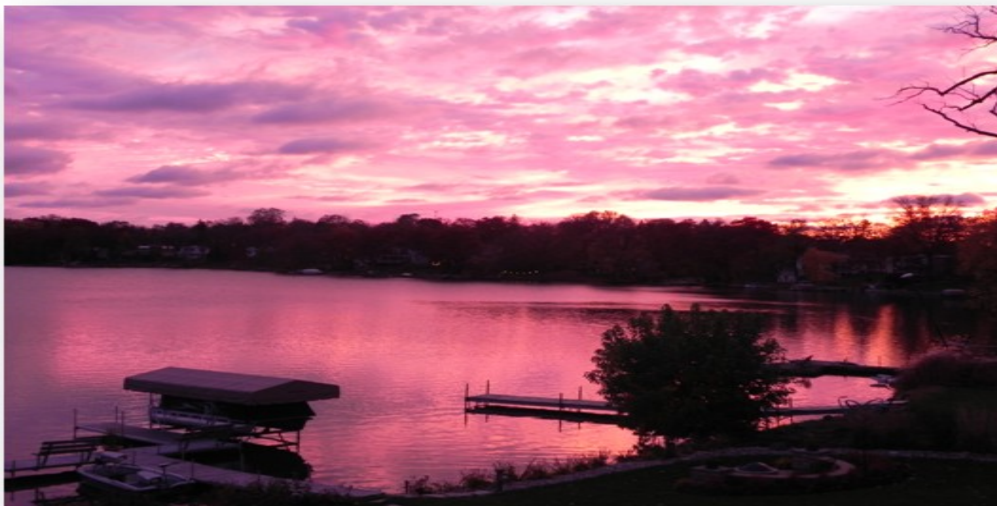
Lake County, Illinois

2011 Forest Lake Summary Report

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT

Population Health Environmental Services



Picture Provided by: Nick Leonard, Forest Lake Community Association

Forest Lake is a shallow, man-made impoundment with a surface area of 39.3 acres adjacent to the town of Hawthorne Woods in unincorporated Ela Township. The lake was created in 1934 by dredging a wetland and flooding the surrounding area by damming the creek. The Forest Lake Community Association manages the lake for recreation including: non-gas powered boating, swimming, and fishing.

Forest Lake, at the top of its watershed, receives storm water from 436 acres and drains north from the outlet to Indian Creek near Windward Lake, eventually draining into the Des Plaines River. The primary land uses within the Forest Lake watershed contributing to storm water runoff were single family homes, transportation, and industrial.

Water quality in Forest Lake remains poor, exceeding multiple impairment levels. Parameters have not changed significantly since 1990, however, many of Forest Lake's best water quality concentrations occurred in 2011. Total phosphorus concentrations

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2011 Forest Lake Summary (continued)

Lake Facts:
Major Watershed: Des Plaines

Sub-Watershed: Indian Creek

Location: T43N, R10E, Section 10&15

Surface Area: 39.80 acres

Shoreline Length: 1.61 miles

Maximum Depth: 9.0 feet

Average Depth: 4.5 feet

Lake Volume: 176.5 acre-feet

Watershed Area: 436.60 acres

Lake Type: Impoundment

Management Entity: Associations

Current Uses: swimming, fishing, non-gas powered boating

Access: Private

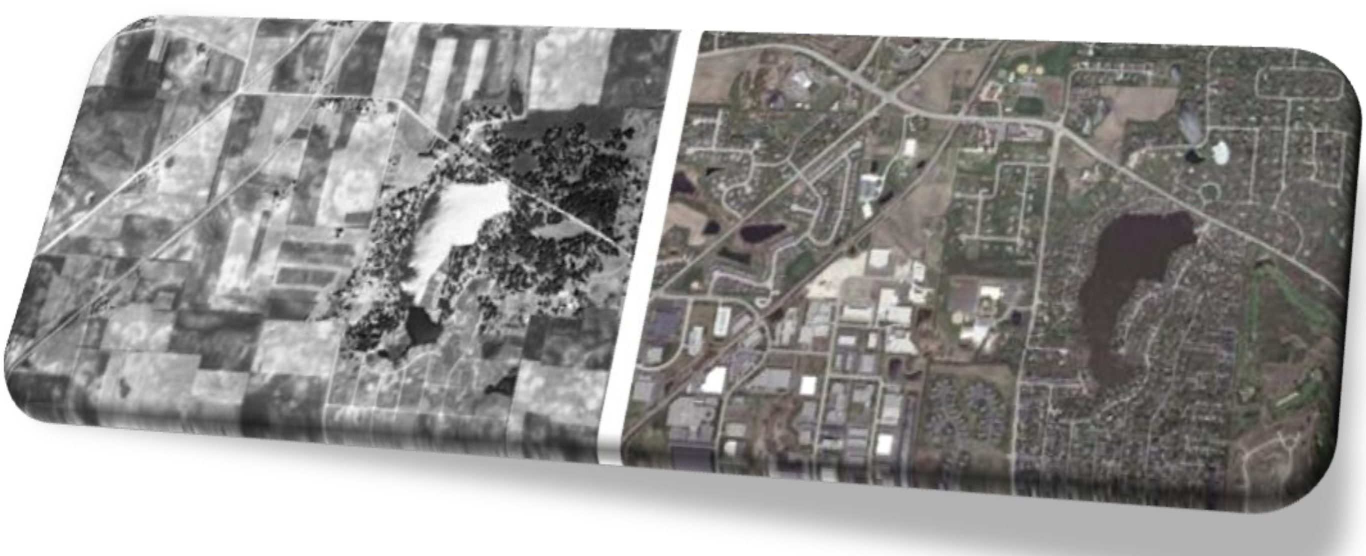
and total Kjeldahl nitrogen concentrations were the lowest recorded in Forest Lake. Total phosphorus averaged 0.082 mg/L. This concentration still exceeds the Illinois Environmental Protection Agency's (IEPA) impairment level of 0.050 mg/L. Nitrogen is the other nutrient critical for algal growth. The average total Kjeldahl nitrogen (TKN) concentration for Forest Lake in 2011 was 1.04 mg/L , which was lower than the 1999 and 2000 value by 39% and 21%, respectively (1.72 mg/L, 1.31 mg/L).

The 2011 average total suspended solids (TSS) concentration for Forest Lake was 13.6 mg/L; this value exceeds the county median (8.6 m/L) by 37% . Water clarity was measured by Secchi depth, with the lowest reading in August (2.00 feet) corresponding with the highest TSS concentration (20 mg/L). The average Secchi depth for the season was 3.27 feet which is above the county median (2.95 feet).

Conductivity concentrations are correlated with chloride concentrations. The average conductivity reading for Forest Lake was 0.9120 (mS/cm), which was above the county median (0.8320 mS/cm). This was a 7% increase from the 2000 concentration (0.8450 mS/cm). The chloride concentration in Forest Lake in 2011 was 184 mg/L, which is also above the county median (145 mg/L).

Plant sampling was conducted on Forest Lake in July. Eight species of aquatic plants were present, covering approximately 27% of the lake. American Pondweed and Curlyleaf Pondweed were the two most abundant species found at 15% of the sites. Slender Naiad was also common at 12% of the sites. The aquatic plant community improved significantly in coverage and diversity since 2010.

The shoreline of Forest Lake was assessed in 2011 for shoreline erosion. Approximately 31% of the shoreline had some degree of erosion. Overall, 69% of the shoreline had no erosion, 10% had slight erosion, 10% had moderate, and 11% had severe erosion.



FOREST LAKE AERIAL PHOTOS 1939 AND 2010, RESPECTIVELY

WATER QUALITY SAMPLING PROCEDURES

Water samples were collected monthly from May through September at the "natural" deepest part of the lake located on the northwest side. There are deeper spots in the lake, however, this sample site was chosen because historical data was collected at this location and it more accurately represents the water quality within the lake. Samples were collected three feet below the surface and analyzed for various water quality parameters. Water samples were collected with a horizontal Van Dorn and analyzed by the Lake County Health Department Laboratory. Dissolved oxygen, temperature, conductivity, and light level were measured at the deep hole with an YSI Sonde®. Readings were taken at the surface and then every foot until reaching the bottom. The Lake County Health Department's Environmental Services Unit (LCHD-ES) also sampled Forest Lake in 1991, 2000, 2003-2006, and 2010. In 2011, Forest Lake implemented additional water quality monitoring at three inlets on the west side of Forest Lake and the outlet. These inlets were monitored during the monthly lake testing and three storm events.

IN 2011 WATER QUALITY DATA WAS COLLECTED AT THREE INLETS, THE OUTLET, AND THE DEEP HOLE IN FOREST LAKE.

Inlet 1

Inlet 2

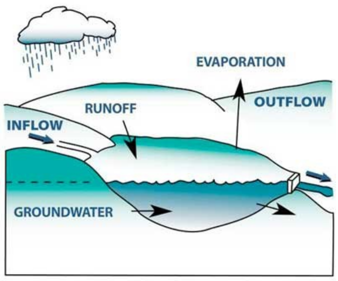
Inlet 3

Outlet

2011						
Location	**TP**	**Cl-**	**TSS**	**COND**	**pH**	**DO**
Inlet 1	0.088	419	7.7	1.6868	7.77	6.77
Inlet 2	0.082	169	14.1	1.1263	8.04	8.43
Inlet 3	0.084	169	11.1	0.8848	8.06	8.87
Outlet	1.055	183	34.3	0.8220	8.39	8.65
Deep Hole	0.082	184	13.6	0.9120	8.25	9.60

2011 AVERAGES FOR TOTAL PHOSPHORUS, CHLORIDES, TOTAL SUSPENDED SOLIDS, AND CONDUCTIVITY, PH, AND DISSOLVED OXYGEN FOR THREE INLETS, THE OUTLET, AND THE DEEP HOLE AT FOREST LAKE.

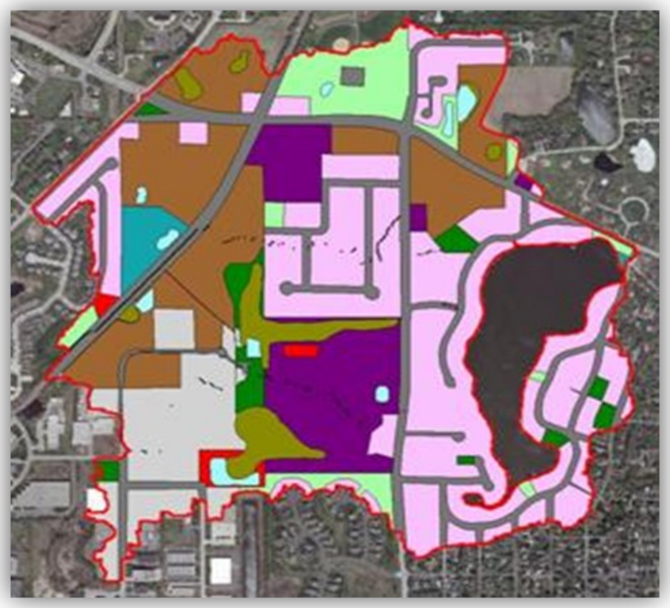
Watershed



IMPOUNDMENT
A MANMADE LAKE CREATED BY DAMMING A STREAM. AN IMPOUNDMENT IS ALSO DRAINED BY A STREAM.

The source of a lake's water supply is very important in determining its water quality and choosing management practices to protect the lake. A watershed is an area of land where surface water from rain and melting snow meet at a point, such as a lake or stream. Forest Lake is in the Indian Creek watershed and receives water from its 436.60 acre watershed. One small, natural tributary drains into Forest Lake at the northwest end, and four storm water outlets empty into the lake at various locations. A 5 foot concrete overflow dam at the northeast end of the lake allows water to flow to Forest Lake Drain, the only outlet. The Drain flows north and enters Indian Creek near Windward Lake, eventually draining into the Des Plaines River. The size of the watershed feeding the lake relative to the lakes size is also an important factor in determining the amount of pollutants in the lake. Retention time, the amount of time it takes for water entering a lake to flow out of it again, was calculated to be approximately 0.45 years. Based on the 2011 data, the current external sources affecting Forest Lake were from the following land uses: single family homes (31%), agriculture (18%), and transportation (15%). Based on the amount of impervious surfaces each land use contributes varied amounts of runoff. Because impervious surfaces (parking lots, roads, buildings, compacted soil) do not allow rain to infiltrate into the ground, more runoff is generated than in the undeveloped condition. The major sources of runoff for Forest Lake were single family homes (28%), transportation (23%) and industrial (22%). The lack of wetland, forest, and grassland areas around the lake increases pollution as runoff and nutrients don't have a chance to be absorbed before entering the lake. When a stream is dammed to create a lake, the natural movement of the water will be restricted, causing sediment and nutrients to collect in the impoundment. Identifying sources of nutrients and sediments that enter Forest Lake from the land's surface is imperative to improving the water quality. Three inlets and the outlet of Forest Lake were sampled for total phosphorus, total suspended solids, and chlorides. Different land uses contribute varied concentrations.

2011 LAND USE IN THE FOREST LAKE WATERSHED



Forest Lake Land Use	Acreage	% of Total	Runoff Coeff.	Estimated Runoff, acft.	% Total of Estimated Runoff
Single Family	135.32	30.99	0.30	111.6	28.3%
Transportation	65.18	14.93	0.50	89.6	22.7%
Industrial	39.39	9.02	0.80	86.6	21.9%
Government and Institutional	44.97	10.30	0.50	61.8	15.7%
Retail/Commercial	7.02	1.61	0.85	16.4	4.2%
Public and Private Open Space	26.67	6.11	0.15	11.0	2.8%
Agricultural	79.69	18.25	0.05	11.0	2.8%
Utility and Waste Facilities	3.31	0.76	0.30	2.7	0.7%
Wetlands	17.97	4.12	0.05	2.5	0.6%
Forest and Grassland	10.71	2.45	0.05	1.5	0.4%
Water	6.37	1.46	0.00	0.0	0.0%
Total Acres	**436.60**	**100.0**		**394.8**	**100.0%**

INLET 1

Inlet one is the only natural tributary flowing into Forest Lake, it is also the largest sub-watershed totaling 181.5 acres. The primary land use in the sub-watershed was agriculture (54.5 acres). The land uses contributing the most runoff were transportation (30%) and single family homes (25.3%). Inlet 1 contributes more than double the amount of chlorides into Forest Lake than the other two inlets tested. Compared to lakes in undeveloped areas, 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 runoff from impervious surfaces such as roads and parking lots can deliver high concentrations of Cl^- to nearby water bodies. Within the sub-watershed, there are three major roads (Quentin, Old McHenry, and Midtholian) and parking lots that can contribute to the Cl^- runoff and increased conductivity.

INLET 2

Inlet 2 directs storm water through drainage ditches and storm grates into Forest Lake; portions of this inlet flow east under Quentin Road and Forest Lake. This sub-watershed includes areas east of Midlothian; including portions of the industrial park, Quentin Road Christian School, and residential areas of Forest Lake accounting for 110.6 acres total. The primary land use in the sub-watershed was agriculture (25.3 acres). The land uses contributing the most runoff were Industrial (39.9%) government and institutional (27.0%) and single family homes (22.7%). Inlet 2 had the highest average concentration of total suspended solids (TSS, 14.1 mg/L). TSS increased May through September, the lowest concentration 1.0 mg/L and the highest 27.0 mg/L. Stream bank erosion can increase TSS concentrations. Moderate erosion was occurring along the banks of inlet 2 in the Forest Lake residential area.

INLET 3

Inlet 3 also directs storm water through ditches, ponds, and storm drains into Forest Lake. Portions of this inlet flow east from the industrial park, Quentin Road Christian School, and residential areas of Forest Lake, accounting for 78.6 acres total. Inlet 3 is the smallest sampled inlet (78.6 acres) and is similar to inlet 2 in function, and water quality. To some extent this can be attributed to the runoff of comparable land uses. The primary land use for inlet 3 was Industrial (23.1 acres). The land uses contributing the most runoff were industrial (78.4%), government and institutional (31.3%), and single family homes (20.5%). The highest TSS concentration (26.3 mg/L) for inlet 3 occurred in July. This sampling event occurred after a moderate rain event. Slight rain events occurred June, August, and September. The elevated concentration can be influenced by steeply eroded banks, as the water level increases more sediment can be washed from the banks into Forest Lake. Inlet 3 has steep, severely eroded banks east of Quentin Road that can further impact water quality during high water levels caused by significant storm events.

VOLUNTEER LAKE MONITORING PROGRAM (VLMP)

The VLMP was established in 1981 to gather information on Illinois inland lakes, and to provide an educational program for citizens. The primary measurement by volunteers is the secchi depth (water clarity). Other observations such as water color, suspended algae and sediment, aquatic plants and odor are also recorded. The sampling season is May through October with measurements taken twice a month. In 2011, there were **42 lakes** that participated in Lake County.

For more information visit: www.epa.state.il.us/water/vlmp/index.html

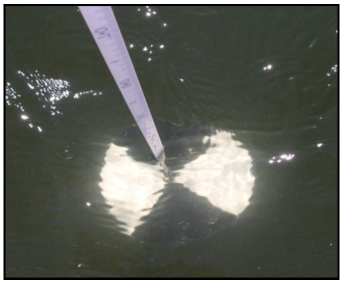
WATER CLARITY

Water clarity is an indicator of water quality related to chemical and physical properties.

Measurements taken with a Secchi disk indicate the light penetration into a body of water.

Algae, microscopic animals, water color, eroded soil, and resuspended bottom sediment are factors that interfere with light penetration and reduce water transparency.

The 2011 average water clarity in Forest Lake was 3.27 feet. This was above the county median of 2.95 feet. The only other time water clarity measured by LCHD-ES exceeded the county median in Forest Lake was 2004.



A Secchi disk is an eight-inch diameter weighted metal plate painted black and white in alternating quadrants. A calibrated rope is used to lower the disc into the water and measure the depth to which it is visible.

WATER CLARITY-VOLUNTEER LAKE MONITOR PROGRAM

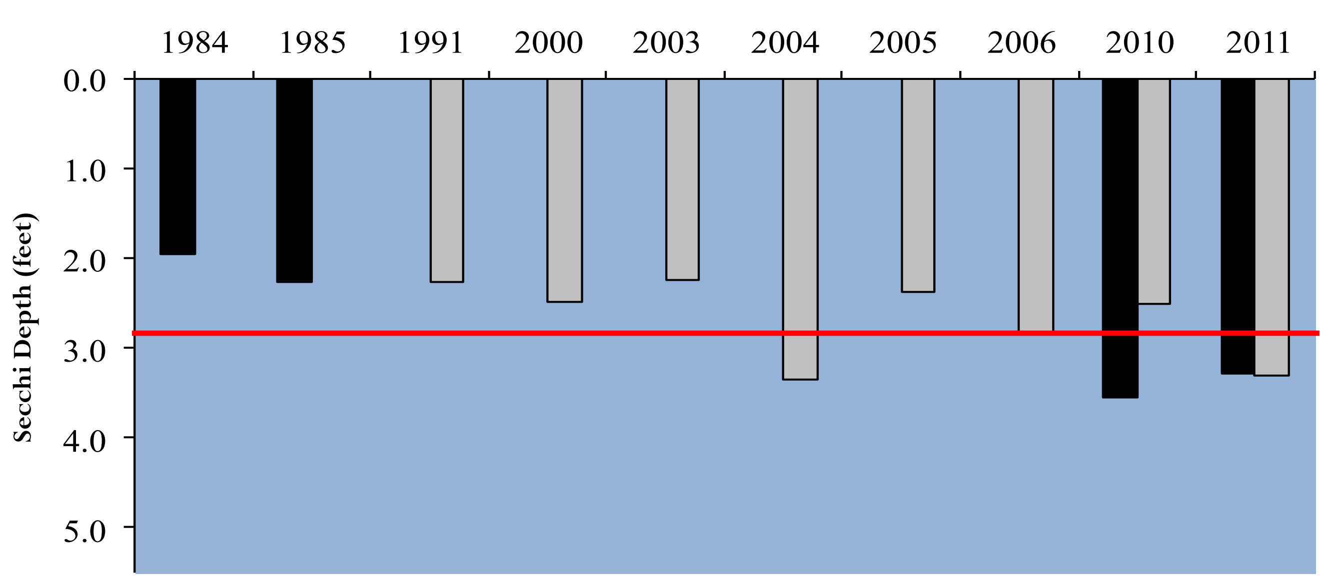
Additional water clarity measurements were taken in Forest Lake through participation in the Illinois Environmental Protection Agency's (IEPA) Volunteer Lake Monitoring Program (VLMP). Forest Lake residents Lou DiNicola and Larry Stecker have participated in the program annually since 2010. Forest Lake also had historical VLMP data from 1984 and 1985. Participation in the VLMP program has provided Forest Lake with baseline data that can be used to determine long-term water quality trends and support current lake management decision making. The average VLMP Secchi disk depth from 2011 was 3.28 feet. Monthly VLMP readings have varied from 1.92 feet in May 1984 to 7.33 feet in May 2010. The volunteers on Forest Lake have provided data that is vital for the continued monitoring and management of this lake. The LCHD-ES would like to thank them for their efforts and recommend continued involvement in the future.

SECCHI DISK AVERAGES FROM VLMP AND LCHD FOR FOREST LAKE 1984-2011.

VLMP

LCHD

LAKE COUNTY 2011 MEDIAN 2.95 FEET



TOTAL SUSPENDED SOLIDS

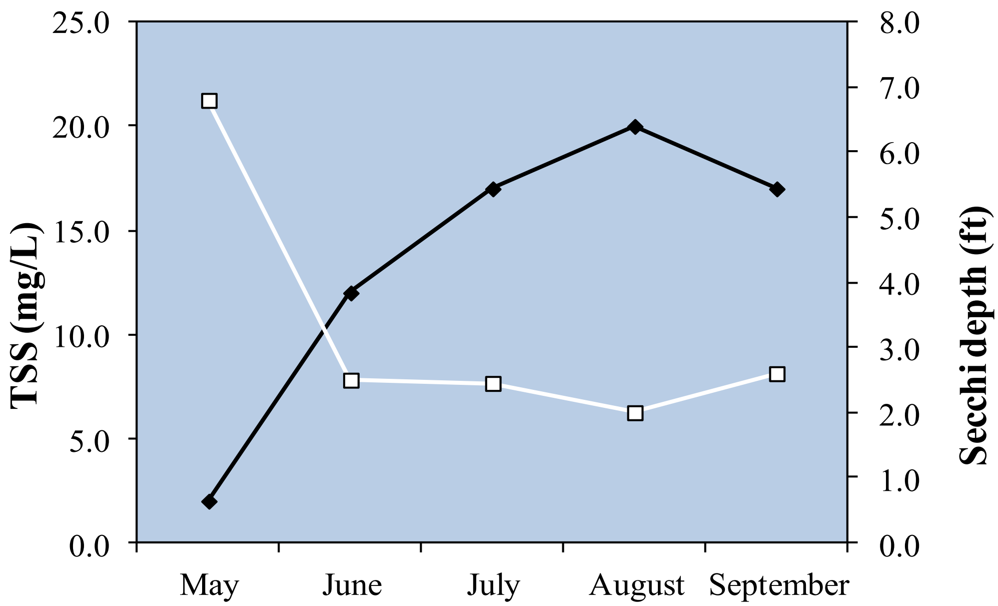
Another measure of water clarity is turbidity, which is caused by particles of matter rather than dissolved organic compounds. Suspended particles dissipate light, which affects the depth at which plants can grow. The total suspended solid (TSS) parameter (turbidity) is composed of nonvolatile suspended solids (NVSS), non-organic clay or sediment materials, and volatile suspended solids (TVS) (algae and other organic matter).

2011 TSS concentrations averaged 13.6 mg/L which was nearly double the county median of 8.6 mg/L; however the concentration was an 18% and 13% reduction from 1991 and 2000, respectively. High TSS values are typically correlated with poor water clarity (Secchi disk depth) and can be detrimental to many aspects of the lake ecosystem, including the plant and fish communities. Calculated nonvolatile suspended solids (NVSS) was 9.1 mg/L. This means that, despite the dense blue-green algae blooms in August and September, the majority of the TSS concentration in 2011 can be attributed to non-organic particles, such as sediments.

AVERAGE TOTAL SUSPENDED SOLIDS CONCENTRATION (MG/L) IN FOREST LAKE

Year	TSS
1991	16.7
2000	15.6
2003	16.8
2004	10.6
2005	14.0
2006	15.3
2010	12.0
2011	13.6

***2011 Lake County median TSS = 8.6 mg/L**



Monthly Total Suspended Solid Concentrations and Secchi Depth in Forest Lake, 2011.

TSS (mg/L)

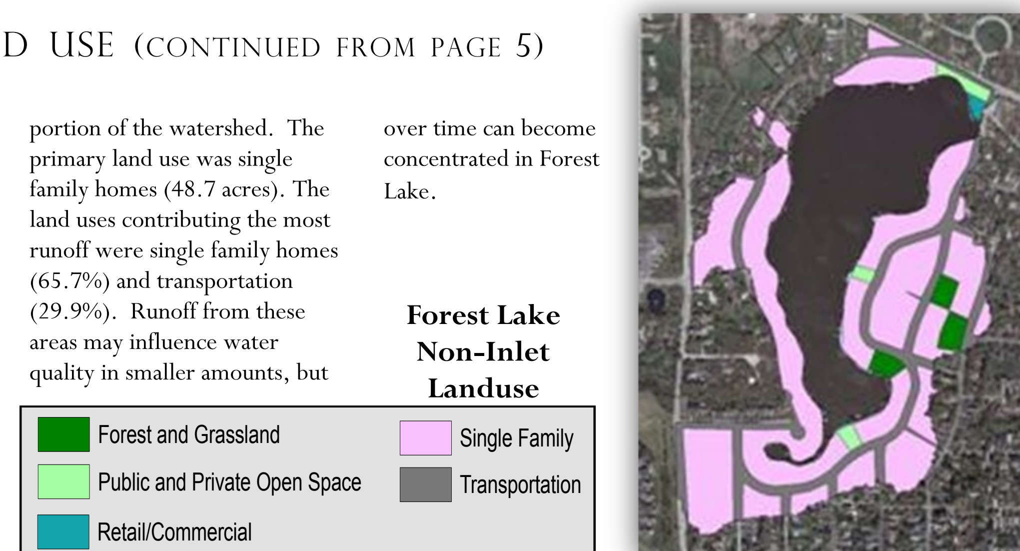
Secchi Depth (feet)

NON INLET LAND USE (CONTINUED FROM PAGE 5)

Continued from page 5.

The inlet sampling around Forest Lake can be used to help identify areas of the watershed that are contributing to elevated levels of nutrients, solids, and chlorides within the sub watershed. However, there are areas within the Forest Lake watershed where runoff cannot be traced back to a specific location. These areas are primarily located around the lake, and the south and east portion of the watershed. The primary land use was single family homes (48.7 acres). The land uses contributing the most runoff were single family homes (65.7%) and transportation (29.9%). Runoff from these areas may influence water quality in smaller amounts, but over time can become concentrated in Forest Lake.

Forest Lake Non-Inlet Landuse



NUTRIENTS

Organisms take nutrients in from their environment. In a lake, the primary nutrients needed for aquatic plant and algal growth are phosphorus and nitrogen. In most lakes, phosphorus is the limiting nutrient, which means everything that plants and algae need to grow is available in excess: sunlight, warmth, and nitrogen. Phosphorus has a direct effect on how much aquatic plants and algae can grow in lakes. In Forest Lake, the limiting nutrient varied throughout the sampling season. In May and June phosphorus was limiting, in August nitrogen was limiting, and in July and September there was sufficient amounts of both nutrients to support heavy algae blooms.

The 2011 average total phosphorus concentration in Forest Lake was 0.082 mg/L. This was a 20% decrease from the 2010 concentration (0.102 mg/L) and the lowest average concentration recorded since 1991. The 2011 concentration remains above the Lake County median of 0.066 mg/L. The most significant total phosphorus concentration occurred in August (0.152 mg/L), which was almost seven times higher than the May concentration (0.022 mg/L). Total phosphorus levels have been decreasing since 2005; however, Forest Lake will be still be on the IEPA 303 (d) list for impaired water as phosphorus concentrations continue to exceed the impairment level of 0.050 mg/L. Concentrations above the impairment level can support high densities of algae and aquatic plants, which can reduce water clarity and dissolved oxygen levels. The 2011 phosphorus concentrations are similar to the 1991 and 2000 (0.094 mg/L and 0.087 mg/L respectively) concentrations when the watershed was less developed. Phosphorus originates from a variety of sources in the Forest Lake watershed, many of which are related to human activities: human and animal waste, soil erosion, detergents, septic systems, common and grass carp, and runoff from driveways and lawns.

Nitrogen is the other nutrient critical for algal growth. Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen, and is typically bound up in algal and plant cells. The average 2011 TKN for Forest Lake was 1.04 mg/L, which was lower than the county median of 1.18 mg/L. TKN concentrations in Forest Lake have decreased by 27% and 21%, (1.43 mg/L and 1.31 mg/L) respectively, since 1991 and 2000. The highest TKN concentration in 2011 occurred in August (1.36 mg/L) corresponding with a blue-green algae bloom.

Inorganic forms of nitrogen include ammonia and nitrite/nitrate nitrogen. These can be used by aquatic plants and algae. Ammonia and nitrite/nitrate was only at detectable levels in Forest Lake in May and June. Aquatic plants and algae in Forest Lake used all the available nitrogen; this occurs when the lake is nitrogen limited. High phosphorus concentrations and low nitrogen is the ideal condition for blue-green algae. Blue green algae can fix nitrogen from the atmosphere when nitrogen supplies are low. Other more desirable types of algae and plants depend on the inorganic nitrate and ammonium forms of nitrogen (more information on blue algae on page 11). As a result, Forest Lake had dense blue-green algae blooms in August and September.

Nitrogen originates from a variety of human related and non-human related sources in the Forest Lake watershed including: air, precipitation, ground water, human and animal waste, septic systems, and lawn fertilizer.

LIMITING NUTRIENT

P VERSUS **N**

Unlike nitrogen, the properties of phosphorus make it the ideal nutrient to manage reductions from surface water inputs, because it has no gas phase in the atmosphere. The relative contribution of this nutrient from the air or by rainfall is generally low and as water moves through soil,

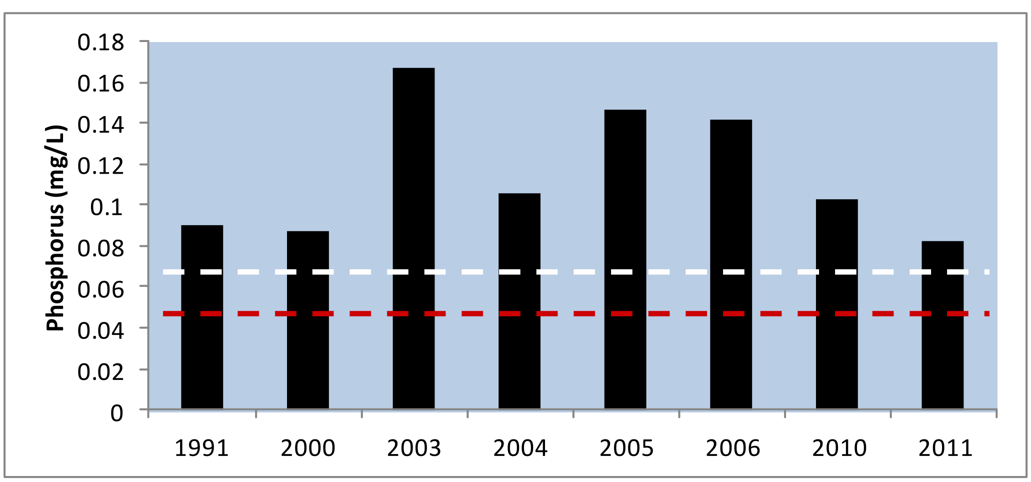
YEAR	TP
1991	0.090
2000	0.087
2003	0.167
2004	0.105
2005	0.147
2006	0.142
2010	0.102
2011	0.082

Average phosphorus concentrations (mg/L) in Forest Lake 1991-2011

AVERAGE PHOSPHORUS CONCENTRATION FROM IN FOREST LAKE 1991-2011.

IEPA IMPAIRMENT LEVEL 0.050 MG/L

LAKE COUNTY 2011 MEDIAN 0.066 MG/L



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. Lakes 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. 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), eutrophic (nutrient-rich, highly productive), or hypereutrophic (extremely nutrient-rich, productive). In 2011, Forest Lake was eutrophic with a TSIp value of 68.00. Based on the TSIp, Forest Lake ranked 95th out of 171 lakes studied by the LCHD-ES from 2000-2011. Since 2010 Forest Lake has increased its ranking by 20 positions.

What Has Been Done to Reduce Phosphorus Levels in Illinois

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.

OLIGOTROPHIC:

Lakes are generally clear, deep and free of weeds or large algae blooms. Though beautiful, they are low in nutrients and do not support large

MESOTROPHIC:

Lakes lie between the oligotrophic and eutrophic stages. Devoid of oxygen in late summer, their hypolimnions limit cold water fish and cause phosphorus cycling from sediments.

EUTROPHIC:

Lakes are high in nutrients, they are usually either weedy or subject to frequent algae blooms, or both. Eutrophic lakes often support large fish populations, but are also susceptible to oxygen depletion.

2011 Swim Bans on Forest Lake

BEACH	SWIM BAN
Central	1
Erker Park	0
Lutrell Park	0
Steinken Park	2

Swimming Beach Monitoring

There are four state licensed swimming beaches on Forest Lake: Central Beach, Erker Park, Lutrell Park, and Steinken Park. They were sampled for the bacteria *Eschericia coli* (*E. coli*) levels every two weeks, from mid May to the end of August, by the LCHD-ES in 2011. The water samples are tested for *E. coli* bacteria, which are found in the intestines of warm-blooded animals. While not all strains of *E. coli* are the same, certain strains can make humans sick if ingested in high enough concentrations. If water samples come back high for *E. coli* (>235 *E. coli*/100 ml), the management body for the bathing beach is notified and a sign is posted indicating the swim ban. *E. coli* is used as an indicator organism, meaning that high concentrations of E. coli might suggest the presence of harmful pathogens such as, *Salemnella*, *Giardia*, etc. There are many ways *E.coli* can end up in a swimming beach. Heavy rainfall and strong wind associated with storms can cause the water to become cloudy with sediment from the lake bottom. Storm water from rain can also wash in other particles from lawns, streets, and buildings. This sediment and storm water may contain high concentrations of *E. coli*. Another source of *E. coli* contamination is the feces of gulls, geese, and other wildlife. Erker Park and Lutrell Park *E. coli* concentrations did not exceed the impairment level during sample events in 2011. Central Beach had one violation and Steinken Park two.

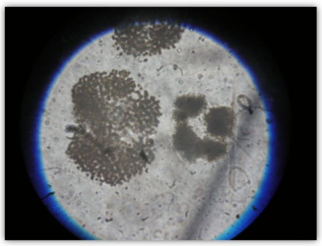
LCHD Lab staff uses black light technology to report E. coli beach data.

Practicing common sense and good hygiene will go a long way in preventing illness from swimming beaches.

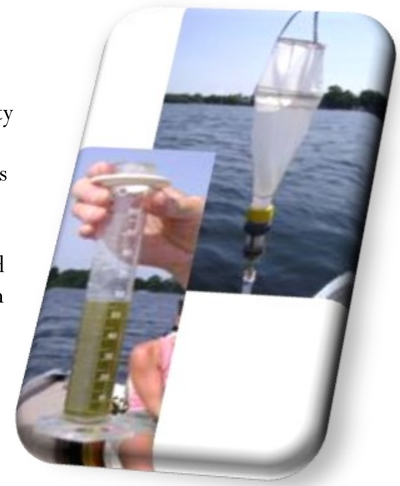
- If you are sick, do NOT swim.
- Do NOT drink the water while swimming.
- Avoid swimming during heavy algae blooms.
- Keep geese off the beach.
- Children who are not toilet trained should wear tight-fitting rubber or plastic pants.
- Take a shower before entering the water, and have kids take frequent bathroom breaks.
- Wash your hands after exiting the lake.

Phytoplankton

MICROCYSTIS SP. IN FOREST LAKE SEPTEMBER, 2011



Phytoplankton (algae) are free-floating and microscopic organisms that are distinguished from plants because they lack roots, stems and leaves. There are four distinct groups of phytoplankton found in Lake County lakes: blue-greens, greens, diatoms, and dinoflagellates/chrysophytes. Blue-greens are also known as cyanobacteria because they are the only group of bacteria that obtain their energy from photosynthesis like plants. Some of these species produce toxins. Green algae are the closest ancestors of land plants and are the most common group. Diatoms are unique because they are encased in a cell wall made of silica that can be very ornate. Dinoflagellates and chrysophytes are almost always flagellated (able to move by flagella, a whip-like tail) and some can both photosynthesize and consume bacteria for food. In 2011, a plankton sample was collected in September, during which a dense blue-green algae bloom was occurring.
Microcystis, a blue-green algae, was the dominant phytoplankton. Blue-green algae possess certain adaptations that enable them to out compete other algae. One of these adaptations is <u>positive buoyancy;</u> blue-greens contain gas vesicles that allow them to rise to the lake surface during calm conditions to take advantage of sunlight. The second adaptation of some blue-green algae is the ability to <u>fix nitrogen</u> from the atmosphere when nitrogen supplies are low. This is especially useful in Lake County where 62% of the lakes have high levels of phosphorus. This means that in lakes with high phosphorus there may not be enough nitrogen, thus the need for this adaptation. Blue-green algae populations are typically abundant July through September in Forest Lake. Microcystis, Anabaena, and Aphanazomenon were all present in the September sample. In addition to having unique adaptations, these three genera can also produce toxins. These are known collectively as cyanotoxins. The phytoplankton sample in September suggests an extremely unbalanced community were other groups of algae have extremely low populations. A late spring or early summer sample should be collected when blue-green populations are low.



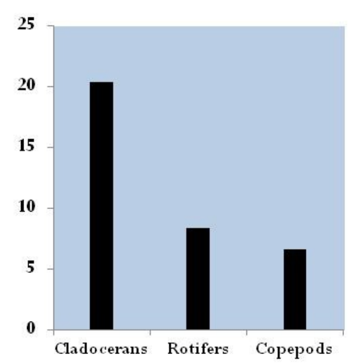
Zooplankton

DAPHINIA SP. IN FOREST LAKE SEPTEMBER, 2011

BROOD SAC

Zooplankton are small animals that occur in the water column and eat other plankton. Zooplankton are a diverse group defined on the basis of their size and function, rather than on their taxonomic affinities. Zooplankton in Forest Lake was made up of rotifers and two crustacean groups; the cladocerans and the copepods. Rotifers are smaller and most have a crown of cilia (hair-like structure) used for movement and drawing in suspended particles to eat. Crustaceans have jointed appendages and are enclosed in an exoskeleton. Cladocerans, such as the "water flea" Daphnia species, are filter-feeders like rotifers, while the copepod group contains both filter-feeders and raptorial species.
The composition of the September zooplankton community in 2011 was dominated by cladocerans (57%). All species of cladocerans are virtually limited to freshwater. They occupy key positions in aquatic communities both as important herbivores, eating algae and bacteria, and as major prey items in the diets of fish, and other invertebrate predators. The life cycle of cladocerans is dominated by asexual reproduction, with occasional periods of sexual reproduction. Many of the clodocerans in the sample were noted having full brood sacs, indicating active recruitment.

ZOOPLANKTON (per mL) FOREST LAKE SEPTEMBER 2011



BLUE-GREEN ALGAE THE FACTS

Blue-green algae, also known as cyanobacteria, are not a true algae but are in fact closely related to bacteria. Similar to bacteria in structure, these simple organisms are credited for first using chlorophyll to make food from sunlight and for boosting oxygen in the Earth's early atmosphere. Today this organism forms an important role at the base of the food chain in our lakes; however they also pose a potential harmful health effect as they reach nuisance and noxious populations due to the high nutrient loads in our lakes. Blue-green algae are naturally present in lakes and streams in low numbers. Blue-green algae can become abundant in warm, shallow, undisturbed surface water that receives ample sunlight. Under some conditions the algae becomes so abundant that they can form floating rafts or scums on the surface of the water. Both true algae and blue-green have similar growth requirements including sunlight, warmth, and nutrients (phosphorus and nitrogen). However, an oversupply of nutrients, especially phosphorus, will often result in excessive growth of blue-green algae because they possess certain adaptations that enable them to out compete true algae. One of these adaptations is <u>positive buoyancy;</u> blue-greens contain gas vesicles that allow them to rise to the lake surface during calm conditions to take advantage of sunlight. The second adaptation of some blue-green algae is the ability to <u>fix nitrogen</u> from the atmosphere when nitrogen supplies are low. This is especially useful in Lake County where 62% of the lakes have high levels of phosphorus. This means that in lakes with high phosphorus there is not enough nitrogen, thus the need for this adaptation.

In addition to having unique adaptations, some blue-green algae can also produce toxins, these are known collectively as cyanotoxins. Not all blue-green algae produce harmful conditions. The three primary genera in our area that are responsible are *Anabaena, Aphanizomenon, and Microcystis*. Algal toxins could pose a health risk to people and animals when they are exposed to the toxins in large quantities. Health effects could occur when surface scums or water containing high levels of blue-green algal toxins are swallowed, come in contact with the skin or when airborne droplets containing toxins are inhaled while swimming, bathing, or showering. Lake County residents get their drinking water from Lake Michigan and ground water; both of which have minimal levels of nutrients and algae cells, unlike our inland lakes. Direct contact or breathing airborne droplets containing high levels of blue-green algal toxins during swimming or showering can cause irritation of the skin, eyes, nose and throat and inflammation in the respiratory tract. To protect yourself against exposure do not swim, boat, etc. in water that looks like "pea soup," green or blue paint, or that has a scum layer or puffy blobs floating on the surface. There is no quick or easy way to control blue-green algae. Chemical treatments can control blue-green algae temporarily, but repeated applications are often necessary. It is best to treat blue-green algae when populations are low. Treating large populations can cause large amounts of toxins to be released at once. Reducing the amount of nutrients in the lake or pond will eventually reduce the frequency and intensity of the blooms. It is not understood when or why blue-green algae release toxins. 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.

Forest Lake September 2011

DURING A BLUE GREEN ALGAE BLOOM THE LAKE CAN DEVELOP A PAINT-LIKE APPEARANCE

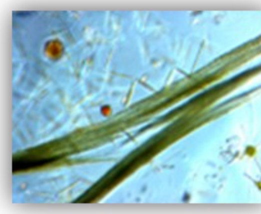
For more information on Blue-green algae.

<u>http://dnr.wi.gov/lakes/bluegreenalgae/</u>

<u>http://www.health.state.ny.us/environmental/water/drinking/bluegreenalgae.pdf</u>

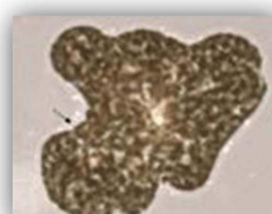
To report a blue-green algae bloom:

Lake County Health Department
Environmental Services
(8470 377-8030



Aphanizomenon ***Sp.***

Anabaena ***Sp.***



Microcystis ***Sp.***

CONDUCTIVITY AND CHLORIDE

Location	Cl-	COND
Inlet 1	419	1.6924
Inlet 2	169	1.1266
Inlet 3	169	0.9166
Outlet	183	0.9358
Deep Hole	184	0.9120

CHLORIDE (CL-) AND CONDUCTIVITY CONCENTRATIONS FOR FOREST

THE CRITICAL VALUE FOR CHLORIDES IN AQUATIC SYSTEMS IS 230 mg/L.

230 mg/L = 1 teaspoon of salt added to **5 gallons of water.**

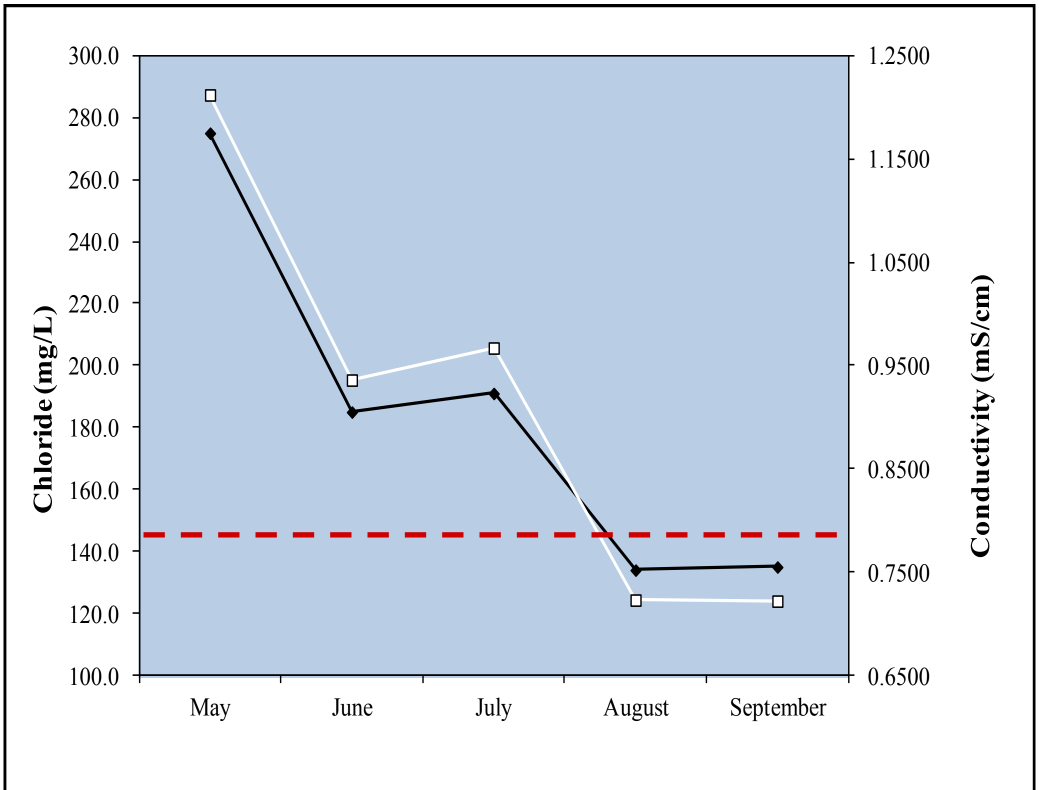
Another parameter measured during 2011 that is important in comparing data from year to year is conductivity. Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Conductivity has been shown to be highly correlated (in urban areas) with chloride ions found in road salt mixtures. Water bodies most subject to the impacts of road salts are streams, wetlands or lakes draining major roadways. In 2011, Forest Lake's average conductivity was 0.9120 mS/cm. This parameter was above the county median of 0.7821 mS/cm and 12% decrease from the 2010 value 1.0386 mS/cm. Conductivity concentrations in the lake were highest in May and decreased throughout the summer, indicating that spring runoff was a major contributor to these concentrations and that over the sampling season a flushing effect occurred. One of the most common dissolved solids is road salt used in winter road deicing. Most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanide salts. Forest Lake 2011 average chloride concentration was 184 mg/L. Inlet 1 had the highest average concentration of chlorides 419 mg/L; this is the largest sub-watershed and includes runoff from deicing applications on Old McHenry and Midlothian Road. 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. 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.

MONTHLY AVERAGE CHLORIDE AND CONDUCTIVITY CONCENTRATIONS IN FOREST LAKE, 2011.

CHLORIDE (MG/L)

CONDUCTIVITY (MS/CM)

LAKE COUNTY 2011 MEDIAN 145 MG/L, 0.7821 MS/CM



DATE	COND	Cl-
May	1.212	275
June	0.936	185
July	0.967	191
August	0.723	134
September	0.722	135

MONTHLY AVERAGE CHLORIDE AND CONDUCTIVITY CONCENTRATIONS IN FOREST LAKE, 2011.

CHLORIDES:

Lake County Division of Transportation:

Is enhancing efficiency of snow removal, and going green through innovation and technology. Global positioning systems (GPS) on snow plows are providing real-time tracking of these vehicles, as well as the application of salt and de-ice materials (beet juice). The data is then used to better coordinate and target services, saving on salt and gas. According to a Lake County news release, the DOT projects a savings of about 600 tons of salt and 1,600 gallons of diesel annually through the new green technologies.

This liquid has several advantages.

1. Beet juice adds moisture to help salt work better.
2. Lowers the working temperature of salt to around 20 degrees below zero.
3. Creates a composition that sticks to the pavement versus dry salt that can bounce off of the pavement.
4. Reduces salt use by 20%.
5. Environmentally friendly product.

Pavement temperature greatly influences the efficiency of salt to melt ice.

Pavement Temp. °F	One Pound of Salt (NaCL) melts	Melt Times
30°	46.3 lbs of ice	5 min.
25°	14.4 lbs of ice	10 min.
20°	8.6 lbs of ice	20 min
15°	6.3 lbs of ice	1 hour
10°	4.9 lbs of ice	Ineffective

NaCl (Road Salt) does not work on cold days, less than 15° F.

TIPS

- De-icers melt snow and ice. They provide no traction on top of snow and ice.
- Anti-icing prevents the bond from forming between pavement and ice.
- De-icing works best if you plow/shovel before applying material.
- Pick the right material for the pavement temperatures.
- Sand only works on top of snow as traction. It provides no melting.
- Anti-icing chemicals must be applied prior to snow fall.

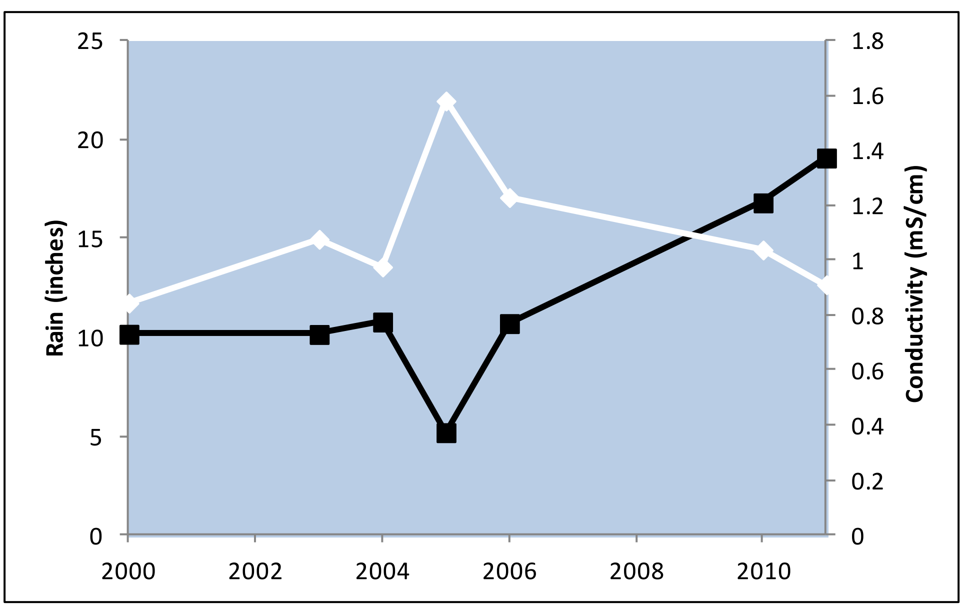
20 YEAR WATER QUALITY SUMMARY

Over the past 20 years (1991-2011) the water quality in Forest Lake has been affected by a variety of factors including: land management practices, aquatic plant populations, and weather. The water quality of Forest Lake is significantly influenced by the weather because of the lake's morphology (structure of the lake). Forest Lake is a small shallow impoundment that has several inlets and an outlet; essentially a drainage lake. The principal water source comes from the drainage of the land within the watershed. Precipitation has a direct effect on the volume of the lake as storm runoff is directed from impervious surfaces into the lake. As the lake volume increases some water quality parameters become less concentrated; creating a flushing effect. 2011 had the lowest concentration of total phosphorus (0.082 mg/L) from 1991-2011 in addition there was a notable reduction in various other water quality parameters including conductivity. 19.08 inches of rain occurred from June-August 2011, according to the National Weather Service this was third wettest summer on record since 1871. 2005 had the highest level of conductivity and the second highest total phosphorus concentration (1.5816 mS/cm and 0.147 mg/L, respectively). Comparatively 2005 was the third driest summer on record with only 5.18 inches of summer precipitation.

Summer Precipitation and Conductivity Concentrations in Forest Lake, 2000-2011.

Rain (inches)

Conductivity (mS/cm)



Storm Water Sampling

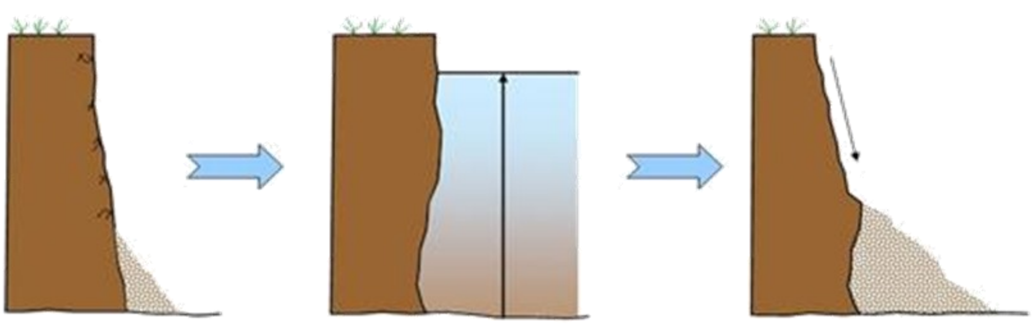
Rain storms can be significant events affecting water quality in a lake. Storm water is the rainfall/snowmelt that flows over yards, streets, parking lots, and buildings that picks up inorganic and organic materials, including fertilizers, pet wastes, oil/ antifreeze, soil, and other pollutants. Areas within the defined watershed/sub-watersheds drain directly into Forest Lake untreated. In 2011 three storm samples were collected in April, July, and September during rain events. Chemical analysis on these samples included total phosphorus, total suspended solids, and chlorides. Storm sampling can help to identify areas of concern and reduce the risk of underestimating baseline concentrations entering the lake from the ambient (monthly) inlet sampling. All the total phosphorus and total suspended solids concentrations were elevated during the three storm events; which was expected. However the total phosphorus concentrations in inlet 1 were excessive (0.358 mg/L), averaging more than four times higher than the ambient sampling concentrations. The highest total phosphorus concentration sample in 2011 occurred in July at inlet 1 during a storm event (0.700 mg/L). Total suspended solid concentrations from inlet 1 and inlet 2 were reasonably higher than the ambient averages. Inlet 3 TSS concentrations were almost three times higher than the ambient, indicating a significant source within the inlet 3 sub-watershed. Compared to the other inlets, inlet 3 has the steepest banks; the top of the banks to the inlet bed can reach 18 feet. These banks are severely eroded, especially near Quentin Road and W. Ravine Drive, so that during times of high water (storm events) these areas can contribute additional sediment to the lake. Coupled with steep eroding banks, a substantial decrease in elevation occurs from the top of W. Ravine (832 feet) to N. Forest Drive (802 feet). This creates a steep slope (0.04) that increases the velocity and sediment transport ability of the inlet. For comparison the slope from Quentin Road to N. Forest Drive at inlet 1 is much more gradual (0.02) and the banks average 5 feet to the inlet bed. This morphology helps to reduce TSS concentrations, the average storm water TSS concentrations from inlet 1 were less than half (12.8 mg/L) of inlet 3. The storm water sampling also indicated another problem area in the inlet 1 sub-watershed. Average Chloride levels were higher during the monthly sampling events when compared to the storm samples (419 mg/L, 279 mg/L respectively). Typically chloride concentrations are higher in the spring and during storm events; reducing in concentration over the course of the sampling season as winter road salts are carried through the watershed. The highest chloride concentration in inlet 1 occurred during the monthly sampling event for July (669 mg/L) following a moderate rain event. May and September also delivered extremely high concentrations (419 mg/L and 508 mg/L, respectively). The May concentration is influenced from winter deicing, however the September chloride concentration is unexplained at this time and warrants further

Storm Drain in the Forest Lake Community that drains to Forest Lake

STORM DRAINS ARE THE OPENINGS YOU SEE ALONG CURBS, IN STREETS AND PARKING LOTS. THEY CARRY AWAY RAINWATER AND SNOWMELT AND TRANSPORT IT THROUGH TO NEARBY LAKES AND STREAMS

2011 Storm water averages for total phosphorus, chlorides, total suspended solids, for three inlets, and the outlet, at Forest Lake.

2011			
Location	TP	Cl-	TSS
Inlet #1	0.358	279	12.8
Inlet #2	0.113	176	20.4
Inlet #3	0.123	263	30.0
Outlet	0.067	239	12.1



DURING STORM EVENTS, SOIL IS ERODED FROM THE BANK TOE, LEAVING AN UNSTABLE BANK. FOLLOWING A DROP IN WATER LEVEL, THE STREAM BANK COLLAPSES, DEPOSITING ADDITIONAL MATERIAL AT THE BANK TOE.

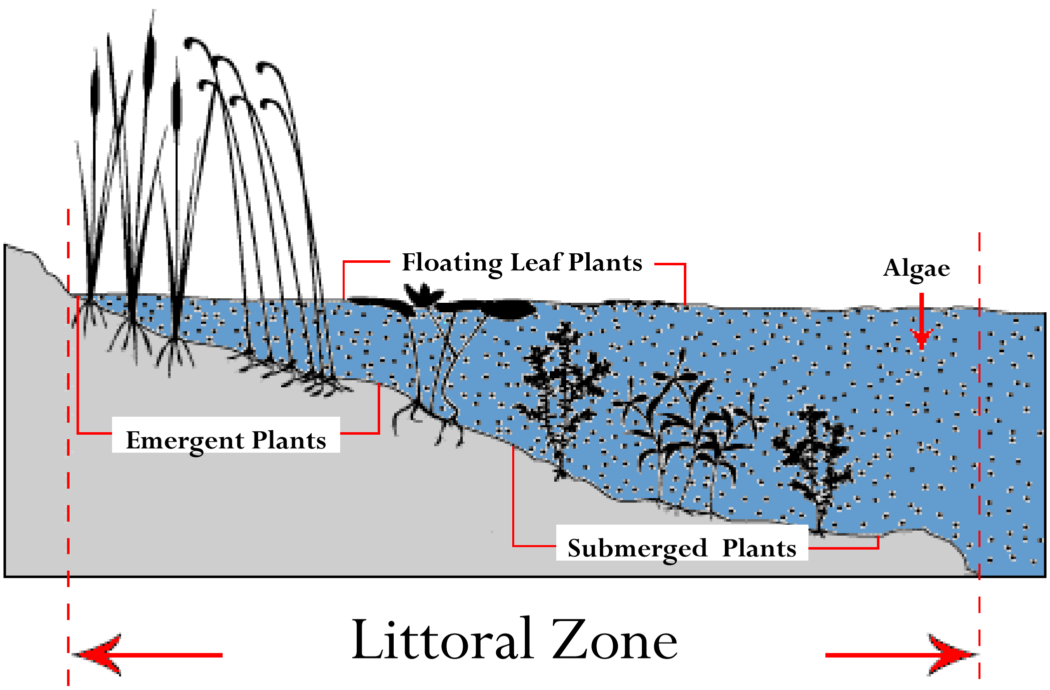
Source: Virginia tech **Picture:** Bank Erosion at Forest Lake Inlet 3, Nick Leonard

FLORISTIC QUALITY INDEX

Floristic quality index (FQI) is an assessment tool designed to evaluate the closeness 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. An FQI is calculated by multiplying the average of these numbers by the square root of the number of these plant species found in the lake. A high FQI number indicates that a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for Lake County lakes from 2000-2011 was 14.3. Forest Lake had an FQI of 17.0 and ranked 55th out of 158 lakes.

Lake County Average

FQI = 14.3



Source: Minnesota Department of Natural Resources

AQUATIC PLANTS: WHERE DO THEY GROW?

Littoral Zone– the area that aquatic plants grow in a lake.

Algae– have no true roots, stems, or leaves and range in size from tiny, one-celled organisms to large, multicelled plant-like organisms.

Submerged Plants– have stems and leaves that grow entirely underwater, although some may also have floating leaves.

Floating-leaf Plants– are often rooted in the lake bottom, but their leaves and flowers flat on the water surface.

Emergent Plants– are rooted in the lake bottom, but their leaves and stems extend out of the water.

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.

- 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.

Excerpt: Department of Ecology, Washington state

AQUATIC PLANT SAMPLING

Rake Density (coverage)	# of Sites	% of Lake
No Plants	30	73.2
>0-10%	5	12.2
10-40%	1	2.4
40-60%	4	9.8
60-90%	1	2.4
>90%	0	0.0
Total Sites with Plants	11	26.8
Total # of Sites	41	100.0

AQUATIC PLANT DENSITY AT 41 SITES ON FOREST LAKE IN JULY 2011 , MAXIMUM DEPTH THAT PLANTS WERE FOUND WAS 5.0 FEET.

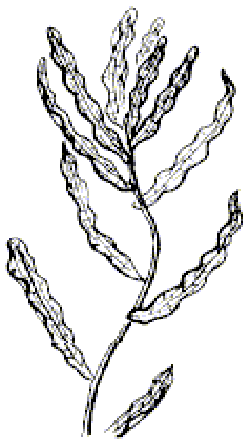
Plants growing in our lakes, ponds, and streams are called macrophytes. These aquatic plants appear in many shapes and sizes. Some have leaves that float on the water surface, while others grow completely underwater. In moderation, aquatic plants are aesthetically pleasing and desirable environmentally. Their presence is natural and normal in lakes. Aquatic plant sampling was conducted on Forest Lake in July 2011. There were 41 points generated based on a computer grid system with points 60 meters apart. Aquatic plants existed at 11 of the sites that included 7 native aquatic plant species, and one exotic invasive (Curlyleaf Pondweed). There was a significant increase in native plant diversity from the 2010 plant community with the addition of four native species Elodea, Slender Naiad, Vallisineria, and White Water Lily. The most abundant species was Curlyleaf Pondweed and American Pondweed both occurring in 15% of the lake. Slender Naiad was also common at 12%. A truly healthy aquatic plant community contains a large number of plant species that provide different types of habitat and structure to the lake that covers approximately 30-40% of the lake. In 2011 Forest Lake aquatic plants covered 27% of the lake bottom. This was a 46% increase in aquatic plant density from the 2010 plant community. The diversity and extent of plant populations can be influenced by a variety of factors. Water clarity and depth are the major limiting factors in determining the maximum depth at which aquatic plants will grow. When the light level in the water column falls below 1% of the surface light level, plants can no longer grow. The 1% light level in Forest Lake reached the 6 foot depth May through August and 5 foot in September. Another factor impacting plant growth is water clarity; in May the Secchi depth was recorded at 6.8 feet, June through September Secchi depths ranged from 2.0 feet in August to 2.6 feet in September. Forest Lake's shallow morphology and wetland origin are obstacles when establishing an effective plant management plan. Abundant aquatic plants are sometimes viewed as undesirable and can reduce recreational activities. In the past ten years Forest Lake's aquatic plant community density as varied from no occurrence to approximately 50% plant coverage in the littoral zone. In 2000 only two small pieces of Sago Pondweed and Curlyleaf Pondweed were found and in 2005 11 species found in depths up to 3.5 feet. In 2011 plants were documented at 5.0 feet. The 2011 management plan should incorporate additional native species that do not "top out" so that impacts on recreation are minimal and benefits of a healthy aquatic plant community is maximized. A healthy aquatic plant population is critical to good lake health and provides important wildlife habitat and food sources. If managed aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available resources.

2011 AQUATIC PLANT DENSITY (LEFT), 2011 LITTORAL ZONE (RIGHT)
MAP ON LEFT SHOWS JULY 2011 PLANT DENSITY, MAP ON THE RIGHT SHOWS THE AREA OF THE LAKE THAT PLANTS COULD OCCUR BASED ON 1% LIGHT LEVEL.

91-100% 61-90% 41-60% 11-40% 1-10% 0%

Curlyleaf Pondweed

Illustration of Curlyleaf Pondweed



Curlyleaf Pondweed (CLP) is an invasive aquatic perennial that is native to Eurasia, Africa, and Australia. It was accidentally introduced to United States waters in the mid-1880s by hobbyists who used it as an aquarium plant. The leaves are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. This aquatic plant has an unusual life history. Unlike our native pondweeds it begins growing in the early spring. CLP has even been documented growing under the ice in lakes! The plant then reaches maturity in midsummer typically June in Lake County when our natives are starting to emerge. CLP becomes invasive in some areas because of its adaptations for low light tolerance and low water temperatures which allow the plant to get a head start and outcompete native plants in the spring. In mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Large populations of CLP also can cause changes in nutrient availability. In midsummer, when CLP plants start to decompose an increase in phosphorus availability may fuel nuisance algal blooms. CLP can form dense mats that may interfere with boating and other recreational uses. In July 2011 in Forest Lake the CLP population was one of the most abundant plant species covering 15% of the lake occurring in depths up to 3.4 feet. This is a slight increase from 2010 when CLP was only documented at 12% of the sample sites. At this time the density of CLP is not causing fluctuations in nutrient availability. Unlike 54 acre Summer Hill Estates Lake, which was observed to have 80 % of the lake with topped out CLP in May, 2009, resulting in reduced recreational opportunities and influx of phosphorus availability in July, 2009. While populations are below nuisance level in Forest Lake action should be taken to eradicate CLP. Hand removal could be an effective management technique. Typically tools such as rakes and cutting bars are used to remove vegetation. Hand removal is a quick, inexpensive, but labor intensive. Proper disposal of CLP should also be considered in the aquatic plant management plan

Plant Density	2011	2010
Present	6	5
Common	0	0
Abundant	0	0
Dominant	0	0
% Plant Occurrence	14.6	12.2

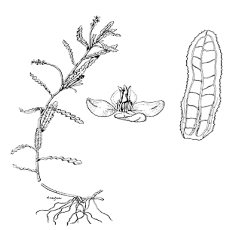
Culyleaf Pondweed density at 41 sites on Forest lake in July 2011 and 2010, Maximum depth that plants were found was 3.4 and feet.

Approximate Presence of Curlyleaf Pondweed in forest Lake July, 2011. Average depth of populations was 2.0 feet.

CURLYLEAF PONDWEED

Potamogeton crispus Exotic*

Turion



Key Features:

Stem: are flattened, branched, can form dense stands in water up to 15 feet deep.

Leaf: alternate all submersed, oblong, stiff, translucent leaves have distinctly wavy edges with fine teeth and 3 main veins.

Flower: tiny, with 4 petal-like lobes. In spikes 1-3cm long on stalks up to 7cm long. (May see turions which over winters as a hard, brown, bur-like bud with crowded, small holly-like leaves).

Common Names:
Curly leaf pondweed

Origin: EOXTIC*
Asia, Africa, and Europe Found through-out lake county and Illinois

Importance:
Invasive: has a tolerance for low light and water temperatures that allow the plant to get a head start on native plants. By mid summer when most aquatic plants are growing, curlyleaf plants are dying off. Which may result in a critical loss of dissolved oxygen and an increase in nutrients.

Look alikes:
none

2003 FISH SURVEY: ILLINOIS DIVISION OF NATURAL RESOURCES

No carp

Common Carp and Grass Carp spawn in late May or early June, this is the best time to document their presence in a lake. Keep an eye on the inlets as they will splash around in the shallows.

Common Carp (above)
Grass Carp (below)

In October of 2003 the Illinois Department of Natural Resources (IDNR) conducted a 60 minute daytime electrofishing survey, and overnight net sets including two trapnets and one 250' experimental mesh gill net. The survey was undertaken to assess the current fish population. The IDNR collected 306 fish representing 17 species. Bluegill was the most abundant fish species collected at 43% of the catch (129 individuals) ranging in length from 1.2 to 8.3 inches. Young of the year bluegills were extremely abundant indicating a strong year class. The majority of these fish were found in the shallows, in an effort to escape predation from larger fish due to the lack of vegetation. In 2011 the LCHD-ES documented a significant increase in aquatic vegetation in Forest Lake (page 16). The majority of the bluegill sample was composed of individuals in the 3"-5" range. This population is likely influenced by fishing pressure; as larger fish tend to be harvested usually between 6"-7". Largemouth bass was the second most abundant fish species collected representing 30% of the catch. Largemouth bass were collected at a rate of 1.4 fish per minute. While this rate is above the general management objective of 1.0 fish per minute, the majority of the individuals were smaller in size. The IDNR used an index called the Proportional Stock Density (PSD) to evaluate adult abundance of Largemouth Bass in the sample. The index compares the number of fish longer than 12" (Quality size) to the number of bass longer than 8" (Stock size) and produces a value that can be used to compare samples from different years or different lakes. The PSD value basically produces a number that represents the percent of sexually mature fish in the sample to fish that survived their first winter (roughly 8" long) and are likely to survive to maturity. A balanced population has a PSD value between 40% and 60%. The PSD for Forest Lake 14.3, this means that 14.3% of the sample was over 12 inches long. Indicating that the largemouth bass population was not balanced and contained a lot of smaller fish.

Two northern pike and a tiger muskie were collected during the survey. Both fish are good predators for our area though successful tiger muskie fisheries are less common than northern pike fisheries. This is attributed to the aggressiveness of the tiger musky as they tend to have higher hook and handling mortality rates at smaller sizes. Another good predator for shallow warm water lakes represented in the sample was channel catfish. Like walleye these fish don't tend to successfully reproduce and need to be stocked to maintain their presence.

Following the 2003 IDNR fish survey fisheries biologist, Frank Jakubicek, concluded.

"Forest Lake contained a completely different fishery than what was expected. When the lake is described as shallow and turbid, the expectations are for a stunted carp population with some black crappie and a couple of largemouth bass (maybe 10) to show up in the sample"…"The high bass catch rate and abundance of bluegills were nice to see. It would be nice to see more bass beyond 13 inches long. Proportionally, 20% to 30% of the sample should be above 13 inches. They could then exploit larger size forage (3" to 4" fish) species in the lake. Vegetation would help the fishery by providing a place for invertebrates (little bugs) to grow and provide cover for small fish to avoid predation. Perhaps, depending on which herbicide is applied, some vegetation could be allowed to grow in areas where access is less of an issue. During the survey whenever we encountered structure we found fish. The lake would benefit positively from this addition". The IDNR had the following recommendations for Forest Lake in 2003 (page 13).

ILLINOIS DIVISION OF NATURAL RESOURCES 2003 CATCH SUMMARY FOR FOREST LAKE

SPECIES	NUMBER	PERCENT	LENGTH (In)		
			MINIMUM	AVERAGE	MAXIMUM
LARGEMOUTH BASS	92	30.07	3.5	9.5	20.1
SMALLMOUTH BASS	1	0.33	7.3	7.3	7.3
BLUEGILL	129	42.16	1.2	4.5	8.3
GREEN SUNFISH	2	0.65	3.3	4.3	5.3
SUNFISH HYBRID	1	0.33	5.9	5.9	5.9
WARMOUTH	8	2.61	4.3	5.5	7.5
BLACK CRAPPIE	31	10.13	3.5	7.6	10.2
WHITE CRAPPIE	6	1.96	8.3	8.9	10.2
YELLOW BASS	1	0.33	8.1	8.1	8.1
WALLEYE	5	1.63	9.4	13.3	24
TIGER MUSKIE	1	0.33	18.2	18.2	18.2
NORTHERN PIKE	2	0.65	22.1	29.1	36.2
CHANNEL CATFISH	4	1.31	20.9	26	30.7
COMMON CARP	9	2.94	22.8	25.3	29.5
GOLDEN SHINER	2	0.65	2.8	2.8	2.8
FATHEAD MINNOW	1	0.33	2.2	2.2	2.2
BLUNTNOSE MINNOW	11	3.59	2.4	2.7	3.2
SPECIES=17 TOTAL=	**306**	**100.00**			

Fishing

Forest Lake is located entirely in unincorporated Lake County and access is limited to Forest Lake residents and their guests. The lake is used for non-gas motor boating and year round fishing. The lake is managed by the Forest Lake Community Association (FLCA). The FLCA has an annual stocking budget of $2,000. Since 2003 stocking has targeted predator and forage fish species. Forest Lake officially follows Illinois Division of Natural resources fishing regulations for daily bag and size limits; although the FCLA encourages catch and release.

Fishing Logs

You can track/ detect changes in the fishery by recording catches and observations in fishing logs!

FISH STOCKING IN FOREST LAKE 2003-2011

Year	Tiger Musky	Channel Catfish	Northern Pike	Largemouth Bass	Smallmouth Bass	Walleye	Golden Shiners	Fathead Minnows
2011	50	100					50 lb	56 lb
2010				160	160	174	25 lb	25 lb
2009				241	136	181		
2008			100	100		150		
2007	No Stocking							
2006			100			300		
2005			100					
2004			100			375		
2003	50					300		

2011 Tiger Muskie Stocking
Picture: Lou DiNicola

Forest Lake Pier Fishing
Picture: Todd Thomas

2011 Largemouth Bass
Picture: Lou DiNicola

IDNR 2003 Recommendations

1. Stock 15 to 25 non-vulnerable channel catfish per acre every other year to maintain diversity in the predator base.
2. Post a one fish per day creel, 15 inch length limit for largemouth bass. (Try and keep larger bass in the lake, < 2% of the sample would be vulnerable to harvest with this regulation)
3. If the lake is treated with herbicides, reduce the amount or change the type of herbicide to allow for some vegetation to grow.
4. Remove any carp caught by fishermen.
5. Watch out for stocking fish on a whim. A stocking plan and consistency work best. Stocking a couple of fish because someone likes the concept of a certain fish type is expensive and usually means that a "fishery" never gets established but some fish get put in the lake. They tend to not contribute to the overall health of the lake or impact any portion of the fishery as a whole. Remember, most fish die in their first 5 years of life and that isn't old enough to establish a trophy fishery. Trophy fisheries usually take a minimum of 10 to 15 years to establish.

Shoreline Erosion

Proportion of Shorelin erosion on Forst Lake 2011 and 2010

Erosion	2011	2010
None	69	59
Slight	10	20
Moderate	10	12
Severe	11	9

Erosion is the natural process of weathering and transport of solids (sediment, soil, rock and other particles) in the natural environment. It usually occurs due to transport by wind, water, or ice; by down-slope creep of soil and other material under the force of gravity; or by living organisms, such as burrowing animals. However this process has been increased dramatically by human land use, especially industrial agriculture, deforestation, and urban sprawl. The shoreline was reassessed in 2011 for significant changes in erosion since 2010. Based on the 2011 assessment, there was a slight decrease in shoreline erosion with approximately 31% of the shoreline having some degree of erosion. Overall, 59% of the shoreline had no erosion, 10% had slight erosion, 10% moderate erosion, and 11% had signs of serious erosion. Since 2010 there was a significant improvement in slight erosion while areas with severe erosion increased slightly. Areas of moderate and severe erosion were fragmented around the lake, but were common along the shoreline between the main lake and the lagoon. These areas should be addressed soon; it is much easier and less costly to mitigate slightly eroding shorelines than those with more severe erosion. Typically the areas with no erosion were armored with rock; native vegetation should be incorporated in these areas as well. Hard structures may cause resuspension of sediment from deflected wave action. Native plants have deep roots which can stabilize sediments and filter nutrients before entering the lake.

Monthly Water Levels in Forest Lake, 2011 and Lake County Stormwater Management Commission Rain gauge data from the Lake Zurich rain gauge

2011	Level (in)	Rain (in)
May	26.00	
June	25.25	7.66
July	29.75	0.94
August	26.50	8.73
September	28.75	3.07

Shoreline erosion on Forest Lake, 2011

Rain gauge
Photo: Lake County Stormwater Management **Commission**

Water Level

Lakes with stable water levels potentially have less shoreline erosion problems. A fluctuation in lake levels was observed during the sampling season. Data from the Stormwater Management Commission's Lake Zurich rain gauge was correlated to rain events and lake levels increases. Over the sample period May to September the lake level decreased 2.75 inches. The highest water level occurred in June and the lowest level in July. The most significant decrease in lake level occurred from June to July with a decrease in lake level by 4.5 inches. Forest Lake appears to be greatly influenced by rain events, the lake receives storm water from its watershed through drainage ditches and storm drains. It appears that rain events contributing around 8 inches of precipitation can raise the lake level approximately three inches. As a result Forest Lake water quality is also greatly influenced by rain events. In order to accurately monitor water levels it is recommended that a staff gauge be installed and levels measured and recorded frequently (daily or weekly).

Shoreline Restoration

Shoreline restoration through the installation of a buffer strip with native, plants can improve lake health three fold. First, the erosion is repaired and the new native plants can stabilize the shoreline to prevent future erosion. Second, the addition of native plants adds habitat for wildlife to a shoreline that is otherwise limited in habitat. Thirdly, buffer habitat can help filter pollutants and nutrients from the near shore areas and keep geese and gulls from congregating, as it is not desirable habitat for them.

In 2011 several shoreline restoration projects took place in Forest Lake. The restored area provides shoreline stabilization, habitat diversity, and an increased ability to filter nutrients. LCHD-ES encourages of the use of shoreline buffer strips for the health of lakes. A successful restoration project includes a long-term plan that factors in maintenance and interaction with community.

Photos: Pre and Post Shoreline restoration by Private homeowner in 2011 (above)
Severe erosion shoreline erosion occurring on forest lake 2011 (below)

LakeCounty
Health Department and
Community Health Center

Environmental Services

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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

Forest Lake's water quality has notably improved over the past 2 years. Total phosphorus, and total suspended solids concentrations have decreased and water clarity increased. The aquatic plant community has also dramatically improved in density and diversity. However many water quality parameters still exceed IEPA impairment levels and Lake County medians another concern is the population increase of the exotic invasive Curlyleaf Pondweed populations.

Forest Lake, lake's management is administered by Forest Lake Community Association. To improve the overall quality of Forest Lake, the ES (Environmental Services) has the following recommendations:

- **Decrease Curlyleaf Pondweed populations**
- **Continue water quality monitoring of inlets**
- **Install permanent water level gage at outlet**
- **Sample phytoplankton in the early summer**
- **Assess current fish population**
- **Develop a long-term stocking program**
- **Update the bathymetric map**
- **Participate Volunteer Lake Monitoring Program**
- **Mitigate shoreline exhibiting erosion**
- **Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips**
- **Install a staff gauge to monitor lake level fluctuations**
- **Use salt alternatives and proper application procedures.**
- **Remove all carp**

Unfortunately fertilizer makes more things grow than just your vegetable garden. Do not use any fertilizer within 15 feet of the lake. One pound of phosphorus can produce 300 pounds of algae.

Water quality data for Forest Lake, 2010 and 2011.

2010	Epilimnion													
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
11-May	3	169	0.66	<0.1	<0.05	0.031	<0.005	339	7.6	864	136	4.72	1.4790	8.41	10.41
8-Jun	3	150	0.76	<0.1	<0.05	0.047	<0.005	208	9.2	607	118	2.00	1.0180	8.34	6.07
13-Jul	3	157	1.40	<0.1	0.14	0.130	0.012	204	14.0	624	137	1.87	1.0290	8.89	11.17
10-Aug	3	140	1.91	<0.1	<0.05	0.185	0.019	160	18.0	502	112	1.50	0.8300	8.82	7.18
14-Sep	3	146	1.42	<0.1	<0.05	0.119	<0.005	160	11.0	509	104	2.38	0.8370	8.55	7.27
	Average	152	1.23	<0.1	0.03^k	0.102	0.006^k	214	12.0	621	121	2.49	1.0386	8.60	8.42

2011	Epilimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
11-May	3	160	0.6	0.1	0.172	0.022	<0.005	275	2.0	731	97	6.8	1.212	7.89	8.98
15-Jun	3	159	1.05	0.4	0.101	0.052	0.011	185	12.0	586	104	2.5	0.936	7.81	7.30
13-Jul	3	167	1.11	<0.1	<0.05	0.096	<0.005	191	17.0	619	111	2.45	0.967	8.44	9.56
10-Aug	3	141	1.36	<0.1	<0.05	0.152	0.016	134	20.0	454	80	2.00	0.723	8.37	8.85
14-Sep	3	146	1.07	<0.1	<0.05	0.088	0.013	135	17.0	452	75	2.6	0.722	8.75	13.30
	Average	155	1.04	0.16^k	0.085^k	0.082	0.010^k	184	13.6	568	93	3.27	0.912	8.25	9.60

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 Data for Forest Lake 2000-2011.

2011							
DATE	DEPTH	TP	TSS	SECCHI	COND	pH	DO
11-May	3	0.022	2.0	6.8	1.212	7.89	8.98
15-Jun	3	0.052	12.0	2.5	0.936	7.81	7.30
13-Jul	3	0.096	17.0	2.45	0.967	8.44	9.56
10-Aug	3	0.152	20.0	2.00	0.723	8.37	8.85
14-Sep	3	0.088	17.0	2.6	0.722	8.75	13.30
	Average	0.082	13.6	3.27	0.912	8.25	9.60

2010							
DATE	DEPTH	TP	TSS	SECCHI	COND	pH	DO
5/11/2010	3	0.031	7.6	4.72	1.4790	8.41	10.41
6/8/2010	3	0.047	9.2	2	1.0180	8.34	6.07
7/13/2010	3	0.130	14.0	1.87	1.0290	8.89	11.17
8/10/2010	3	0.185	18.0	1.5	0.8300	8.82	7.18
9/14/2010	3	0.119	11.0	2.38	0.8370	8.55	7.27
	Average	0.102	12.0	2.49	1.039	8.60	8.42

2006							
DATE	DEPTH	TP	TSS	SECCHI	COND	pH	DO
5/16/2006	3	0.077	9.2	2.30	1.4460	8.02	7.37
6/13/2006	3	0.054	6.7	4.26	1.3260	8.33	7.20
7/11/2006	3	0.181	10.1	3.31	1.2070	7.91	3.23
8/8/2006	3	0.273	35.0	1.83	1.1110	9.09	10.25
9/12/2006	3	0.126	15.7	2.52	1.0590	8.23	4.72
	Average	0.142	15.3	2.84	1.2298	8.32	6.55

2005							
DATE	DEPTH	TP	TSS	SECCHI	COND	pH	DO
5/17/2005	3	0.024	5.9	4.39	1.6010	7.81	9.27
6/21/2005	3	0.040	6.0	3.54	1.6050	8.38	11.59
7/19/2005	3	0.160	13.3	1.74	1.6390	8.23	7.07
8/16/2005	3	0.215	16.0	1.15	1.5030	8.56	10.76
9/20/2005	3	0.296	29.0	1.05	1.5600	8.46	6.88
	Average	0.147	14.0	2.37	1.5816	8.29	9.11

2004							
DATE	DEPTH	TP	TSS	SECCHI	COND	pH	DO
5/11/2004	3	0.029	5.0	4.43	1.3340	7.80	7.01
6/8/2004	3	0.041	5.2	6.07	0.9160	7.40	6.58
7/13/2004	3	0.052	7.9	2.92	0.8595	8.52	10.48
8/10/2004	3	0.195	19.0	1.67	0.8770	8.29	7.98
9/14/2004	3	0.210	15.7	1.64	0.8970	8.70	9.82
	Average	0.105	10.6	3.35	0.9767	8.14	8.37

Water Quality Data for Forest Lake 2000-2011 (continued).

2003

DATE	DEPTH	TP	TSS	SECCHI	COND	pH	DO
5/14/2003	3	0.046	8.7	3.64	1.0970	8.34	9.32
6/11/2003	3	0.045	7.8	3.62	1.0990	8.74	9.39
7/16/2003	3	0.152	17.0	1.44	1.0570	8.78	9.22
8/13/2003	3	0.245	22.6	1.02	1.0700	8.46	5.40
9/17/2003	3	0.346	27.7	1.41	1.0650	8.87	7.89
	Average	0.167	16.8	2.23	1.0776	8.64	8.24

2000

DATE	DEPTH	TP	TSS	SECCHI	COND	pH	DO
5/8/2000	2	0.032	5.6	4.27	1.0690	7.97	6.34
6/12/2000	3	0.076	20.1	2.03	0.9306	8.24	6.64
7/10/2000	3	0.099	18.0	2.07	0.7800	8.27	6.75
8/14/2000	3	0.109	19.0	1.94	0.7060	8.88	7.30
9/11/2000	3	0.121	15.1	2.10	0.7396	8.51	7.22
	Average	0.087	15.6	2.48	0.8450	8.37	6.85

Glossary

TP = Total phosphorus, mg/L
TSS = Total suspended solids, mg/L
SECCHI = Secchi Disk Depth, ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

2000 - 2011 Water Quality Parameters, Statistics Summary

	ALKoxic <=3ft00-2011	
Average	**165**	
Median	**160**	
Minimum	**65**	**IMC**
Maximum	**330**	**Flint Lake**
STD	**42**	
n =	**842**	

	ALKanoxic 2000-2011	
Average	**199**	
Median	**190**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**52**	
n =	**241**	

	Condoxic <=3ft00-2011	
Average	**0.8642**	
Median	**0.7821**	
Minimum	**0.2260**	**Schreiber Lake**
Maximum	**6.8920**	**IMC**
STD	**0.5273**	
n =	**841**	

	Condanoxic 2000-2011	
Average	**0.9953**	
Median	**0.8320**	
Minimum	**0.3210**	**Lake Kathyrn, Schreiber Lake**
Maximum	**7.4080**	**IMC**
STD	**0.7929**	
n =	**241**	

	NO3-N, Nitrate+Nitrite,oxic <=3ft00-2011	
Average	**0.516**	
Median	**0.198**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.059**	
n =	**841**	

*ND = Many lakes had non-detects (75.0%)
Only compare lakes with detectable
concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

	NH3-Nanoxic 2000-2011	
Average	**2.135**	
Median	**1.360**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.405**	
n =	**241**	

*ND = 22.0% Non-detects from 34 different lakes

	pHoxic <=3ft00-2011	
Average	**8.35**	
Median	**8.35**	
Minimum	**7.07**	**Bittersweet #13**
Maximum	**10.40**	**Summerhill Estates**
STD	**0.46**	
n =	**840**	

	pHanoxic 2000-2011	
Average	**7.31**	
Median	**7.27**	
Minimum	**6.24**	**Banana Pond**
Maximum	**9.16**	**White Lake**
STD	**0.42**	
n =	**241**	

	All Secchi 2000-2011	
Average	**4.39**	
Median	**2.95**	
Minimum	**0.25**	**McDonald 2/Ozaukee/Rollins 2**
Maximum	**20.34**	**Lake Carina**
STD	**3.43**	
n =	**767**	

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2000 - 2011 Water Quality Parameters, Statistics Summary (continued)

	TKNoxic <=3ft00-2011	
Average	**1.511**	
Median	**1.180**	
Minimum	**<0.1**	***ND**
Maximum	**41.200**	**Almond Marsh**
STD	**1.740**	
n =	**842**	

*ND = 3.6% Non-detects from 14 different lakes

	TKNanoxic 2000-2011	
Average	**2.823**	
Median	**2.120**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.345**	
n =	**241**	

*ND = 2.9% Non-detects from 4 different lakes

	TPoxic <=3ft00-2011	
Average	**0.114**	
Median	**0.066**	
Minimum	**<0.01**	***ND**
Maximum	**7.270**	**Almond Marsh**
STD	**0.307**	
n =	**842**	

*ND = 2.1% Non-detects from 7 different lakes

	TPanoxic 2000-2011	
Average	**0.313**	
Median	**0.181**	
Minimum	**0.012**	**Independence Grove**
Maximum	**3.800**	**Taylor Lake**
STD	**0.404**	
n =	**241**	

	TSSall <=3ft00-2011	
Average	**16.6**	
Median	**8.6**	
Minimum	**<0.1**	***ND**
Maximum	**220.0**	**Rollins 2**
STD	**23.4**	
n =	**848**	

*ND = 0.9% Non-detects from 8 different lakes

	TVSoxic <=3ft00-2011	
Average	**127.2**	
Median	**122.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**1090.0**	**Almond Marsh**
STD	**53.0**	
n =	**797**	

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 <=3ft00-2010	
Average	**193**	
Median	**128**	
Minimum	**3.5**	**Schreiber Lake**
Maximum	**2390**	**IMC**
STD	**313**	
n =	**174**	

	CLoxic <=3ft00-2011	
Average	**183**	
Median	**145**	
Minimum	**2.7**	**Schreiber Lake**
Maximum	**2760**	**IMC**
STD	**212**	
n =	**638**	

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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 2000-2011 (n=1398).

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

LCHD Environmental Services ~ 12/12/2011

Water Quality for Forest Lake Inlets and Outlet, 2011.

2011	Inlet #1					
DATE	TP	Cl-	TSS	COND	pH	DO
16-May	0.031	419	1.3	1.7150	NA	NA
15-Jun	0.065	202	20.5	0.9080	7.88	9.69
13-Jul	0.176	669	7.6	2.6940	7.58	6.29
10-Aug	0.072	295	2.9	0.9860	7.76	10.11
14-Sep	0.097	508	6.4	2.1590	7.85	0.99
Average	**0.088**	**419**	**7.7**	**1.6924**	**7.77**	**6.77**

2011	Inlet #2					
DATE	TP	Cl-	TSS	COND	pH	DO
16-May	0.014	236	1.0	1.1280	NA	NA
15-Jun	0.043	148	12.0	0.7640	7.69	11.60
13-Jul	0.072	193	13.3	1.0210	8.38	11.05
10-Aug	0.169	135	17.0	1.0570	8.14	10.33
14-Sep	0.113	134	27.0	1.6630	7.96	0.73
Average	**0.082**	**169**	**14.1**	**1.1266**	**8.04**	**8.43**

2011	Inlet #3					
DATE	TP	Cl-	TSS	COND	pH	DO
16-May	0.029	210	3.2	1.0440	NA	NA
15-Jun	0.083	99	11.0	0.5580	7.84	12.91
13-Jul	0.066	271	26.3	1.3010	8.11	10.99
10-Aug	0.155	101	4.2	0.7040	7.95	9.24
14-Sep	0.085	162	10.8	0.9760	8.34	2.35
Average	**0.084**	**169**	**11.1**	**0.9166**	**8.06**	**8.87**

2011	Outlet					
DATE	TP	Cl-	TSS	COND	pH	DO
16-May	0.025	275	5.8	1.2540	NA	NA
15-Jun	0.043	183	6.7	0.9590	NA	NA
13-Jul	0.093	192	14.0	0.9580	8.41	10.17
10-Aug	0.112	133	15.0	0.7870	8.24	8.78
14-Sep	5.000	130	130.0	0.7210	8.53	7.00
Average	**1.055**	**183**	**34.3**	**0.9358**	**8.39**	**8.65**

Glossary

TP = Total phosphorus, mg/L
Cl^- = Chloride ions, mg/L
TSS = Total suspended solids, mg/L
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

NA = Not Applicable

Water Quality for Forest Lake Storm Events, 2011

2011	Inlet #1						
DATE	TP	Cl-	TSS	COND	pH	DO	Rain
21-Feb	0.131	324	4.5	1.4660	8.16	11.81	
19-Apr	0.700	405	22.0	1.8090	7.92	12.77	0.25
22-Jul	0.243	109	12.0	0.6010	7.92	6.28	0.20
Average	**0.358**	**279**	**12.8**	**1.2920**	**8.00**	**10.29**	**0.23**

2011	Inlet #2						
DATE	TP	Cl-	TSS	COND	pH	DO	Rain
21-Feb	0.113	179	8.3	0.9710	8.17	13.94	
19-Apr	0.080	238	27.6	1.2220	8.03	13.07	0.25
22-Jul	0.147	111	25.2	0.6320	8.51	7.52	0.20
Average	**0.113**	**176**	**20.4**	**0.9417**	**8.24**	**11.51**	**0.23**

2011	Inlet #3						
DATE	TP	Cl-	TSS	COND	pH	DO	Rain
21-Feb	0.115	428	35.4	1.7460	8.00	13.53	
19-Apr	0.072	179	32.0	1.0640	8.10	13.30	0.25
22-Jul	0.183	182	22.7	0.9560	8.35	7.22	0.20
Average	**0.123**	**263**	**30.0**	**1.2553**	**8.15**	**11.35**	**0.23**

2011	Outlet						
DATE	TP	Cl-	TSS	COND	pH	DO	Rain
21-Feb	0.059	245	9.2	1.2370	7.85	11.60	
19-Apr	0.042	279	14.0	1.4720	8.03	12.16	0.25
22-Jul	0.100	192	13.0	0.9540	8.72	7.20	0.20
Average	**0.067**	**239**	**12.1**	**1.2210**	**8.20**	**10.32**	**0.23**

Glossary

TP = Total phosphorus, mg/L
Cl^- = Chloride ions, mg/L
TSS = Total suspended solids, mg/L
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L
Rain = Inches

Note: "k" denotes that the actual value is knov
NA = Not Applicable

Forest Lake 2011 IEPA Ranking

				Weighting Criteria	**Points**	**Overall Use Support Points**	**Degree of Support**
TROPHIC STATUS			**AQUATIC LIFE USE IMPAIRMENT INDEX**				
Carlson's TSIp	67.7	Eutrophic	Mean Trophic State	67.7	50		
			Macrophyte Impairment	Substantial	0		
IMPAIRMENT ASSESSMENTS			Sediment Impairment (NVSS)	Minimal	0		
Total Phosphorus	Yes		Degree of Use Support		**50**	0	**Full**
Total Nitrogen	None						
pH	None		**RECREATION USE IMPAIRMENT INDEX**				
Low DO	None		Mean Trophic State Index	67.7	67.7		
Total Dissolved Solids	None		Macrophyte Impairment	Substantial	5		
Total Supended Solids	Yes		Sediment Impairment (NVSS)	Minimal	0		
Aquatic Plants-Native	None		Degree of Use Support		**72.7**	1	**Partial**
Non-Native Aquatic Plants	None						
Non-Native Animals	Yes		**Overall Use Index**			**0.50**	**Partial**

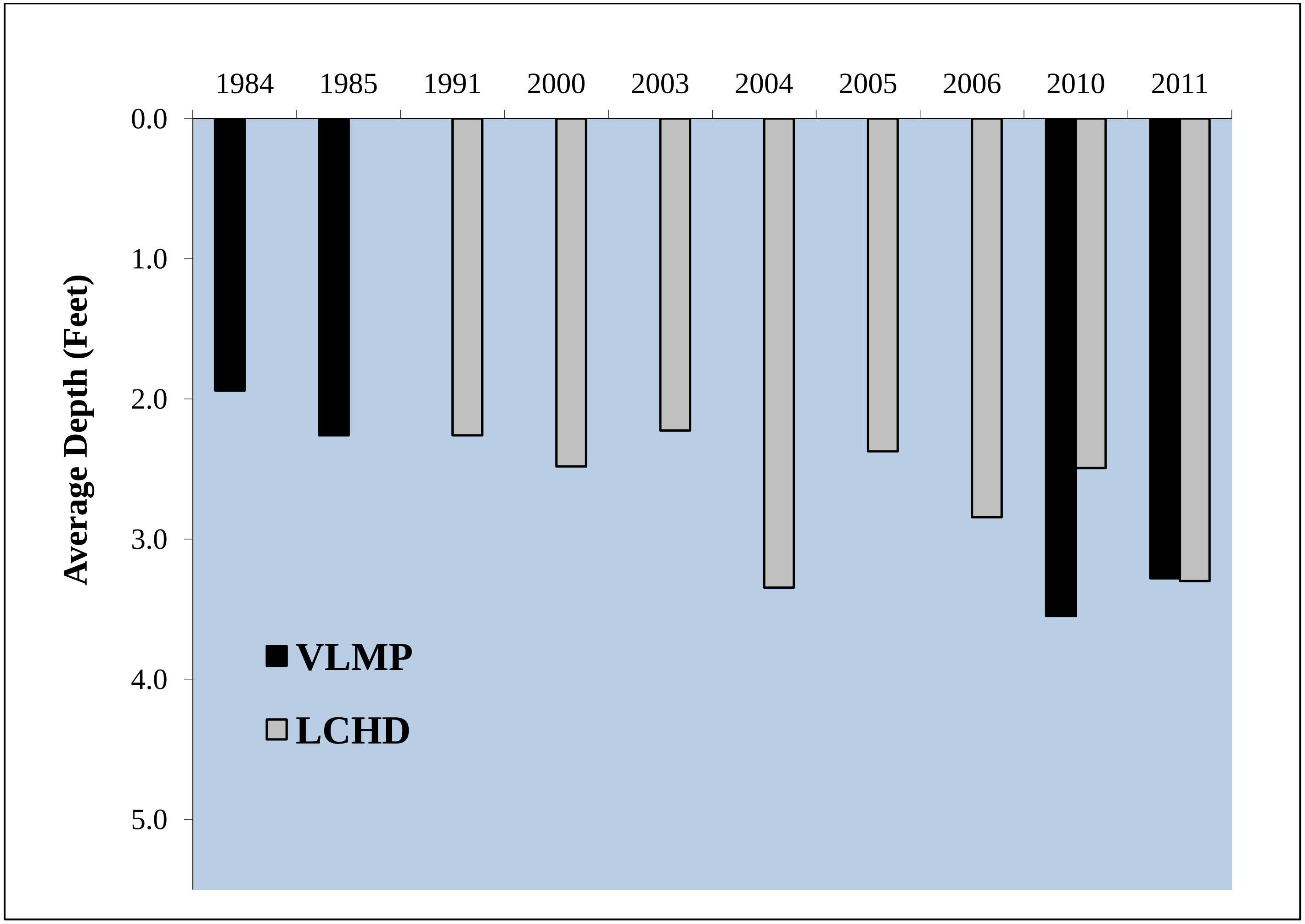
Forest Lake Landuse and Estimated Runoff, 2011

Land Use	Acreage	% of Total
Single Family	135.32	30.99
Transportation	65.18	14.93
Industrial	39.39	9.02
Government and Institutional	44.97	10.3
Retail/Commercial	7.02	1.61
Public and Private Open Space	26.67	6.11
Agricultural	79.69	18.25
Utility and Waste Facilities	3.31	0.76
Wetlands	17.97	4.12
Forest and Grassland	10.71	2.45
Water	6.37	1.46
Total Acres	**436.60**	**100.00**

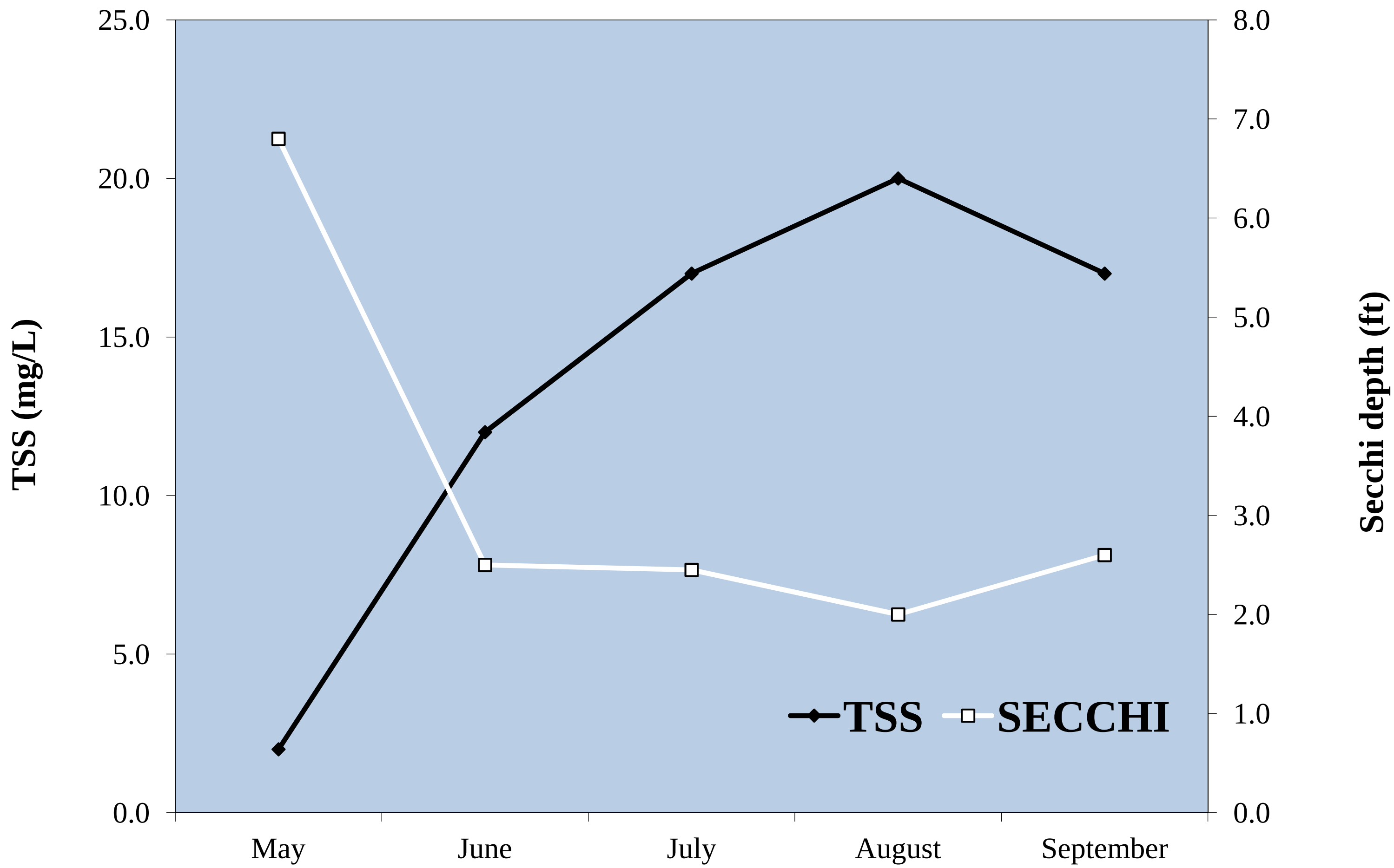
Forest Lake Land Use	Acreage	Runoff Coeff.	Estimated Runoff, acft.	% of Total
Single Family	135.32	0.3	111.6	28.27
Transportation	65.18	0.5	89.6	22.70
Industrial	39.39	0.8	86.6	21.94
Government and Institutional	44.97	0.5	61.8	15.65
Retail/Commercial	7.02	0.85	16.4	4.15
Public and Private Open Space	26.67	0.15	11	2.79
Agricultural	79.69	0.05	11	2.79
Utility and Waste Facilities	3.31	0.3	2.7	0.68
Wetlands	17.97	0.05	2.5	0.63
Forest and Grassland	10.71	0.05	1.5	0.38
Water	6.37	0	0	0.00
Total Acres	**436.6**		**394.8**	**100.00**

Lake volume	**176.50**	**acre-feet**
Retention Time (years)= lake volume/runoff	**0.45**	**years**
	163.18	**days**

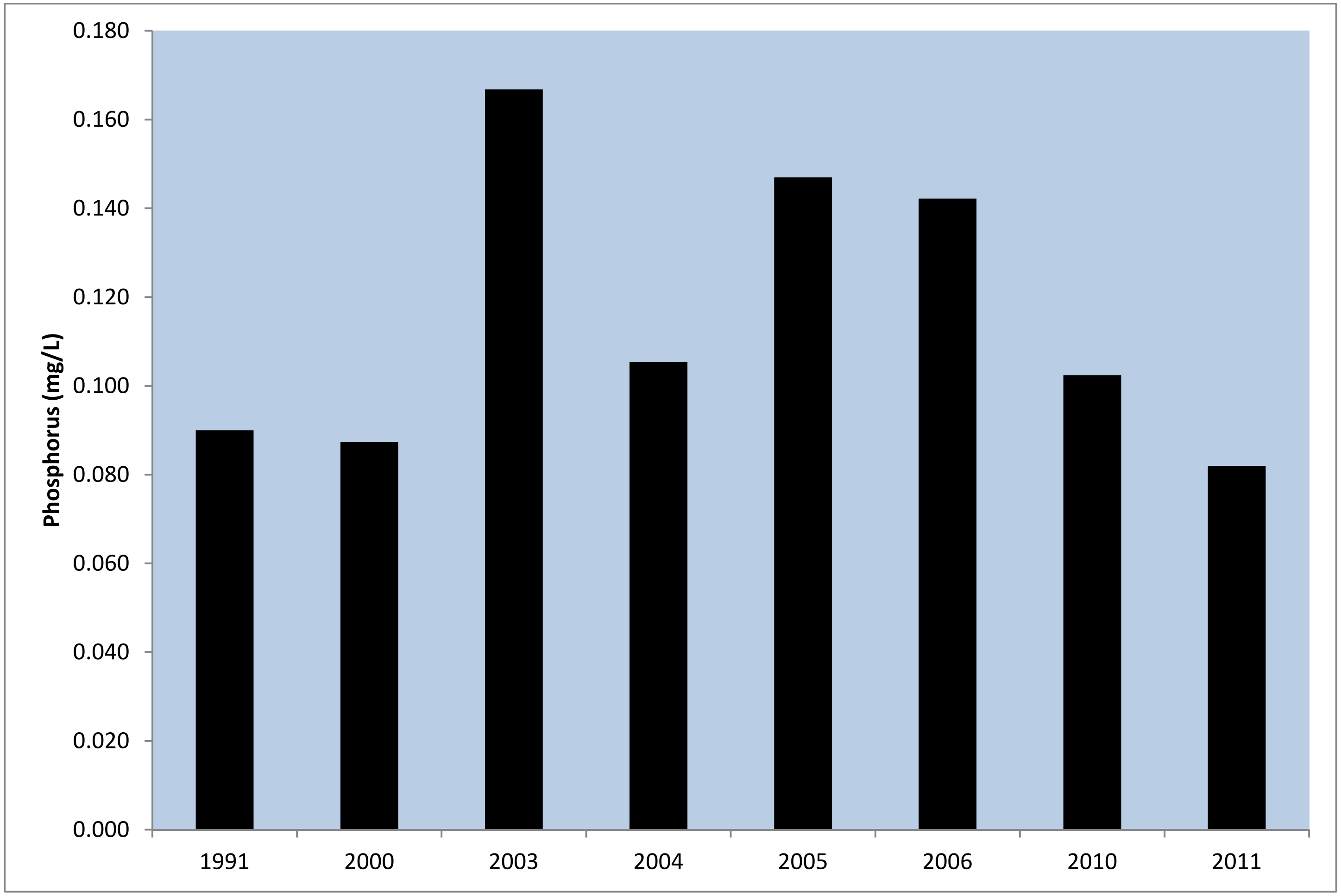
Secchi Depth (feet) from Volunteer Lake Monitoring Program (VLMP) and Lake County Health Department (LCHD) for Forest Lake 1984-2011.



Total Suspended Solids (TSS) Vs. Secchi Depth in Forest Lake, 2011.



Phosphorus Concentrations for Forest Lake, 1991-2011.



Lake County average TSI phosphorus (TSIp) ranking 2000-2011.

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	West Loon	0.0152	43.00
7	Windward Lake	0.0160	44.13
8	Sand Pond (IDNR)	0.0165	44.57
9	Cedar Lake	0.0170	45.00
10	Pulaski Pond	0.0180	45.83
11	Gages Lake	0.0200	47.00
12	Banana Pond	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	Cranberry Lake	0.0230	49.00
22	Deep Lake	0.0230	49.36
23	Lake of the Hollow	0.0230	49.36
24	Round Lake	0.0230	49.36
25	Stone Quarry Lake	0.0230	49.36
26	Little Silver Lake	0.0250	50.57
27	Bangs Lake	0.0260	51.00
28	Lake Leo	0.0260	51.13
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	53.33
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	Hendrick Lake	0.0340	55.00
39	Honey Lake	0.0340	55.00
40	Sand Lake	0.0380	56.00
41	Diamond Lake	0.0370	56.22
42	Sullivan Lake	0.0370	56.22
43	Channel Lake	0.0380	56.60
44	Ames Pit	0.0390	56.98
45	East Loon	0.0400	57.00
46	Schreiber Lake	0.0400	57.34

Lake County average TSI phosphorus (TSIp) ranking 2000-2011.

RANK	LAKE NAME	TP AVE	TSIp
47	Waterford Lake	0.0400	57.34
48	Hook Lake	0.0410	57.70
49	Duck Lake	0.0430	58.39
50	Nielsen Pond	0.0450	59.04
51	Seven Acre Lake	0.0460	59.36
52	Turner Lake	0.0460	59.36
53	Willow Lake	0.0460	59.36
54	East Meadow Lake	0.0480	59.97
55	Lucky Lake	0.0480	59.97
56	Old Oak Lake	0.0490	60.27
57	College Trail Lake	0.0500	60.56
58	Hastings Lake	0.0520	61.13
59	Lake Lakeland Estates	0.0520	61.13
60	Butler Lake	0.0530	61.40
61	West Meadow Lake	0.0530	61.40
62	Little Bear Lake	0.0550	61.94
63	Lucy Lake	0.0550	61.94
64	Lake Linden	0.0570	62.45
65	Lake Napa Suwe	0.0570	62.45
66	Lake Charles	0.0580	62.70
67	Lake Christa	0.0580	62.70
68	Owens Lake	0.0580	62.70
69	Briarcrest Pond	0.0580	63.00
70	Lake Naomi	0.0620	63.66
71	Lake Tranquility (S1)	0.0620	63.66
72	Liberty Lake	0.0630	63.89
73	Werhane Lake	0.0630	63.89
74	Countryside Glen Lake	0.0640	64.12
75	Davis Lake	0.0650	64.34
76	Lake Fairview	0.0650	64.34
77	Leisure Lake	0.0650	64.34
78	Tower Lake	0.0660	64.56
79	St. Mary's Lake	0.0670	64.78
80	Mary Lee Lake	0.0680	65.00
81	Wooster Lake	0.0690	65.00
82	Crooked Lake	0.0700	65.41
83	Lake Helen	0.0720	65.82
84	Grandwood Park Lake	0.0720	66.00
85	ADID 203	0.0730	66.02
86	Bluff Lake	0.0730	66.02
87	Spring Lake	0.0730	66.02
88	Harvey Lake	0.0770	66.79
89	Broberg Marsh	0.0780	66.97
90	Countryside Lake	0.0780	67.00
91	Sylvan Lake	0.0790	67.16
92	Big Bear Lake	0.0810	67.52

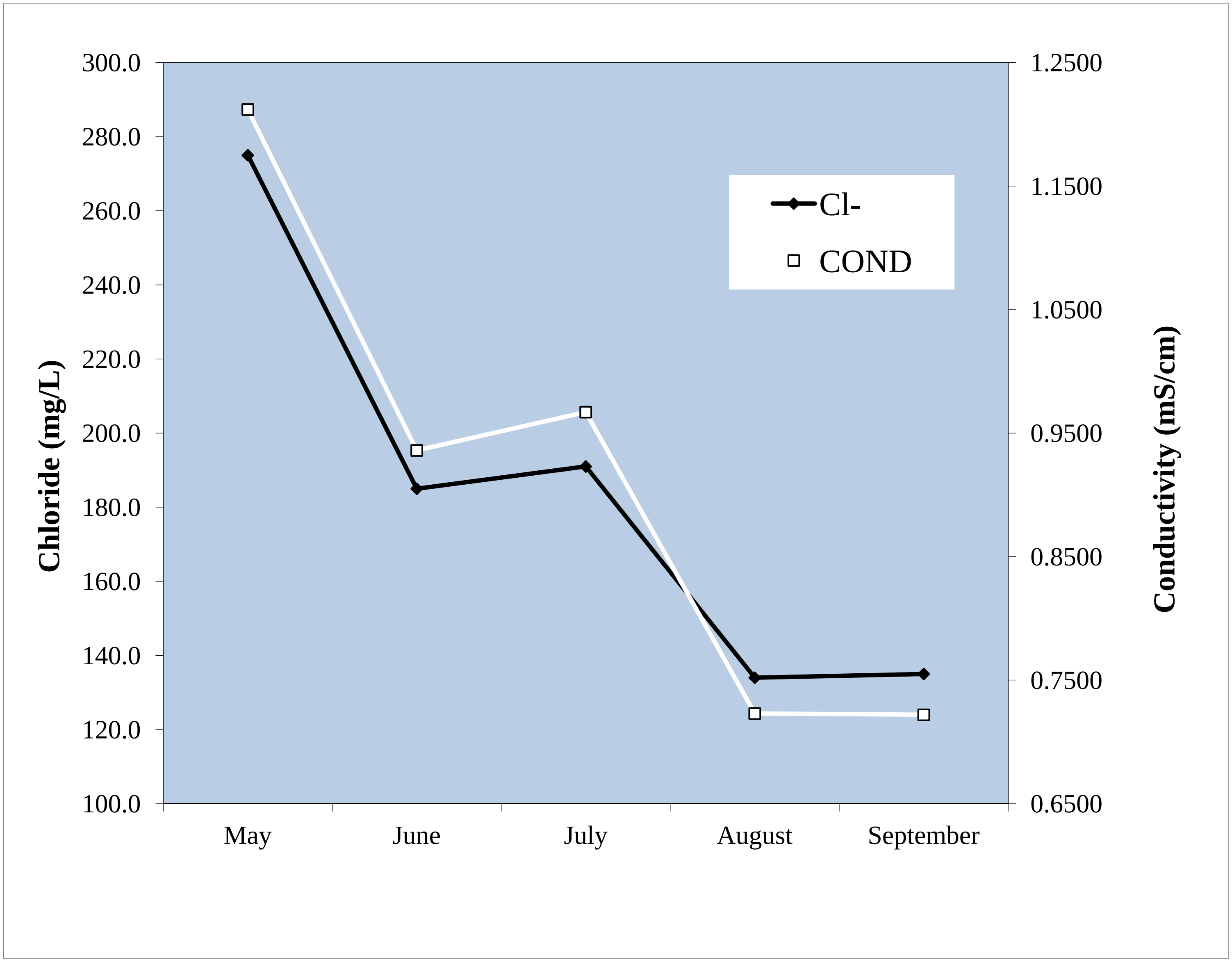
Lake County average TSI phosphorus (TSIp) ranking 2000-2011.

RANK	LAKE NAME	TP AVE	TSIp
93	Redwing Slough	0.0822	67.73
94	Petite Lake	0.0830	67.87
95	Forest Lake	0.0820	68.00
96	Lake Marie	0.0850	68.21
97	Potomac Lake	0.0850	68.21
98	Timber Lake (South)	0.0850	68.21
99	White Lake	0.0862	68.42
100	Grand Ave Marsh	0.0870	68.55
101	North Churchill Lake	0.0870	68.55
102	McDonald Lake 1	0.0880	68.71
103	North Tower Lake	0.0880	68.71
104	Long Lake	0.0850	69.00
105	Rivershire Pond 2	0.0900	69.04
106	South Churchill Lake	0.0900	69.04
107	McGreal Lake	0.0910	69.20
108	Deer Lake	0.0940	69.66
109	Dunn's Lake	0.0950	69.82
110	Eagle Lake (S1)	0.0950	69.82
111	International Mine and Chemical Lake	0.0950	69.82
112	Valley Lake	0.0950	69.82
113	Fish Lake	0.0960	69.97
114	Lochanora Lake	0.0960	69.97
115	Island Lake	0.0990	70.41
116	Woodland Lake	0.0990	70.41
117	Nippersink Lake	0.1000	70.56
118	Longview Meadow Lake	0.1020	70.84
119	Lake Barrington	0.1050	71.26
120	Lake Forest Pond	0.1070	71.53
121	Bittersweet Golf Course #13	0.1100	71.93
122	Fox Lake	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	Columbus Park Lake	0.1230	73.54
130	Lake Nipperink	0.1240	73.66
131	Echo Lake	0.1250	73.77
132	Grass Lake	0.1290	74.23
133	Lake Holloway	0.1320	74.56
134	Redhead Lake	0.1410	75.51
135	Antioch Lake	0.1450	75.91
136	Slocum Lake	0.1500	76.40
137	Lakewood Marsh	0.1510	76.50
138	Pond-A-Rudy	0.1510	76.50

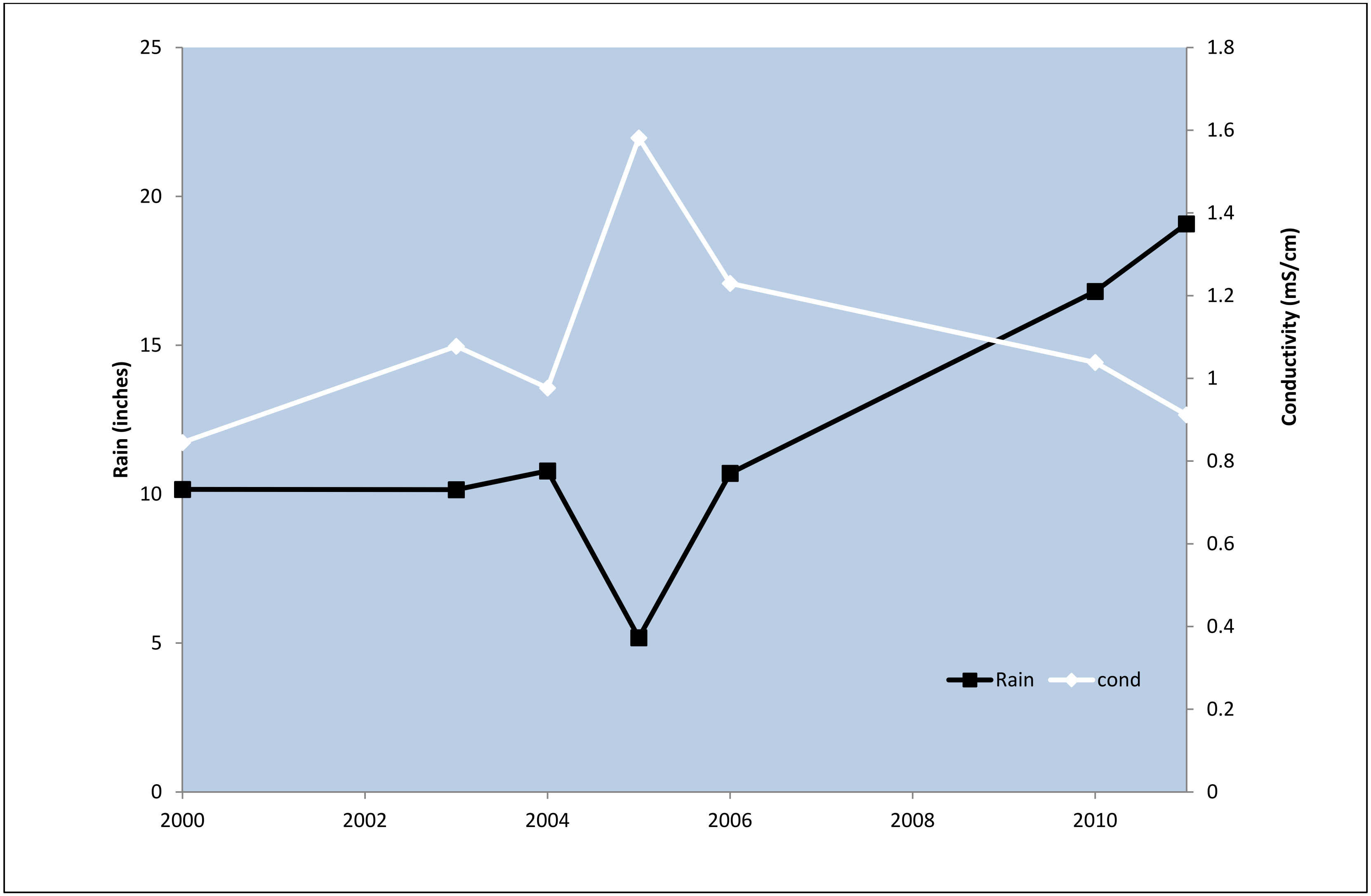
Lake County average TSI phosphorus (TSIp) ranking 2000-2011.

RANK	LAKE NAME	TP AVE	TSIp
139	Lake Matthews	0.1520	76.59
140	Buffalo Creek Reservoir	0.1550	76.88
141	Middlefork Savannah Outlet 2	0.1590	77.00
142	Pistakee Lake	0.1590	77.24
143	Grassy Lake	0.1610	77.42
144	Salem Lake	0.1650	77.78
145	Half Day Pit	0.1690	78.12
146	Lake Eleanor	0.1810	79.11
147	Lake Farmington	0.1850	79.43
148	Lake Louise	0.1850	79.43
149	ADID 127	0.1890	79.74
150	Patski Pond	0.1970	80.33
151	Dog Bone Lake	0.1990	80.48
152	Summerhill Estates Lake	0.1990	80.48
153	Redwing Marsh	0.2070	81.05
154	Stockholm Lake	0.2082	81.13
155	Bishop Lake	0.2160	81.66
156	Ozaukee Lake	0.2200	81.93
157	Hidden Lake	0.2240	82.19
158	McDonald Lake 2	0.2250	82.28
159	Fischer Lake	0.2280	82.44
160	Oak Hills Lake	0.2790	85.35
161	Loch Lomond	0.2950	86.16
162	Heron Pond	0.2990	86.35
163	Rollins Savannah 1	0.3070	87.00
164	Fairfield Marsh	0.3260	87.60
165	ADID 182	0.3280	87.69
166	Slough Lake	0.3860	90.03
167	Flint Lake Outlet	0.5000	93.76
168	Rasmussen Lake	0.5030	93.85
169	Rollins Savannah 2	0.5870	96.00
170	Albert Lake, Site II, outflow	1.1894	106.26
171	Almond Marsh	1.9510	113.00

Chloride (Cl^-) vs. Conductivity Concentrations for Forest Lake, 2011.



Chloride (Cl^-) vs. Conductivity Concentrations for Forest Lake, 2011.



Aquatic Plant Density at 41 Sites on Forest Lake in July 2011.
Maximum Depth that Plants were Found was 5.0 feet.

Plant Density	American Pondweed	Coontail	Curlyleaf Pondweed	Elodea	Flatstem Pondweed	Slender Naiad	Vallisineria	White Water Lily
Present	3	0	6	1	1	4	1	2
Common	1	1	0	2	0	0	0	1
Abundant	2	2	0	1	0	1	0	0
Dominant	0	0	0	0	0	0	0	0
% Plant Occurrence	14.6	7.3	14.6	9.8	2.4	12.2	2.4	7.3

Distribution of rake density across all sampling sites.

Rake Density (coverage)	# of Sites	% of Lake
No Plants	30	73.2
>0-10%	5	12.2
10-40%	1	2.4
40-60%	4	9.8
60-90%	1	2.4
>90%	0	0.0
Total Sites with Plants	11	26.8
Total # of Sites	41	100.0

Site: Lake
Locale: Forest Lake
Date: July 21, 2011 3 hours
By: Deem
File: Untitled study

FLORISTIC QUALITY DATA						
7 NATIVE SPECIES	Native	7	87.5%	Adventive	1	12.5%
8 Total Species	Tree	0	0.0%	Tree	0	0.0%
6.4 NATIVE MEAN C	Shrub	0	0.0%	Shrub	0	0.0%
5.6 W/Adventives	W-Vine	0	0.0%	W-Vine	0	0.0%
17.0 NATIVE FQI	H-Vine	0	0.0%	H-Vine	0	0.0%
15.9 W/Adventives	P-Forb	6	75.0%	P-Forb	1	12.5%
-5.0 NATIVE MEAN W	B-Forb	0	0.0%	B-Forb	0	0.0%
-5.0 W/Adventives	A-Forb	1	12.5%	A-Forb	0	0.0%
AVG: Obl. Wetland	P-Grass	0	0.0%	P-Grass	0	0.0%
	A-Grass	0	0.0%	A-Grass	0	0.0%
	P-Sedge	0	0.0%	P-Sedge	0	0.0%
	A-Sedge	0	0.0%	A-Sedge	0	0.0%
	Cryptogam	0	0.0%			

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
CERDEM	5	Ceratophyllum demersum	-5	OBL	Nt P-Forb	HORNWORT
ELOCAN	5	Elodea canadensis	-5	OBL	Nt P-Forb	COMMON WATERWEED
NAJFLE	6	Najas flexilis	-5	OBL	Nt A-Forb	SLENDER NAIAD
NYMTUB	7	Nymphaea tuberosa	-5	OBL	Nt P-Forb	WHITE WATER LILY
POTCRI	0	POTAMOGETON CRISPUS	-5	OBL	Ad P-Forb	BEGINNER'S PONDWEED
POTNOD	7	Potamogeton nodosus	-5	OBL	Nt P-Forb	LONG-LEAVED PONDWEED
POTZOS	8	Potamogeton zosteriformis	-5	OBL	Nt P-Forb	FLAT-STEMMED PONDWEED
VALAME	7	Vallisneria americana	-5	OBL	Nt P-Forb	EEL GRASS

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
1	Cedar Lake	38.4	37.0
2	East Loon Lake	37	35.6
3	West Loon Lake	33.7	32.3
4	Little Silver	31.6	29.6
5	Deep Lake	31.2	29.7
6	Round Lake Marsh North	29.9	29.1
7	Cranberry Lake	28.9	28.0
8	Sullivan Lake	28.5	26.9
9	Independence Grove	27.5	24.6
10	Fourth Lake	27.1	24.7
11	Lake Zurich	27.1	24.3
12	Bangs Lake	26.9	25.2
13	Sterling Lake	26.9	24.5
14	Sun Lake	26.1	24.3
15	Round Lake	25.9	23.5
16	Honey Lake	25.1	23.3
17	Lake of the Hollow	24.8	23.0
18	Schreiber Lake	24.8	23.9
19	Lakewood Marsh	24.7	23.8
20	Redwing Slough	24.0	25.8
21	Deer Lake	23.5	24.4
22	Butler Lake	23.1	21.4
23	Duck Lake	22.9	21.1
24	Countryside Glen Lake	22.8	21.9
25	Cross Lake	22.4	24.2
26	McGreal Lake	22.1	20.2
27	Druce Lake	21.8	19.1
28	Third Lake	21.7	13.2
29	Broberg Marsh	21.4	20.5
30	Davis Lake	21.4	21.4
31	Fish Lake	21.2	19.3
32	Redhead Lake	21.2	19.3
33	Turner Lake	21.2	18.6
34	Wooster Lake	21.1	19.4
35	Timber Lake (North)	20.9	23.4
36	Lake Kathryn	20.7	19.6
37	ADID 203	20.5	20.5
38	Salem Lake	20.2	18.5
39	Old Oak Lake	19.1	18.0
40	Grandwood Park Lake	19.0	17.2
41	Highland Lake	18.9	16.7
42	Lake Miltmore	18.7	16.8
43	Lake Helen	18.0	18.0
44	Bresen Lake	17.8	16.6
45	Potomac Lake	17.8	17.8
46	Hendrick Lake	17.7	17.7
47	Lake Barrington	17.7	16.7
48	Long Lake	17.7	15.8
49	Rollins Savannah 2	17.7	17.7
50	Windward Lake	17.6	16.3
51	Diamond Lake	17.4	16.3
52	Almond Marsh	17.3	16.3
53	Osprey Lake	17.3	15.5
54	Owens Lake	17.3	16.3

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
55	Forest Lake	17.0	15.9
56	Lake Tranquility (S1)	17.0	15.0
57	McDonald Lake 1	16.7	17.7
58	Island Lake	16.6	14.7
59	Countryside Lake	16.3	15.2
60	Grand Avenue Marsh	16.3	14.3
61	Lake Fairview	16.3	15.2
62	Lake Nippersink	16.3	14.3
63	Taylor Lake	16.3	14.3
64	Grays Lake	16.1	16.1
65	White Lake	16.0	17.0
66	Dog Training Pond	15.9	14.7
67	Dog Bone Lake	15.7	15.7
68	Ames Pit	15.5	13.4
69	Seven Acre Lake	15.5	17.0
70	Dugdale Lake	15.1	14.0
71	Eagle Lake (S1)	15.1	14.0
72	Heron Pond	15.1	15.1
73	Mary Lee Lake	15.1	13.1
74	Old School Lake	15.1	13.1
75	Bishop Lake	15	13.4
76	Hastings Lake	15.0	17.0
77	North Churchill Lake	15.0	15.0
78	Timber Lake (South)	14.7	12.7
79	Buffalo Creek Reservoir	14.3	13.1
80	Lake Carina	14.3	12.1
81	Lake Leo	14.3	12.1
82	Lambs Farm Lake	14.3	12.1
83	Crooked Lake	14.0	16.0
84	Dunn's Lake	13.9	12.7
85	Lake Minear	13.9	11.0
86	Lake Napa Suwe	13.9	11.7
87	Longview Meadow Lake	13.9	13.9
88	Summerhill Estates Lake	13.9	12.7
89	Stockholm Lake	13.5	12.1
90	Antioch Lake	13.4	11.3
91	Hook Lake	13.4	11.3
92	Lake Charles	13.4	11.3
93	Rivershire Pond 2	13.3	11.5
94	Flint Lake	13.0	11.8
95	Harvey Lake	13.0	11.8
96	Briarcrest Pond	12.5	11.2
97	Gages Lake	12.5	10.2
98	Lake Naomi	12.5	11.2
99	McDonald Lake 2	12.5	12.5
100	Pulaski Pond	12.5	11.2
101	Rollins Savannah 1	12.5	12.5
102	Stone Quarry Lake	12.5	12.5
103	Loch Lomond	12.1	9.4
104	Pond-A-Rudy	12.1	12.1
105	Grassy Lake	12.0	12.0
106	Lake Matthews	12.0	12.0
107	Nielsen Pond	12.0	10.7
108	Werhane Lake	12.0	9.8
109	Lake Lakeland Estates	11.5	10.0
110	Big Bear Lake	11.0	9.5
111	Fischer Lake	11.0	9.0

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
112	Little Bear Lake	11.0	9.5
113	Redwing Marsh	11	11.0
114	Tower Lake	11.0	11.0
115	West Meadow Lake	11.0	11.0
116	Lake Holloway	10.6	10.6
117	Lake Fairfield	10.4	9.0
118	Lake Louise	10.4	9.0
119	Sand Lake	10.4	8.0
120	College Trail Lake	10.0	10.0
121	Valley Lake	9.9	9.9
122	Woodland Lake	9.9	8.1
123	Lake Christa	9.8	8.5
124	Lake Farmington	9.8	8.5
125	Lucy Lake	9.8	8.5
126	Banana Pond	9.2	7.5
127	Columbus Park Lake	9.2	9.2
128	Sylvan Lake	9.2	9.2
129	Waterford Lake	9.2	9.2
130	Leisure Lake	9.0	6.4
131	Albert Lake	8.7	7.5
132	Fairfield Marsh	8.7	7.5
133	Lake Eleanor	8.7	7.5
134	Ozaukee Lake	8.7	6.7
135	East Meadow Lake	8.5	8.5
136	Lake Forest Pond	8.5	6.9
137	Peterson Pond	8.5	6.0
138	South Churchill Lake	8.5	8.5
139	Bittersweet Golf Course #13	8.1	8.1
140	Lake Linden	8.0	8.0
141	IMC Lake	7.1	5.0
142	Patski Pond	7.1	7.1
143	Rasmussen Lake	7.1	7.1
144	Slocum Lake	7.1	5.8
145	Lucky Lake	7.0	7.0
146	Deer Lake Meadow Lake	6.4	5.2
147	ADID 127	5.0	5.0
148	Half Day Pit	5.0	2.9
149	Liberty Lake	5.0	5.0
150	Lochanora Lake	5.0	2.5
151	Oak Hills Lake	5.0	5.0
152	Sand Pond (IDNR)	5.0	3.5
153	Slough Lake	5.0	5.0
154	Echo Lake	0.0	0.0
155	Hidden Lake	0.0	0.0
156	North Tower Lake	0.0	0.0
157	St. Mary's Lake	0.0	0.0
158	Willow Lake	0.0	0.0
	Mean	**15.2**	**14.1**
	Median	**14.3**	**13.1**

Monthly Water Level at Forest Lake, 2011.

2011	Level (in)	Seasonal Change (in)	Monthly Change (in)	Rain (in)
May	26.00			
June	25.25	0.75	0.75	7.66
July	29.75	-3.75	-4.50	0.94
August	26.50	-0.50	3.25	8.73
September	28.75	-2.75	-2.25	3.07

Right side of outlet, water to top of concrete

Forest Lake 2011 Multiparameter data

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											1.085
5/11/2011	0.5	0.50	19.08	8.98	97.3	1.2120	7.89	2567	Surface		
5/11/2011	1	1.00	18.81	9.02	97.2	1.2180	7.84	2552	Surface	100%	
5/11/2011	2	2.01	18.47	8.93	95.6	1.2140	7.88	667	0.261	26%	5.14
5/11/2011	3	3.00	18.02	8.98	95.3	1.2120	7.89	515	1.251	20%	0.21
5/11/2011	4	4.01	17.61	8.98	94.4	1.2110	7.87	528	2.257	21%	-0.01
5/11/2011	5	5.01	16.46	9.20	94.5	1.2100	7.88	477	3.264	19%	0.03
5/11/2011	6	6.07	15.81	8.87	89.8	1.2130	7.86	373	4.321	15%	0.06

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.992
6/15/2011	0.5	0.52	21.18	9.99	112.8	0.9360	8.09	692	Surface		
6/15/2011	1	1.01	21.19	7.46	84.2	0.9350	7.81	653	Surface	26%	
6/15/2011	2	2.05	21.20	7.15	80.8	0.9350	7.81	151	0.297	6%	4.93
6/15/2011	3	3.00	21.19	7.30	82.4	0.9360	7.81	125	1.253	5%	0.15
6/15/2011	4	3.97	21.14	6.12	69.0	0.9290	7.74	61	2.222	2%	0.32
6/15/2011	5	4.97	20.95	5.72	64.3	0.9360	7.78	40	3.219	2%	0.14
6/15/2011	6	6.00	20.90	7.47	83.8	0.9360	7.84	17	4.248	0.7%	0.19
6/15/2011	7	7.06	20.89	7.90	88.6	0.9260	7.85	6	5.308	0.2%	0.22

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											1.386
7/13/2011	0.5	0.65	27.59	9.51	121.0	0.9650	8.42	4695.2	Surface		
7/13/2011	1	0.98	27.63	9.59	122.0	0.9660	8.43	4313	Surface	169%	
7/13/2011	2	2.01	27.62	9.60	122.1	0.9670	8.44	710	0.259	28%	6.96
7/13/2011	3	2.99	27.62	9.56	121.7	0.9670	8.44	268	1.236	11%	0.79
7/13/2011	4	4.05	27.60	9.52	121.0	0.9670	8.43	613	2.302	24%	-0.36
7/13/2011	5	5.02	27.55	9.44	119.9	0.9660	8.44	269	3.265	11%	0.25
7/13/2011	6	6.07	27.44	8.92	113.1	0.9670	8.41	138	4.321	5%	0.16
7/13/2011	7	7.05	27.42	8.44	107.0	0.9500	7.93	9	5.297	0.3%	0.52

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.817
8/10/2011	0.5	0.482	26.51	9.09	113.2	0.723	8.38	2366.4	Surface		
8/10/2011	1	0.980	26.51	8.46	105.4	0.723	8.37	2762.6	Surface	108%	
8/10/2011	2	2.059	26.47	8.84	110.0	0.723	8.36	961.1	0.309	38%	3.42
8/10/2011	3	2.988	26.45	8.85	110.2	0.723	8.37	567.6	1.238	22%	0.43
8/10/2011	4	3.966	26.40	8.54	106.2	0.723	8.35	216.8	2.216	8%	0.43
8/10/2011	5	5.020	26.37	9.04	112.4	0.723	8.33	96.8	3.27	4%	0.25
8/10/2011	6	6.001	26.37	8.81	109.5	0.723	8.34	39.3	4.251	2%	0.21
8/10/2011	7	7.016	26.29	8.71	108.2	0.748	8.22	16.6	5.266	0.7%	0.16

Forest Lake 2011 Multiparameter data (continuted)

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.852
9/14/2011	0.5	0.41	21.31	13.92	157.4	0.7200	8.89	581	Surface		
9/14/2011	1	1.03	21.36	13.66	154.6	0.7210	8.76	562	Surface	22%	
9/14/2011	2	2.07	21.38	13.78	156.0	0.7220	8.76	178	0.319	7%	3.60
9/14/2011	3	3.04	21.38	13.36	151.3	0.7220	8.75	83	1.29	3%	0.59
9/14/2011	4	4.07	21.38	13.21	149.5	0.7220	8.76	39	2.318	2%	0.32
9/14/2011	5	5.07	21.37	13.64	154.4	0.7220	8.76	22	3.316	0.9%	0.18
9/14/2011	6	6.00	21.38	13.64	154.5	0.7230	8.76	12	4.254	0.5%	0.14
9/14/2011	7	6.99	21.37	12.24	138.5	0.7220	8.76	3	5.237	0.1%	0.28

APPENDIX A. METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES

Water Sampling and Laboratory Analyses

One 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.

Plankton Sampling

Plankton were sampled at the same location as water quality samples. Using the Hydrolab DataSonde® 4a or YSI 6600 Sonde® 1% light level depth (depth where the water light is 1% of the surface irradiance) was determined. A plankton net/tow, with 63μm mesh, was then lowered to the pre-determined 1% light level depth and retrieved vertically. On the way up the water column, plankton were collected within a small cup on the bottom of the tow. The collected sample was then emptied into a pre-labeled brown plastic bottle. The net was rinsed with deionized water into the bottle in order to ensure all the plankton were collected. The sample was then transferred to a graduated cylinder to measure the amount of milliliters (mL) that the sample was. The sample was then returned to the bottle and preserved with Lugol's iodine solution (5 drops/mL). The sample bottle was then closed and stored in a cooler until returning to the lab, where it was transferred to the refrigerator until enumeration. Enumeration was performed within three months, but ideally within one month, under a microscope. Prior to sub-sample being removed for enumeration, the sample bottle was inverted several times to ensure proper homogenization. An automated pipette was used to retrieve 1 mL of sample, which was then placed in a Sedgewick Rafter slide. This is a microscope slide on which a rectangular chamber has been constructed, measuring 50 mm x 20 mm in area and 1 mm deep. The slide was then placed under the microscope and counted at a 20X magnification (phytoplankton) or 10X magnification (zooplankton). For phytoplankton, twenty fields of view were randomly counted with all species within each field counted. Due to their larger size, zooplankton were counted throughout the entire slide. Through calculations, it was determined how many of each species were in 1 mL of lake water.

Phytoplankton (algae) are free-floating and microscopic and are distinguished from plants because they lack roots, stems and leaves. There are four distinct groups of phytoplankton found in Lake County lakes: blue-greens, greens, diatoms, and dinoflagellates/chrysophytes. Blue-greens are also known as cyanobacteria because they are the only group of bacteria that obtain their energy from photosynthesis like plants. Some of these species can be toxic. Green algae are the closest ancestors of land plants and are the most common group. Diatoms are unique because they are encased in a cell wall made of silica that can be very ornate. Dinoflagellates and chrysophytes are almost always flagellated (able to move by flagella, a whip-like tail) and some can both photosynthesize and consume bacteria for food.

Zooplankton are made up of rotifers and two crustacean groups; the cladocerans and the copepods (broken down further into calanoids and cyclopoids). Rotifers are smaller and most have a crown of cilia (hair-like structure) used for movement and drawing in suspended particles to eat. Crustaceans have jointed appendages and are enclosed in an exoskeleton. Cladocerans, such as the “water flea” Daphnia species, are filter-feeding like rotifers, while the copepod group contains both filter-feeders (calanoids and cyclopoids) and raptorial species (cyclopoids).

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.

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