LAKE COUNTY, IL

2015 HONEY LAKE SUMMARY REPORT

LAKE COUNTY HEALTH DEPARTMENT

ECOLGOICAL SERVICES

Honey Lake, 2015

Honey Lake is a 66-acre glacial lake in southwestern Lake County. Honey Lake receives water from Grassy Lake Drain and empties into Grassy Lake, eventually flowing into Flint Creek. Members of Biltmore Country Club and private homeowners use the lake for swimming, fishing, and non-motorized boating. Honey Lake is listed as an ADID (advanced identification) wetland by the U.S. Environmental Protection Agency and an Illinois Natural Areas Inventory (INAI) by the state of Illinois. This indicates that the lake and surrounding natural environments have potential to have high quality aquatic resources based on water quality and hydrology values.

In 2015, the Lake County Health Department– Ecological Services (LCHD-ES) monitored Honey Lake. Two water samples were collected once a month from May through September. Sample locations were at the deepest point in the lake (Appendix A) three feet below the surface, and 3 feet above the bottom. Water chemistry can be significantly different between the epilimnion (warm upper layer) and hypolimion (cool bottom layer) of a lake. Samples were analyzed for nutrients, solid concentrations and other physical parameters. Additionally, an aquatic plant survey was conducted in July (2015) and a shoreline assessment surveyed in October (2015).

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LAKE FACTS

MAJOR WATERSHED:

FOX RIVER

SUB-WATERSHED:

FLINT CREEK

SURFACE AREA:

65.6 ACRES

SHORELINE LENGTH:

2.2 MILES

MAXIMUM DEPTH:

18.7 FEET

AVERAGE DEPTH:

8.8 FEET

LAKE VOLUME:

584.1 ACRE-FEET

WATERSHED AREA:

1259.3 ACRES

LAKE TYPE:

GLACIAL

CURRENT USES:

SWIMMING, FISHING, NON-MOTORIZED BOATING.

ACCESS:

PRIVATE ACCESS—RESIDENTS ONLY AND OPEN TO BILTMORE COUNTRY CLUB MEMBERS AND GUESTS

Honey lake Summary

Following are summary highlights of the water quality sampling, shoreline survey and aquatic macrophyte surveys from the 2015 monitoring season. The water quality of Honey Lake has declined since the 2008 sampling although many parameters remain below the Lake County median values. The complete data sets for water quality, aquatic plant sampling, and shoreline surveys conducted on Honey Lake can be found in Appendix A & B of this report, and discussed in further detail in the following sections.

- Average water clarity based on secchi depth in 2015 was 3.11 ft., which is a 56% decrease since 2008; yet remains above the Lake County median secchi depth of 2.96 ft.
- Water clarity is influenced by amount of particles in the water column; this is measured by total suspended solids. The average TSS concentrations on Honey Lake was 6.6 mg/L in 2015, which is below the Lake County median of 8.2 mg/L but a 94% increase since 2008 sampling.
- Nutrient availability indicated that Honey Lake was phosphorus limited with an average TN:TP ratio of 25:1.
- In 2015 the average total phosphorus concentration was 0.059 mg/L. This is above the Illinois Environmental Protection Agency (IEPA) water quality standard of 0.050 mg/L; meaning Honey Lake is impaired for phosphorus.
- Total phosphorus concentrations have increased since 2008 by 73%.
- Trophic State index (TSIp) for Honey Lake was 59; meaning Honey Lake is considered eutrophic.
- Honey Lake thermally stratified throughout the monitoring season; May—September.
- Dissolved oxygen (DO) concentrations dropped below 5 mg/L during all sampling months. During June, July, and August DO dropped below 5 mg/L at depths greater than 3 ft., 4ft., and 5 ft., respectively.
- Dissolved oxygen concentrations reached anoxic conditions (<1 mg/L) during all months during the sample season.
- The July aquatic macrophyte survey showed that 43% of all sampling sites had plant coverage.
- A total of 9 plant species and Chara (a macro-algae) were present with the most dominant species being Coontail and White Water Lily.
- Aquatic invasive plant species were not present during the 2015 sampling season.
- 17% of the Honey Lake shoreline was experiencing some degree of erosion.
- Based on the 2015 shoreline condition survey, 40% of Honey Lake's lakeshore buffer condition was classified as poor.
- Honey Lake has a licensed beach at the Biltmore Country Club. There were zero beach closures due to E.coli in 2015.

Honey Lake is in the Flint Creek Watershed, which is part of the Fox River Watershed.

LAKES SAMPLED IN 2015

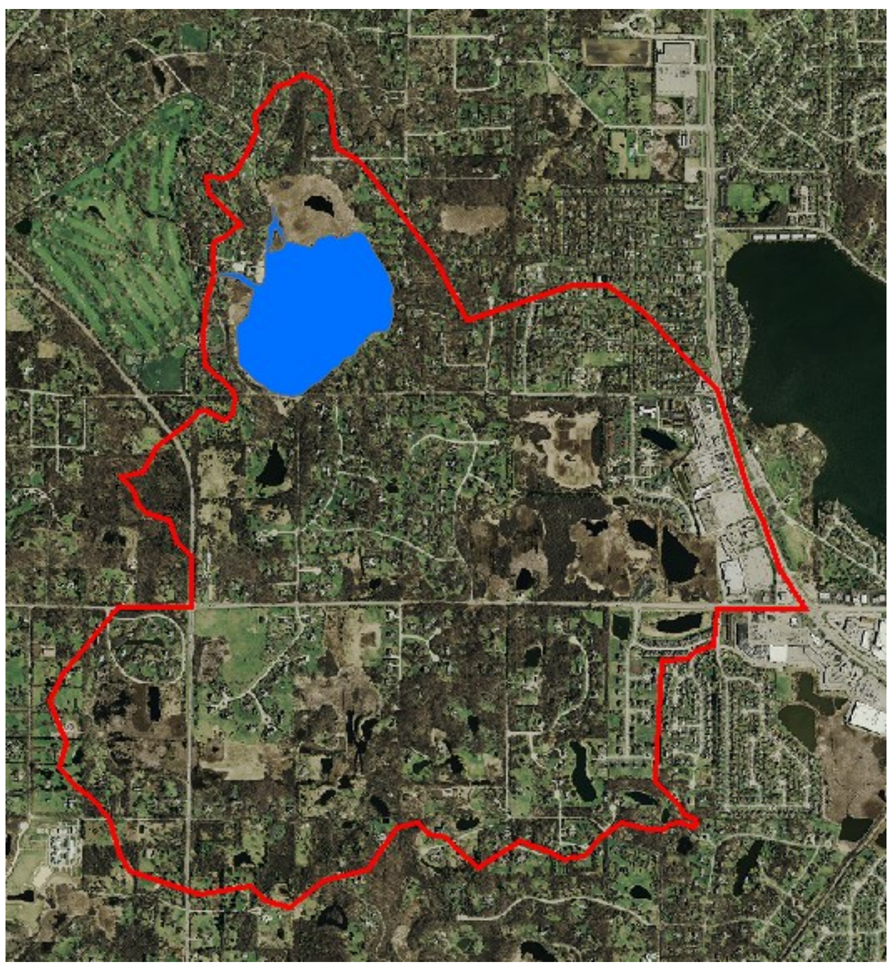
Echo Lake
Lake Zurich
Lake Barrington
Honey Lake
Lake Antioch
Little Silver Lake
Lake Tranquility
Cross Lake
Lake Minear
Lake Louise
St. Mary's Lake
Loch Lomond Lake
Butler Lake

WATERSHED & LANDUSE

A watershed is an area of land where all surface water from rain, melting snow and ice, converge at a lower elevation, usually a lake, river, or other body of water. The source of a lake's water supply is very important in determining its water quality and choosing management practices to protect the lake. The Honey Lake watershed is 1259.3 acres (Figure 1). The watershed to lake ratio is important in understanding how nutrients enter the lake. Honey Lake has a relatively large watershed to lake ratio (19:1), which may make it difficult to control runoff and minimizes pollutants such as phosphorus, nitrogen, and chlorides from entering the lake.

Land use plays a significant role on water quality of a lake. Based on the 2015 landuse data, the current external sources affecting Honey Lake are from the following dominant landuses: Single-Family (52.6%) and Wetlands (12.9%) (Figure 2, Page 4). As areas become more developed, that typically means an increase in impervious surfaces, reducing the amount of open space for infiltrating and storing precipitation. Based on the amount of impervious surfaces each land use contributes varied amounts of runoff. Impervious surfaces (parking lots, roads, buildings, compacted soil) impact water quality in lakes by increasing pollutant loads and water temperature. During storm events, pollutants such as excess nutrients (nitrogen and phosphorus), metals, oil, grease, and bacteria are easily transferred from impervious surfaces to rivers, wetlands, and lakes.

Figure 1: Honey Lake Watershed Delineation



Everyone lives in a watershed! 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.

As a watershed is developed, the amount of impervious surface increases resulting in a greater influx of runoff entering our waters due to reduced infiltration of rainwater into the ground.

WATERSHED & LANDUSE (CONT.)

Honey Lake receives the majority of it's runoff from singly family residential areas. Approximately 54.8% of runoff is attributed to the single family landuse; followed by transportation (27.1%) (Table 1). Lakes that receive a significant amount of stormwater runoff can have variable water quality that is heavily influenced by human activity. It's also important to note that while other landuses may contribute a smaller percentage of runoff, they can still deliver high concentrations of total suspended solids and total phosphorus. Alternatively, a low percentage of landuse can still deliver higher amounts of runoff, for instance, the transportation landuse is not a dominant landuse in the Honey Lake watershed, but a is a dominant runoff.

Figure 2: Land Use in the Honey Lake Watershed

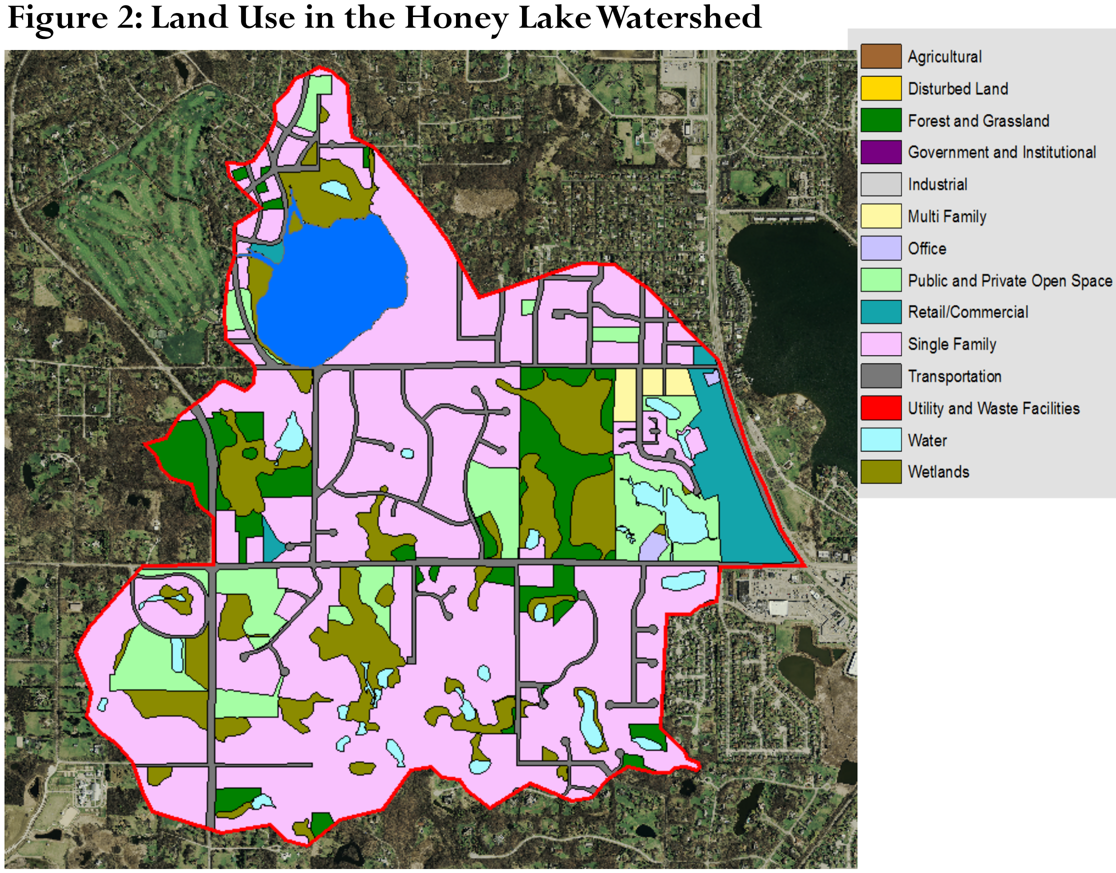
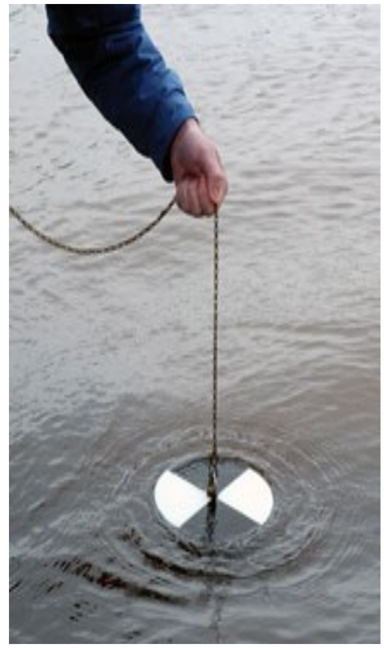


Table 1: Runoff Percentages by Landuse in the Honey Lake Watershed

Land Use	Acreage	% of Total Watershed	Estimated Runoff, acft.	% Total of Estimated Runoff
Forest and Grassland	98.79	7.8%	13.6	1.4%
Multi Family	13.90	1.1%	19.1	1.9%
Office	0.66	0.1%	1.5	0.2%
Public and Private Open Space	66.03	5.2%	27.2	2.7%
Retail/Commercial	41.31	3.3%	96.6	9.7%
Single Family	662.84	52.6%	546.8	54.8%
Transportation	115.78	9.2%	270.6	27.1%
Water	97.84	7.8%	0.0	0.0%
Wetlands	162.06	12.9%	22.3	2.2%
TOTAL	**1259.22**	**100.0%**	**997.8**	**100.0%**

WATER CLARITY



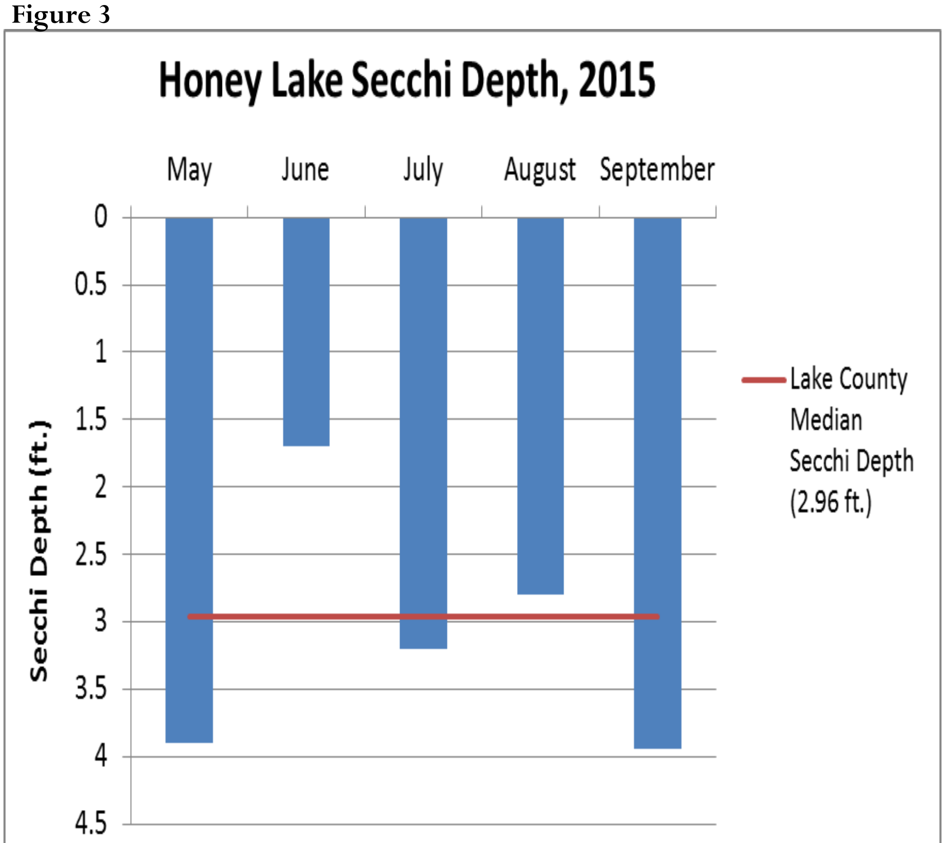
Water clarity, or water transparency, is an indicator of water quality related to chemical and physical properties. Water clarity is typically measured with a Secchi disk and indicates the amount of light penetration into a body of water. It can also provide an indirect measurement of the amount of suspended material in water. A number of factors can interfere with light penetration and reduce water transparency. This includes: algae, water color, re-suspended bottom sediments, eroded soil and invasive species. Boat propellers can also impact water clarity by redistributing loose bottom sediment and creating more turbid waters.

Secchi disk depth is primarily used as an indicator of algal abundance and general lake productivity. Although it is only an indicator, Secchi disk depth is the simplest and one of the most effective tools for estimating a lake's productivity.

The 2015 average water clarity in Honey Lake was 3.11 ft., a 56.0% decrease in water clarity from 2008 sampling. Compared to other lakes in Lake County, Honey Lake is above the median Lake County Secchi depth of 2.96 ft (Figure 3). June had the lowest Secchi depth reading correlating with heavy precipitation events which occurred within 48 hours of sampling.

HONEY LAKE SECCHI DEPTH WAS 3.11 FT.;
WHICH IS ABOVE THE LAKE COUNTY MEDIAN.

Figure 3



WHAT YOU CAN DO TO IMPROVE WATER QUALITY ON HONEY LAKE?

- Do not throw leaves, grass clippings, pet waste, and other organic debris into the street or driveway. Runoff carries these through storm sewers, directly into Honey Lake.
- Build a rain garden to filter run-off from roofs, driveways, and streets. This allows the phosphorus to be bound to the soil so it does not reach surface waters.
- Plant a buffer around your lake shoreline to reduce runoff and filter nutrients from entering your lake.
- Sweep up fertilizer that is spilled or inadvertently applied to hard surface areas, do not hose it away.

VOLUNTEER LAKE MONITORING PROGRAM (VLMP)

The VLMP was established in 1981 by the Illinois Environmental Protection Agency (IEPA) to be able to collect information on Illinois inland lakes, and to provide an educational program for citizens. The volunteers are primarily lakeshore residents, lake owners/managers, members of environmental groups, and citizens with interest in a particular lake.

The VLMP relies on volunteers to gather information on their chosen lake. The primary measurement by volunteers is Secchi depth (water clarity). Water clarity can provide an indication of the general water quality of the lake. 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.

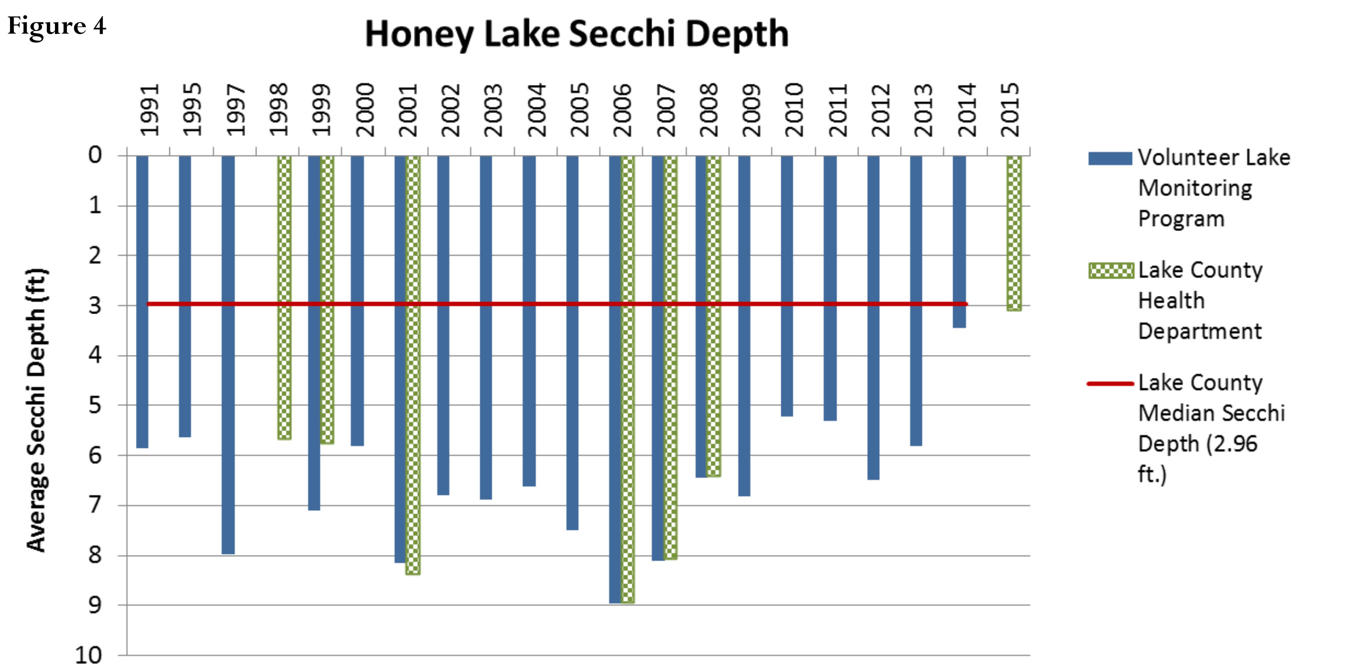
Honey Lake has participated in the VLMP since 1991 (Figure 4). Participating provides annual data that helps document water quality impacts and support lake management decisions. It is recommended that an homeowner association member continue to participate in the VLMP program. Honey Lake is fortunate to have such a long VLMP record and it is recommended that Honey Lake continues to participate in this program.

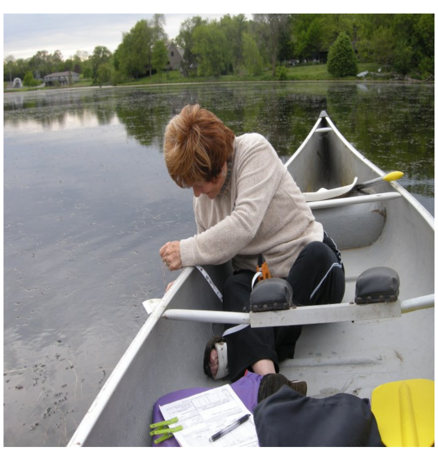
LAKE MONITORING VOLUNTEER PROGRAM ILLINOIS

For more information visit:

www.epa.state.il.us/water/vlmp/index.html

Figure 4





FOR MORE INFORMATION ON THE VLMP PROGRAM

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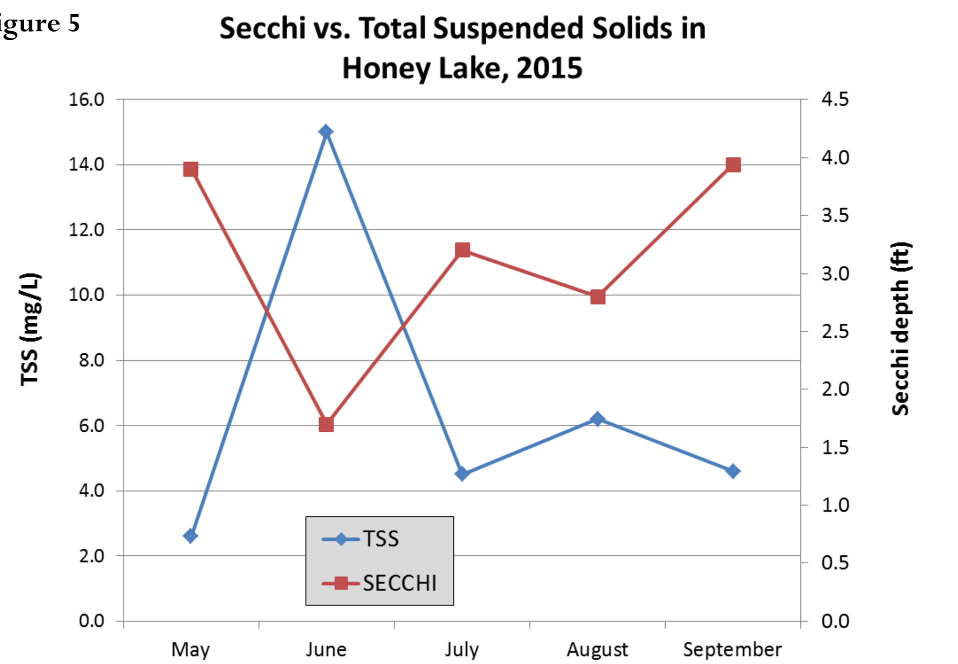
TOTAL SUSPENDED SOLIDS

Another measure of water clarity is turbidity and total suspended solids. Suspended particles dissipate light, which affects the depth at which plants can grow. The total suspended solid (TSS) parameter represents the concentration of all organic and inorganic materials suspended in the lake's water column. Typical inorganic components of TSS are referred to as non-volatile suspended solids (NVSS). NVSS originate from weathering and erosion of rocks and soils in the lake's watershed and re-suspension of lake sediments. The organic portion of TSS are called volatile suspended solids (TVS). TVS is mostly composed of algae and other organic matter such as decaying plant and animal matter.

2015 TSS concentrations in the epilimnion of Honey Lake averaged 6.6 mg/L. The 2015 concentrations were a 94% increase of in TSS since the 2008 sampling, but still remains below the Lake County median of 8.2 mg/L. High TSS values correlated with poor water clarity (Secchi disk depth) and can be detrimental to many aspects of lake ecosystem including the plant and fish communities. Secchi depth and total suspended solids are inversely related (Figure 5).

A lake can have a TSS impairment which is based on if the median surface NVSS is greater or equal to 12 mg/L for the monitoring season. Based on the 2015 sampling data, median surface NVSS was only 4.2 mg/L, thus there is no TSS impairment.

Figure 5



TSS

Total Suspended Solids

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

TVS

Total Volatile Solids

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

NVSS

Non-Volatile Suspended Solids

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

TDS

Total Dissolved Solids

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

TOTAL SUSPENDED SOLIDS (CONTINUED)

The percentage of TSS that are non-volatile suspended solids gives insight into the source of the suspended solids. Lakes that have a higher percentage of NVSS to TSS represent more allochthonous (originating outside of the lake) input or re-suspended sediment (Jones and Knowlton, 2005). Another way to describe it is that lakes with a higher ratio of NVSS to TSS indicate that the suspended solids represent more inorganic material whereas lakes with lower % NVSS may represent more algae and organic material. The calculated average nonvolatile suspended solids (NVSS) was 4.2 mg/L. Approximately 64 % of the total suspended solids concentration in in 2015 can be attributed to organic clay and sediments suspended in the water column. The increase in turbidity could have been caused by heavy rainfall events washing in sediments that became suspended in the water column.

The algae and organic matter in the water column was higher in August. The average TVS for the monitoring season was 136 mg/L which is slightly above the county median of 121.0 mg/L (Table 2). Algae blooms were noted in August and September.

There was an increase in TSS in Honey Lake from 2008 to 2015. This correlated with a decrease in water clarity and increase in phosphorus concentrations from 2008 to 2015.

Table 2. 2015 Solid concentrations in the epiliminion of Honey

Month	Total Suspended Solids (mg/L)	Total Solids (mg/L)	Total Volatile Solids (mg/L)
May	2.6	690	110
June	15.0	675	147
July	4.5	669	152
August	6.2	670	137
September	4.6	677	136
Average	*6.6*	*676*	*136*

NUTRIENTS: PHOSPHORUS

Organisms take nutrients in from their environment. In a lake, the primary nutrients needed for aquatic plant and algal growth are phosphorus (P) and nitrogen (N). Phosphorus is a vital nutrient for converting sunlight into usable energy and essential for cellular growth and reproduction. Phosphorus occurs in dissolved organic and inorganic forms or attached to sediment particles. Phosphates, the inorganic form, are preferred for plant growth but other forms can be used. Phosphorus builds up in the sediments of a lake.

The source of phosphorus to a lake can be external, internal, or both. Phosphorus originates from a variety of external sources, many of which are related to human activities including: human and animal waste, soil erosion, detergents, sewage treatment plants, septic systems, and runoff from lawn. Internal sources of phosphorus originate within the lake and are typically linked to the lake sediment. When it remains in the sediments it is generally not available for use by algae, however, various chemical and biological processes can allow phosphorus to be released from the sediment and be available in the water column. Carp spawning and feeding activity can release phosphorus by stirring up the bottom sediment and can add phosphorus through their fecal matter. Sediment resuspension and subsequent phosphorus release can occur through wind/wave action or heavy boat traffic. Lakes that experience anoxic conditions also contribute to the release of P from the bottom sediments.

NUTRIENTS: PHOSPHORUS

2015 Total Phosphorus (TP) concentrations in the epiliminion of Honey Lake averaged 0.059 mg/L, a 74% increase since the 2008 sampling of 0.034 mg/L (Figure 6).

Surface TP exceeded 0.05 mg/L on Honey Lake, which is the IEPA water quality standard. Honey Lake exceeded the 0.05 mg/L value only during May and June of 2015. Lakes with concentrations exceeding 0.050 mg/L may support high densities of algae and aquatic plants, which can reduce water clarity and dissolved oxygen and are considered impaired for phosphorus and are considered impaired. Increased TP concentrations in May and June could be a result of the heavy precipitation events noticed early in the season. This could mean more TP inputs from within the watershed entering Honey Lake.

Table 3: Phosphorus concentrations in Honey Lake, 2015

Date	TP Epiliminion	SRP Epiliminion	TP Hypolimnion	SRP Hypolimnion
12-May	0.067	<0.005	0.076	0.026
16-Jun	0.097	<0.005	0.718	0.618
14-Jul	0.048	0.009	0.084	0.027
11-Aug	0.039	0.010	0.635	0.339
16-Sep	0.042	0.008	1.320	1.130
Average	*0.059*	*0.009*	*0.567*	*0.428*

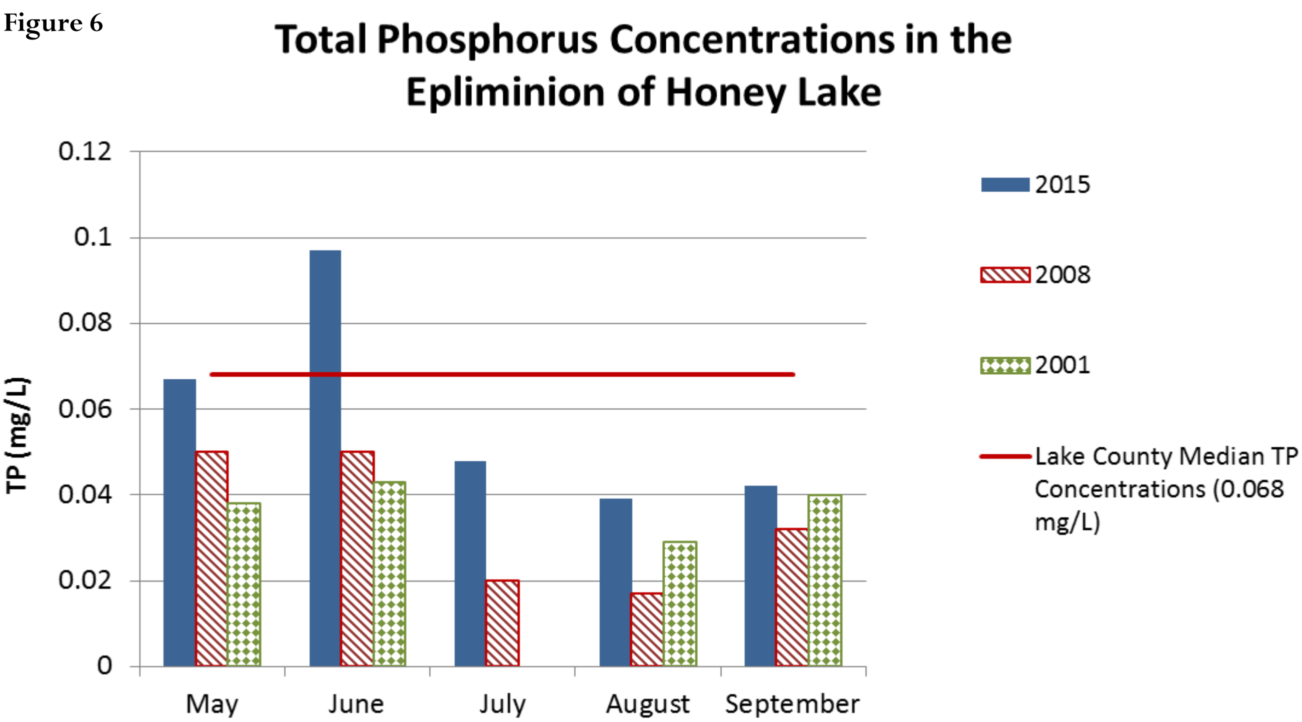
WHAT HAS BEEN DONE TO REDUCE PHOSPHORUS LEVELS IN ILLINOIS?

2007- *The Village of Barrington passed a resolution supporting the use of phosphorus-free fertilizers and detergents in the village of Barrington.*

July 2010—*The state of Illinois passed a law to reduce the amount of phosphorus content in dishwashing and laundry detergent*

July 2010: *The state of Illinois passed another law restricting the use of lawn fertilizers containing phosphorus by commercial applicators.*

Figure 6

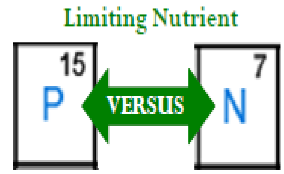


NUTRIENTS: NITROGEN

Nitrogen, in the forms of nitrate (NO_3^-), nitrite (NO_2^-), or ammonium (NH_4^+) is a nutrient needed for plant and algal growth. Nitrogen enters the ecosystem in a several chemical forms and a lake's nitrogen source can vary widely. Sources of nitrogen include septic systems, animal feed lots, agricultural fertilizers, manure, industrial waste waters, and sanitary landfills, and atmospheric deposition. All inorganic forms of nitrogen (NO3-, NO2-, and NH4+) can be used by aquatic plants and algae. If these inorganic forms exceed 0.3 mg/L, there is sufficient nitrogen to support summer algae blooms. If the surface median total nitrogen as N (TKN + NO2/NO3-N) exceeds 3.6 mg/L for the monitoring season, there is a nitrogen impairment for the water body.

Nitrogen concentrations (NO3-N and NH3-N) were below detectable concentrations for most months during the study except for May, where nitrate was 0.068 mg/L. Higher levels of nitrates in these months could have been related to runoff, as May had heavier precipitation. Overall, there were no nitrogen impairments for Honey Lake. Total Kjeldahl nitrogen (TKN), an organically (algae) associated form of nitrogen, in Honey Lake averaged 1.43 mg/L, which is above the Lake County median of 1.20 mg/L. Total Kjeldahl nitrogen is a measure of organic nitrogen, and is typically bound up in algal and plant cells.

The TN:TP ratio looks at TKN + NO3 to total phosphorus. This ratio can indicate whether plant and algae growth in a lake is limited by nitrogen of phosphorus. Typically ratios of less than 10:1 suggest the lake is limited by nitrogen, while ratios greater than 20:1 are limited by phosphorus. Honey Lake has a TN:TP ratio of 25:1, meaning the lake is phosphorus limited and additions of phosphorus into the lake system can contribute to algae issues.



TN:TP Ratio

<10:1 = nitrogen limited

>20:1= phosphorus limited

TN:TP Ratio on Honey Lake: 25:1

Honey Lake is Phosphorus Limited

WAYS TO REDUCE NUTRIENTS IN YOUR LAKE

Phosphorus and nitrogen originate from a variety of sources, many of which are related to human activities. Some sources include: human and animal waste, soil erosion, detergents, septic systems, common carp, and runoff from lawns and fields, fertilizers, manure and atmospheric deposition. Installing best management practices, such as buffer strips, planting more native plants, rain gardens, and using minimal amount of fertilizer are ways to help reduce nutrient runoff from your own property. Below are some suggestions to reduce nutrients to your lake:

Waterfowl management (ducks and geese)

- Do not feed or encourage others to feed waterfowl
- Use good landscaping practices to discourage waterfowl. Landscapes with taller plants and shrubbery can discourage geese.

Fertilizer use:

- If you apply fertilizers to lawns and gardens, have your soil tested to determine how much fertilizer to apply.
- Check the weather before applying fertilizer—avoid applying before heavy rainfalls.
- Sweep up any fertilizer which is spilled on impervious surfaces such as walks and driveways.
- Do not spread fertilizer within 75 feet of surface waters or wetlands

Pet Waste Disposal

- Regularly scoop up and dispose of pest waste.

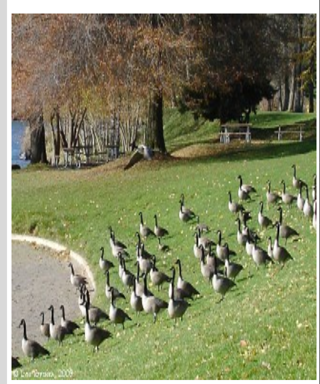
Landscaping Practices

- Consider native vegetation as a quality alternative to lawns. Native vegetation provides a more diverse plant community, and can filter out nutrients and also provides habitat for important pollinators.
- Plant a buffer strip of native plants (at least 20 feet) between the lake's edge and your property.

Keep fall leaves out of the storm drains

- Never rake leaves into or near storm drains, ditches, creeks, or on lakeshore.

Regularly inspect septic systems



TROPHIC STATE INDEX

LAKE COUNTY AVERAGE TSIP = 66.1

HONEY LAKE TSIP = 59.7

TROPHIC STATE: EUTROPHIC

RANK = 53/173

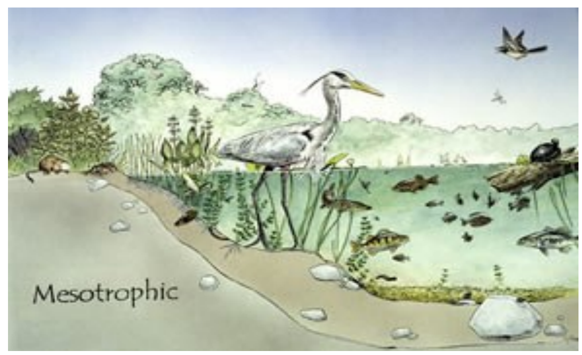
Trophic state describes the overall productivity of a lake, which has implications for the biological, chemical and physical conditions of the lake. The Trophic State Index (TSI) value is based on phosphorus (TSIp) and Secchi (TSIsd) and are calculated from the monitoring data. Lakes are classified into four main categories of trophic states that reflect nutrient levels and productivity. The four categories are: oligotrophic, mesotrophic, eutrophic, and hypereutrophic. These range from nutrient poor and least productive (oligotrophic) to most nutrient rich and most productive (eutrophic).

A lake's 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 and nitrogen (such as fertilizer, household products, waste by-products, etc.) are accelerating the eutrophication process.

In 2015, Honey Lake was considered eutrophic with a TSIp value of 59.7. Based on the TSIp, Honey Lake ranked 53 out of 173 lakes studied by the LCHD-ES from 2000 –2015 (Appendix B).

OLIGOTROPHIC

Lakes have low nutrients and are generally deep and free of weeds or large algae blooms. They do not support large fish populations.

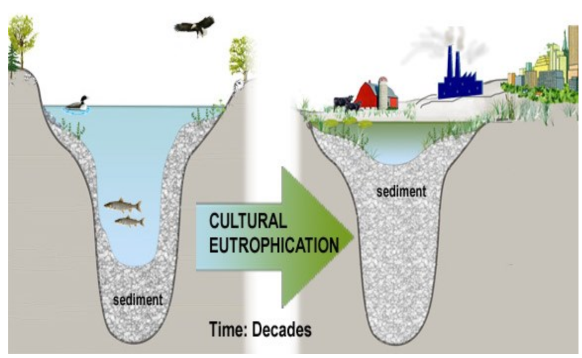


MESOTROPHIC

Lakes have medium nutrients and intermediate level of productivity. Mesotrophic lakes typically have clear water with beds of submerged aquatic plants. Mesotrophic lakes can have a diverse fish population.

EUTROPHIC

Lakes are high in nutrients, and are usually weedy or subject to frequent algae blooms. Eutrophic lakes often support large fish populations but are also susceptible to oxygen depletion. Increased sedimentation also is typical of eutrophic lakes



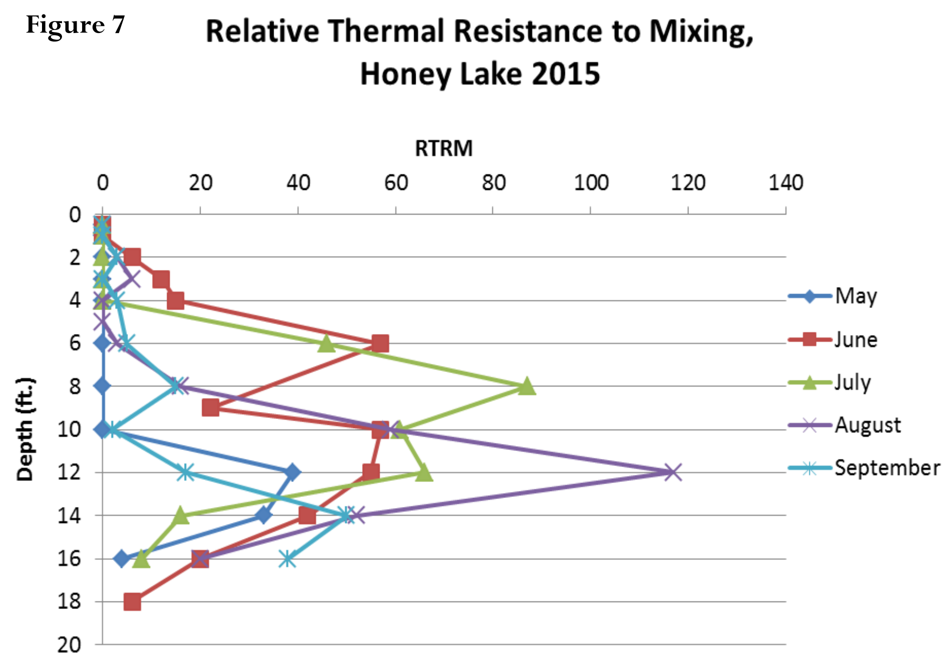
CULTURAL EUTROPHICATION

An enrichment and accumulation of a lake with nutrients, sediments, and organic matter from the surrounding watershed. It can be a natural process in lakes, occurring as they age through geologic time. Human activity that occurs in the watershed can accelerate eutrophication, known as cultural eutrophication and can lead to increased algal growth, increased rooted plant growth, and lower dissolved oxygen concentrations.

STRATIFICATION

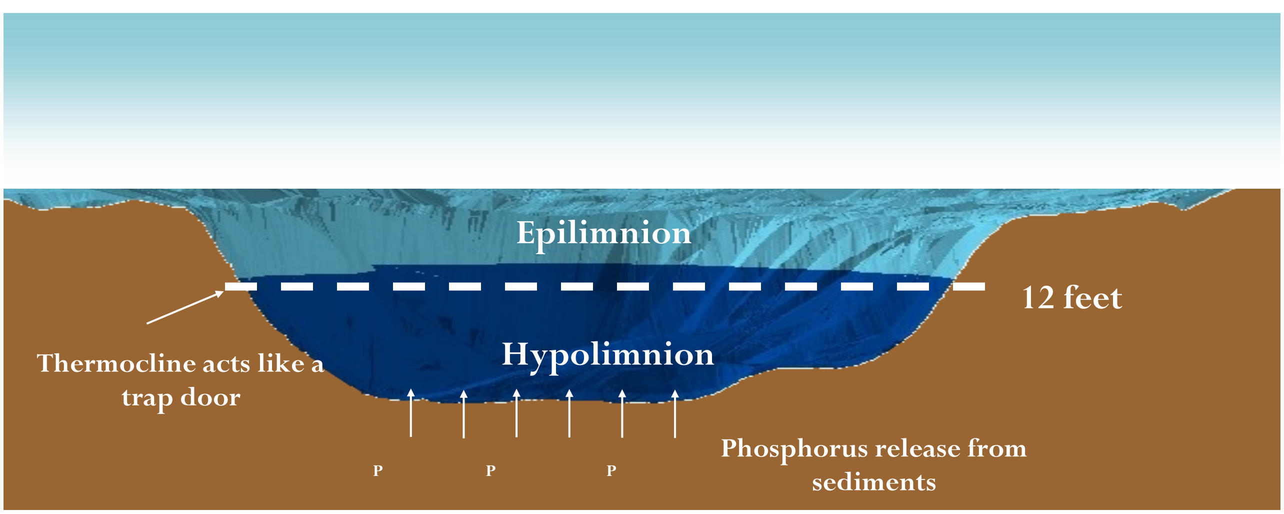
A lake's water quality and ability to support fish are affected by the extent to which the water mixes. Honey Lake was thermally stratified throughout the monitoring season. Thermal stratification is when a lake divides into an upper, warm water layer (epiliminion) and a lower, cold water layer (hypoliminion).

Figure 7



Monthly depth profiles were measured on Honey Lake by measuring water temperature, dissolved oxygen, conductivity, and pH every foot from the lake surface to 4 feet, and then every 2 feet thereafter to the lake bottom. Temperature is used to determine the relative thermal resistance to mixing (RTRM), an index for quantifying thermal stratification in lakes. Calculating the RTRM for each month's depth profiles can identify the thermocline and stability of stratification. The peak RTRM identifies the location and intensity of the thermocline (steepest density gradient). When an RTRM value is greater than 20, it is identified as strong enough to stratify. The maximum RTRM indicates the thermocline. Figure 6 shows the RTRM values by month/ For Honey Lake, RTRM values reached >20 for all months; with the greatest density gradient occurring in August. The peak thermocline occurred at a depth of 12 ft. (May), 10 ft. (June), 8 ft. (July), 12 ft. (August), and 14 ft. (September).

During anoxic conditions lake sediments release phosphorus (internal phosphorus) into the water column. While the lake is stratified the phosphorus remains in the hypolimnion but once turn over occurs the internal phosphorus is released into the entire water column. The water quality data shows higher levels of both TP and SRP in the hypoliminon while the lake is stratified. Deeper, more stratified lakes, lakes have stronger thermoclines making it more difficult for the phosphorus to mix and re-enter the epliminion. Honey Lake did not turnover during the monitoring season.

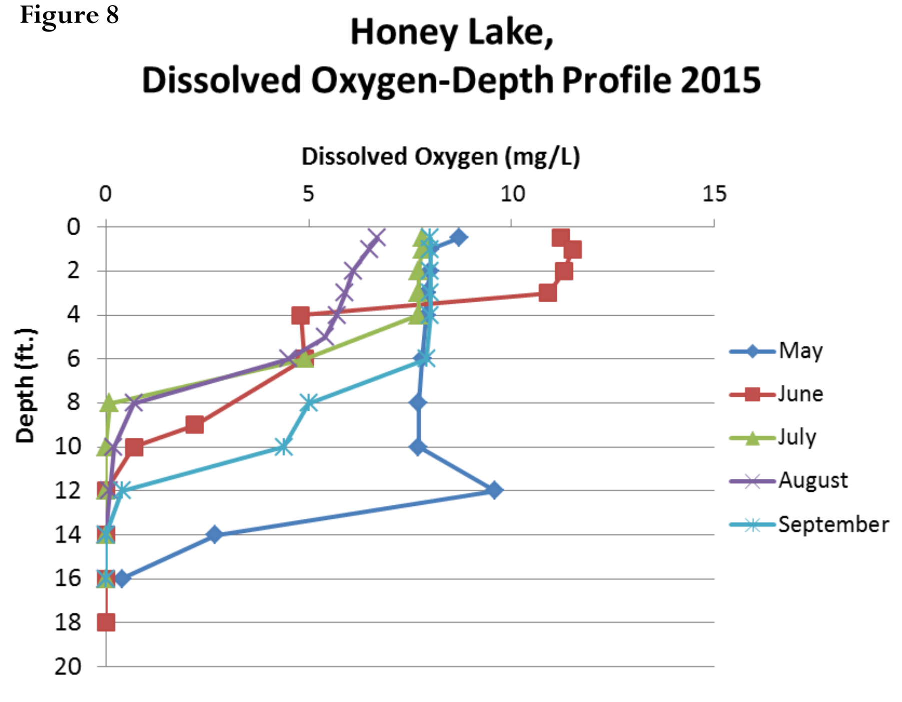


Schematic of stratification in Honey Lake, 2015

DISSOLVED OXYGEN

Dissolved oxygen (DO) concentrations were measured by taking depth profiles on Honey Lake (Figure 8). DO dropped below 5.0 mg/L at depths greater than 12 ft. (May), 3 ft. (June), 4 ft. (July), 5 ft. (August), and 6 ft. (September). When oxygen drops below 5mg/L it can stress aquatic life, meaning the fisheries may be restricted to the epiliminion of Honey Lake and not able to use the deep portion. Honey Lake did reach anoxic conditions, where dissolved oxygen drops below 1 mg/L, from May—September. Anoxic conditions occurred at depths greater than 14 ft. (May) , 9 ft. (June), 8 ft. (July) and 8 ft. (August) and 12 ft. (September). Under anaerobic conditions, phosphorus releases from bottom sediments into the water column becoming a source of phosphorus entering the lake.

Figure 8



The dissolved oxygen depth profile on Honey Lake shows that anoxic conditions (<1 mg/L) are reached throughout the monitoring season. Additionally, DO dropped below 5 mg/L at depths greater than 16 ft.; which may restrict fisheries to the epliminion of Honey Lake.

LAKE LEVELS

Lakes with stable water levels potentially have less shoreline erosion problems. Water levels on Honey Lake are primarily impacted by precipitation and runoff. Lake level was measured monthly during water quality sampling. Lake level is measured off of a permanent structure. In Honey Lake, that structure was a bird house near the beach. Lake level was measured from the bottom of the birdhouse to the top of the lake.

During the monitoring season (May - September), lake levels only fluctuated at most 4 inches. The lowest lake level occurred in August (49.8 inches) and the highest was in June (45 inches). The high lake levels in June corresponds with the significant rainfalls experienced during the month. The installation of a staff gauge can be beneficial to better monitor lake level fluctuations.

Month	Level (inches)	Seasonal Change (in)	Monthly Change (in)
May	48		
June	45	-3	-3
July	49.2	1.2	4.2
August	49.8	1.8	0.6
September	47.28	-0.72	-2.52

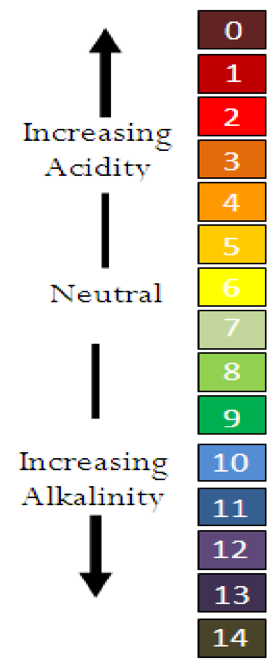
ALKALINITY AND PH

Alkalinity is the buffering capacity of a water body. It measures the ability of water bodies to neutralize acids and bases to maintain a stable pH. In a lake, alkalinity acts to buffer lakes from the effects of acid rain. Alkalinity comes from rocks, soils, salts, and certain plant activities. If a lakes watershed contains large quantities of calcium carbonate (CaCO3, limestone), the surface waters tend to be more alkaline.; while granite bedrock does not have high amounts of CaCO3 and therefore lacks alkaline materials to buffer acidic inputs.

pH is a measure of the hydrogen ion concentration of water. As the hydrogen ions are removed, pH goes up or halts its decline. A well buffered lake also means that daily fluctuations of CO2 concentrations result in only minor changes in pH throughout the day. Aquatic organisms benefit from stable pH. Each organism has an ideal pH threshold, but most aquatic organisms prefer pH of 6.5—8.0. pH values <6.5 or >9.0 cause a water quality impairment.

In 2015, the average alkalinity (CaCO3) concentration in Honey Lake was 187 mg/L, which is above the Lake County median of 163 mg/L. The USEPA considers lakes with CaCO3 concentrations greater than 20 mg/L to not be sensitive to acidification.

Honey Lake's average pH in 2015 was 8.25, which is slightly below the Lake County median of 8.33 but remains within an adequate pH value for most aquatic organisms.

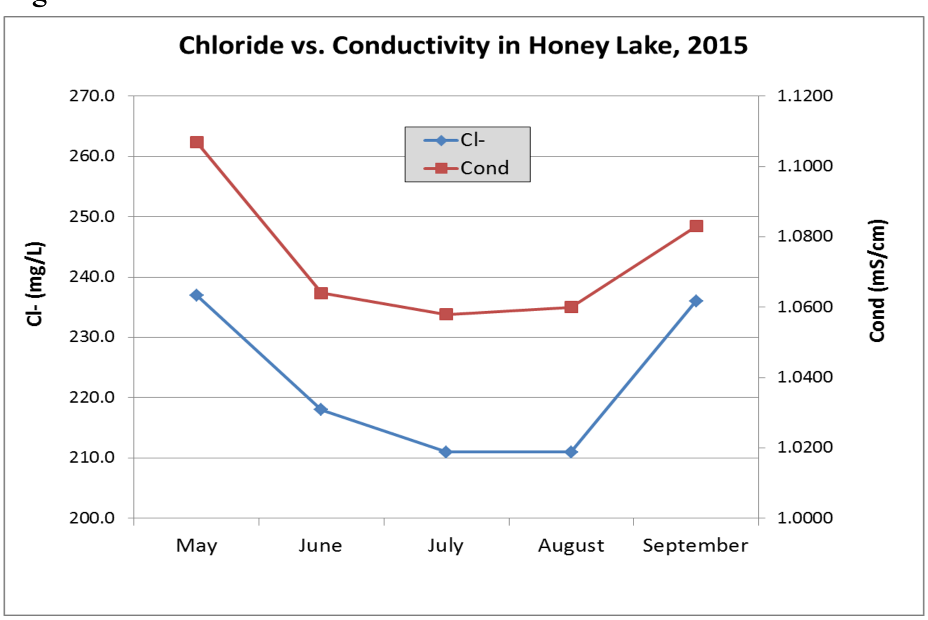


The pH scale ranges from 0 to 14. A pH of 7 is considered neutral. Substances with a pH of less than 7 are acidic, and greater than 7 are basic.

CONDUCTIVITY

Another parameter measured during the 2015 monitoring season 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, size of the watershed flowing into the lake, the land use, evaporation, and bacterial activity. Conductivity in urban areas has been shown to be highly correlated with chloride ions found in road salt mixes (Figure 9). In 2015, Honey Lake's average conductivity reading was 1.074 mS/cm which is above the lake county median of 0.7920 mS/cm. Conductivity has decreased since the 2008 monitoring by LCHD-ES.

Figure 9



CHLORIDES

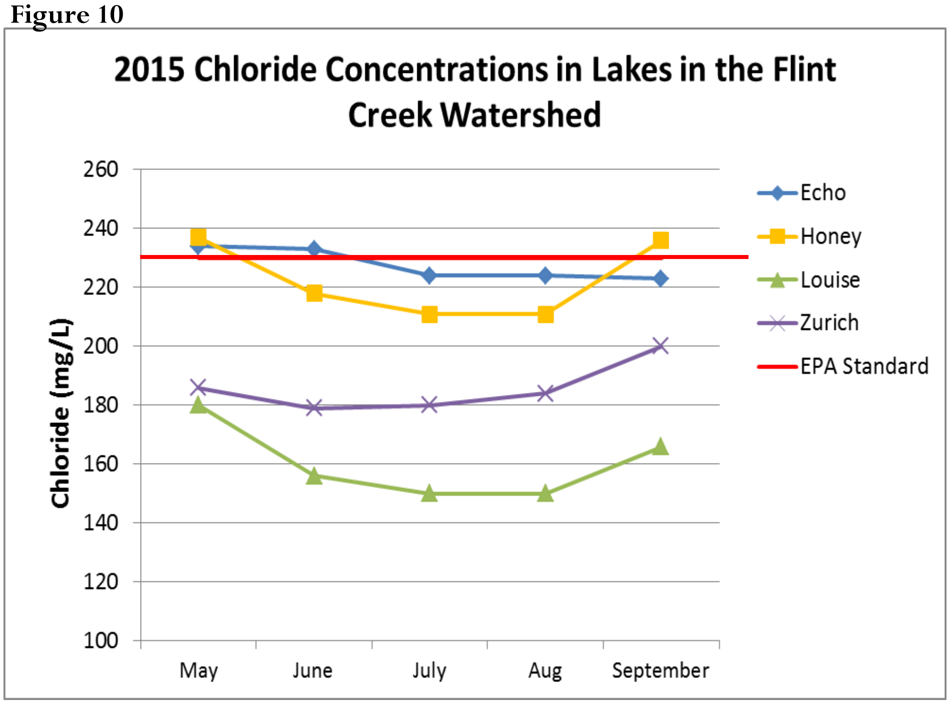
One of the most common dissolved solids is road salt used in winter road deicing. Most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocynaide salts. Honey Lake's chloride concentration was 223 mg/L which is well above the Lake County median of 139 mg/L. The United States Environmental Protection agency has determined that chloride concentrations higher than 230 mg/L can disrupt aquatic systems. Honey Lake exceeded that 230 mg/L in May and September. This was an improvement since 2008 when the chloride concentration averages 296 mg/L. Chloride ions do not break down and accumulate within a watershed. High chloride concentrations may make it difficult for many of our native plant species to survive while many of our invasive species such as Eurasian Watermilfoil, Cattail, and Common Reed are tolerant to high chloride levels.

The LCHD-ES and Lake County Stormwater Management Commission (LCSMC) have been holding annual training sessions targeting deicing maintenance personnel for both public and private entities to hopefully reduce the amount of chloride being introduced into our environment while maintaining safe passageways. Almost all deicing products contain chloride so it is important to read an follow product labels for proper application. For instance, at 10°F Fahrenheit, rock salt is not at all effective in melting ice and will blow away before it melts anything. The Flint Creek Watershed had a range of chloride values in the 2015 sampling season from the lowest concentration in Lake Louise (160.4 mg/L) and the highest at Echo Lake (228 mg/L) (Figure 9). It appears that road salt is compounding in many lakes in the county with conductivity and chloride readings increasing.

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.

Figure 10



ICE FACTS

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

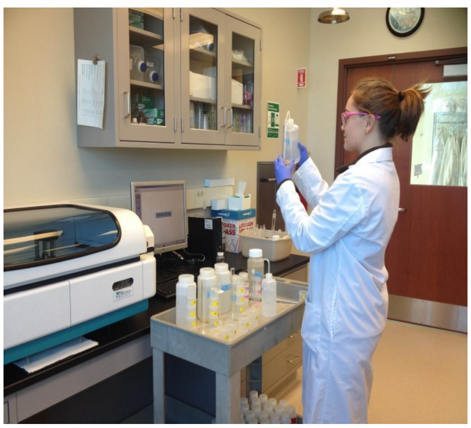
Pavement Temp (F)	One Pound of Salt (NaCl) melts	Melt times
30	46.3 lbs. of ice	5 min.
25	14.4 lbs. of ice	10 min.
20	8.6 lbs. of ice	20 min.
15	6.3 lbs. of ice	1 hour
10	4.9 lbs. of ice	Dry salt is ineffective and will blow away before it melts anything

BEACHES

There is one state licensed swimming beach on Honey Lake at Biltmore Country Club. This beach has been monitored every two weeks from mid May to the end of August by LCHD-ES . 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, Salmonella, Giardia, etc.

In 2015, Biltmore Country Club beach had no closures related to bacteria.

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. Stormwater from rain can also wash in other particles from lawns, streets, and buildings. This sediment and stormwater may contain high concentrations of E. coli. Another source of E. coli contamination is the feces of gulls, geese, and other wildlife.



HOW TO PREVENT ILLNESS AND BEACH CLOSURE

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

- If you are sick or have diarrhea, do NOT swim.
- Do NOT drink the water while swimming.
- Avoid swimming during heavy algae blooms.
- Keep pets, ducks, and geese out of the beach area
- 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.

HARMFUL ALGAL BLOOMS

Algae are important to freshwater ecosystems and most species of algae are not harmful. Algae can grow quickly in water and is often associated with increased concentrations of nutrients such as nitrogen and phosphorus. Blue-green algae, or "cyanobacteria" are a type of algae that can bloom and produce toxins, hence termed HAB's (harmful algal blooms). HABs are similar to bacteria in structure but utilize photosynthesis to grow. However, their presence does not mean that toxins are present. It is still unclear what triggers HABs to produce the toxins. Due to the potential presence of toxins, the IEPA and the LCHD have initiated a program to collect HABs from beaches and test for presence of microcystin, a common toxin produced by HABs.

In 2015, there were no significant blue-green blooms noticed during sampling or reported by homeowner associations on Honey Lake.

Phosphorus and nitrogen fuel algal growth. HAB's additionally can fix atmospheric nitrogen as well as utilize other forms. It becomes important to maintain or control nutrients inputs for this reason. Honey Lake has low nutrient levels and a healthy plant community. Maintaining a healthy plant community and reducing nutrient input will help keep blue-green algae away in Honey lake. Blooms should always be reported to LCHD-ES to be tested for toxins.

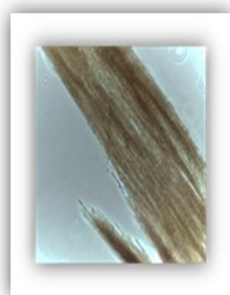
For More Information On Blue-green algae:
www.epa.state.il.us/water/surface-water/blue-green-algae.html

To report blue-green algae bloom:
Lake County Health Department 847-377-8030

For more information or to report a blue-green algae bloom, contact the Lake County Health Department Environmental Services (847) 377-8030.

Anabaena Sp.

Microcystis Sp.



Aphanizomenon Sp.

BATHYMETRIC MAPS PROVIDE LAKE MANAGERS WITH AN ACCURATE LAKE VOLUME THAT CAN BE USED FOR HERBICIDE APPLICATION AND HELP ANGLERS FIND POTENTIAL FISHING SPOTS.

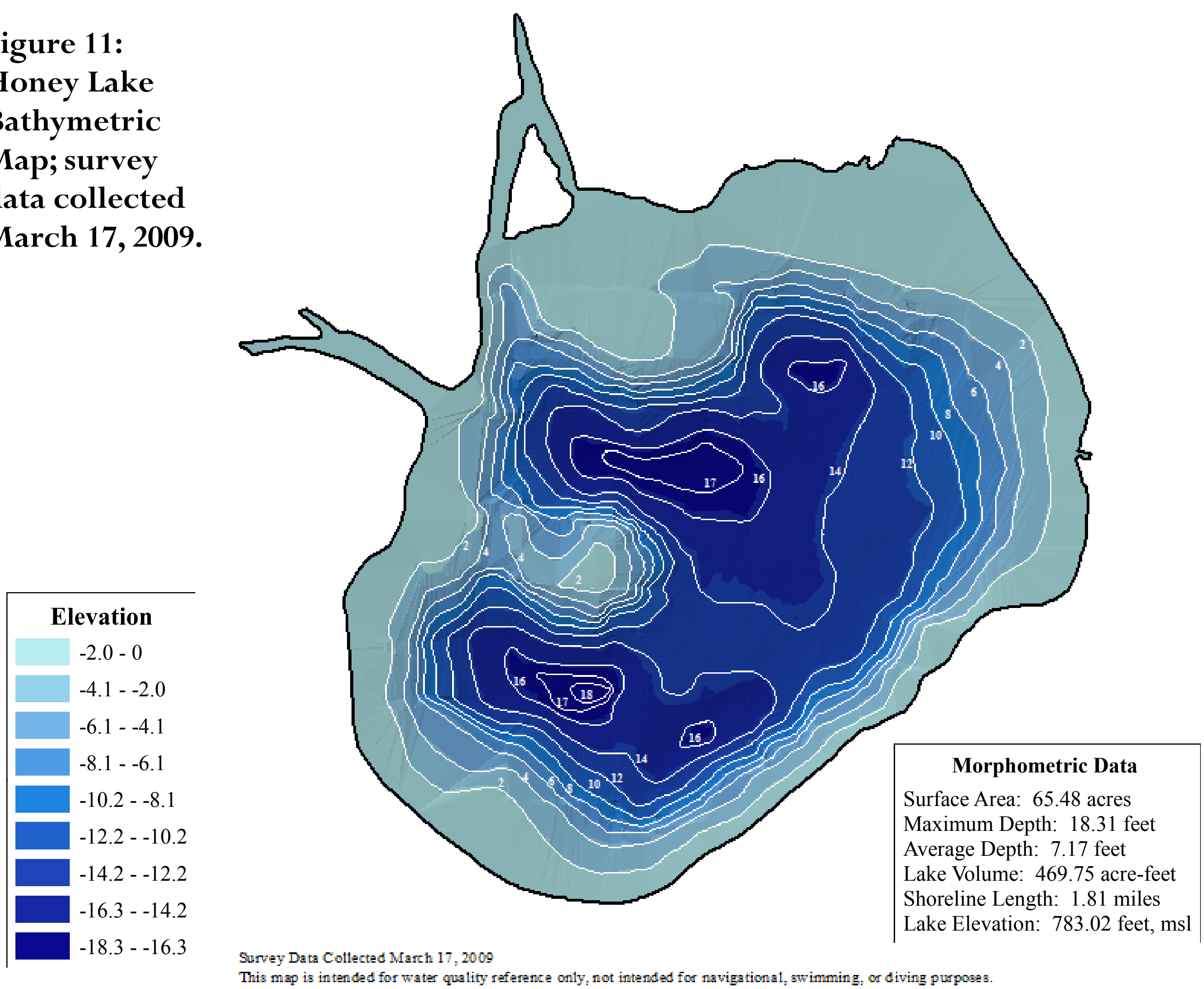
BATHYMETRIC MAPS

Bathymetric maps are also known as depth contour maps and display the shape and depth of a lake. They are valuable tools for lake managers because they provide information about the surface area and volume of the lake at certain depths. This information can then be used to determine the volume of lake that goes anoxic, how much of the lake bottom can be inhabited by plants, and is essential in the application of whole-lake herbicide treatments, harvesting activities and alum treatments of your lake. Other common uses for the map include sedimentation control, fish stocking, and habitat management.

The LCHD-ES collects field data for bathymetrics using a Lowrance HDS-5 Gen2; Lowrance cites accuracy measures of approximately 5m however actual acrruacy is typically better than this conservative estimate and has been discovered to be sub-meter (CIBiobase,2013). Once collected, the data was analyzed and imported into ArcGiS 10.2 for further analysis. In ArcGIS 10.2, the contours and volumes were generated from the triangular irregular network (TIN).

Honey Lake had a bathymetric map conducted by LCHD-ES in 2009 (Figure 11). LCHD-ES recommends bathymetric maps be updated every 10 years as the maps and their corresponding morphometric data are useful tools for assisting lake managers to make decisions about their lake such as fish habitat, plant management, etc.

Figure 11: Honey Lake Bathymetric Map; survey data collected March 17, 2009.



SHORELINE EROSION

Erosion is a natural process primarily caused by water resulting in the loss of material from the shoreline. Disturbed shorelines caused by human activity such as clearing of vegetation and beach rocks, and increasing runoff will accelerate erosion. Eroded materials cause turbidity, sedimentation, nutrients, and pollutants to enter a lake. Excess nutrients are the primary cause of algal blooms and increased aquatic plant growth. Once in the lake, sediments, nutrients and pollutants are harder and more expensive to remove.

A shoreline erosion study was assessed for Honey Lake in 2015 (Figure 11). Honey Lake was divided into reaches, and the shoreline evaluated for none, slight, moderate and severe erosion based on exposed soil and tree/plant roots, failing infrastructure, undercut banks, and other signs of erosion. Based on the 2015 data, 17% of Honey Lake's shoreline has some degree of erosion; with 12% being slight erosion and 5% being moderate erosion (Appendix B). This is an increase since the 2008 sampling, which only had 3% of the shoreline being eroding. A majority of the shoreline had good buffer strip and native vegetation that helped prevent erosion. Fixing areas with slight erosion are recommended as it is most cost efficient. As erosion worsens, it becomes more expensive to fix.

Figure 12: Shoreline Erosion Condition in Honey Lake, 2015

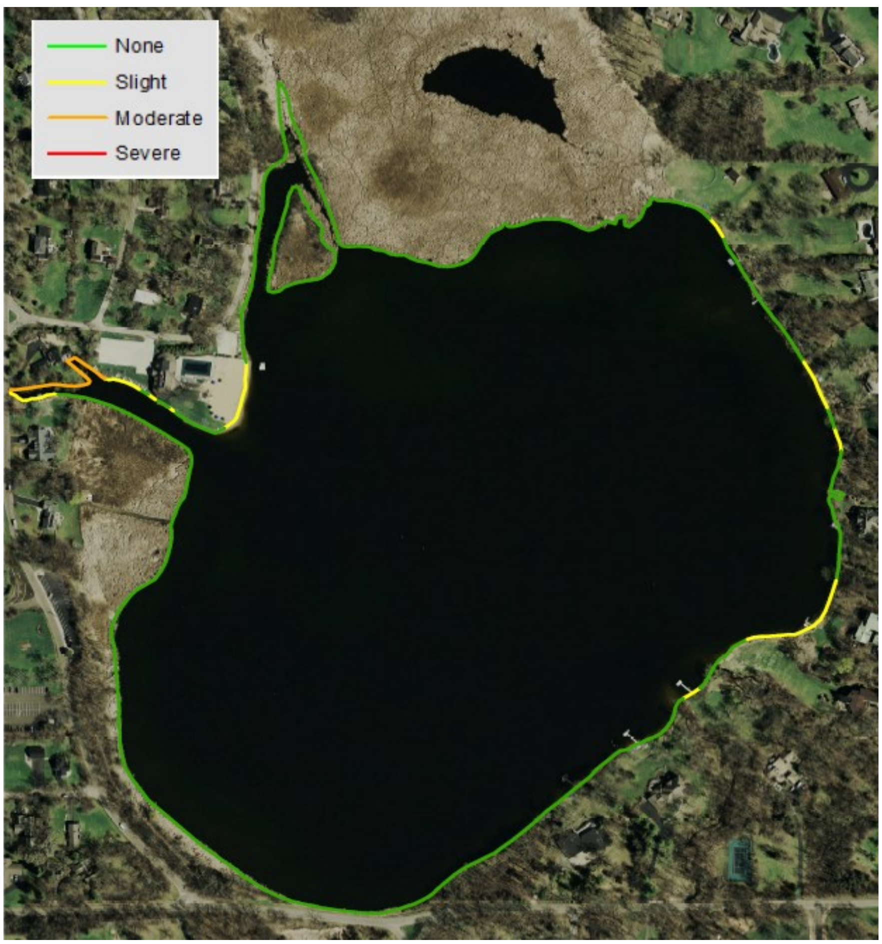


Table 4. Shoreline Erosion Condition in Honey Lake, 2015

Erosion Condition	Linear ft.	% of Total Shoreline
None	7966	83%
Slight	1146	12%
Moderate	439	5%
Severe	0	0%
Total	9551	100%

SHORELAND BUFFERS

Poor		Fa
Linear ft.	% Reach	Linear ft.
6695	39%	5900

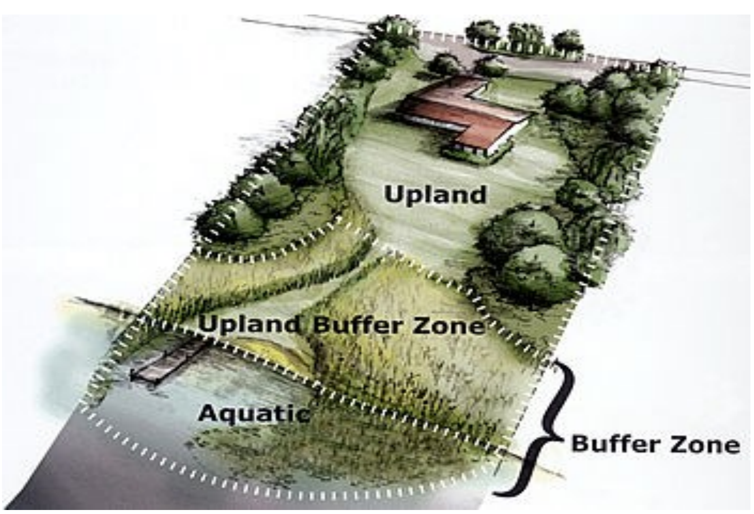
Many properties along the lake have manicured lawn and turf up to the lakes edge. Replacing lawn and turf grass at the shoreline with a buffer strip containing native deep-rooted plants will help with erosion and add wildlife habitat. A shoreland buffer helps stabilize the sediment near the lakes edge which prevents soil erosion. The buffer will also filter out pollutants and unwanted nutrients from entering the lake.

Buffer strips should be at least 25 feet wide and can include native wildflowers, native grasses, and native wetland plants. Wider buffers may be needed for areas with a greater slope or additional runoff issues. Areas that are already severely or moderately eroding, a buffer strip of native plants may need to be bolstered for additional stability. A concern with shoreland buffers is often that it may limit access to the lakefront. A smaller mowed path to the shoreline can still allow access to the lake while not interrupting the integrity of the buffer strip. The mowed path for lake access should be kept at least 6 inches tall and not more than 6 feet wide. Buffers do not have to block the view of the lake as there are many colorful, low-growing plants that can be incorporated in the buffer strip and will provide all the benefits of improved water quality.

A shoreland buffer condition of Honey Lake was assessed by looking at the land within 25 feet of the lake's edge on aerial images in ArcGIS. Shoreland buffer's were classified into three categories; poor, fair or good based on the amount of unmowed grasses, forbs, tree trunks and shrubs, and impervious surfaces within that 25 foot range. In 2015, Honey Lake had 40% of the shoreline with poor buffer, 9% with fair, and 51% with good (Appendix B). The natural wetland plants around Honey Lake provide a good buffer condition. It is recommended that Honey Lake encourage homeowners to plant shoreland buffers along their lakeshore property for areas with poor

Table 5: Shoreland Buffer Condition on Honey Lake, 2015

Poor		Fair		Good		Total
Linear ft.	% Reach	Linear ft.	% Reach	Linear ft.	% Reach	ft.
3820	40%	874	9%	4855	51%	9551



Vertical seawalls can reflect wave energy

Rip rap with a native plant buffer

Buffer strip between upland area and lake edge

"VEGETATIVE BUFFER ZONES CAN PLAY A KEY ROLE IN LIMITING NEGATIVE WATER QUALITY IMPACTS FROM DEVELOPED SHORELAND PROPERTY"

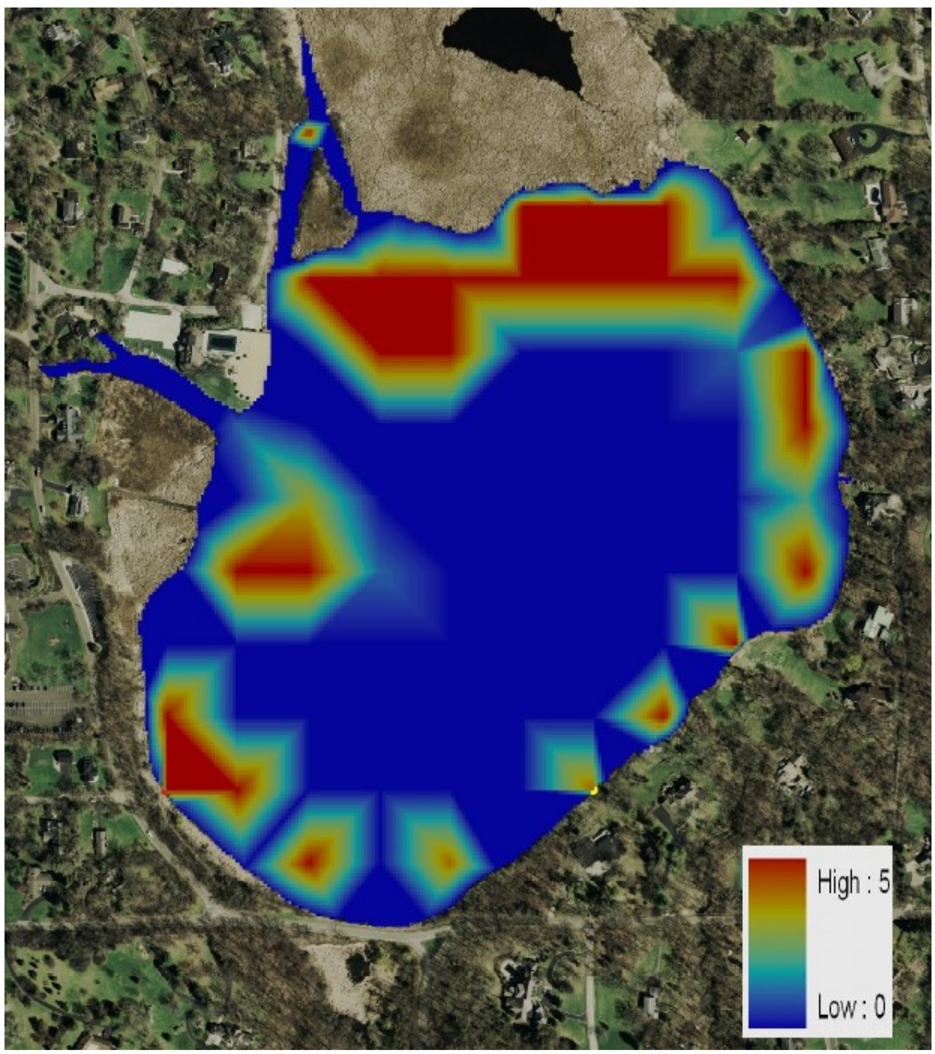
AQUATIC PLANTS

Aquatic plants are a critical feature in lakes as they compete against algae for nutrients, improve water quality and provide fish habitat for nesting and nursery. **Their presence is natural and normal in lakes.** An aquatic vegetation survey was conducted on Honey Lake in July 2015. There were 73 points generated based on a 60-meter computer grid system that were assessed. During the July survey when most aquatic plants are growing, plants occurred at 31 of the 73 sites (42.5% total lake coverage) with plants found at depths up to 5.6 feet. There were a total of 9 aquatic plant species and chara, a macro-algae found in the lake. The most dominant species found in Honey Lake were Coontail, White Water Lily, and Chara (Appendix B).

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 surface light level, plants can no longer grow. 1% surface light level is roughly at 2 times the average Secchi depth or can be measured with a photosynthetically active radiation (PAR) sensor. For Honey Lake, the 1% light level based on PAR sensor averages approximately 8 ft. There was an overall decrease in aquatic plant species found in 2015 since the 2008 sampling. Plants that were observed in 2008 that were not observed in 2015 include: Common Bladderwort, Curlyleaf Pondweed, Northern Watermilfoil, Spiny Naiad and Whitewater Crowfoot. While Curlyleaf Pondweed was not noted in the 2015 survey, this invasive species has an earlier life cycle than other native plants, and it is possible that our July survey missed it during it's max growing season.

Figure 13: Overall plant rank density for all species on Honey Lake, July 2015

Rake Density (coverage)	# of Points	% of Sites
No Plants	42	57.5%
>0-10%	3	4.1%
10-40%	1	1.4%
40-60%	1	1.4%
60-90%	2	2.7%
>90%	24	32.9%
Total Sites with Plants	31	42.5%
Total # of Sites	73	100.0%



AQUATIC PLANTS (CONTINUED)

Aquatic plants provide many water quality benefits and play an important role in the lakes ecosystem by providing habitat for fish and shelter for aquatic organism. Plants provide oxygen, reduce nutrients such as phosphorus to prevent algae blooms, and help stabilize sediment. A native plant community tends to be diverse and usually does not impede lake activities such as boating, swimming and fishing.

Common Plants found in Honey Lake, 2015

COONTAIL

CERATOPHYLLUM DEMERSUM

OVERWINTERS AS A EVERGREEN PLANT, IT PROVIDES IMPORTANT HABITAT TO MANY INVERTEBRATES AND FISH.

WHITE WATER LILY

NYMPHAEA TUBEROSA

ROUND, LEAF SLIT ON ONE SIDE ATTACHES TO ROUND STEM WHICH CONTAINS AIR PASSAGEWAYS

CHARA (MACRO-ALGAE)

Chara

BRANCHES USUALLY COVERED WITH CALCIUM CARBONATE GIVING GRITTY FEEL

Table 2. plant species found in Honey Lake

Plants 2015	Plants 2008
Chara	*Common Bladderwort*
Coontail	*Chara*
Duckweed	*Coontail*
Flatstem Pondweed	*Curlyleaf Pondweed*
Sago Pondweed	*Duckweed*
Spadderdock	*Flatstem Pondweed*
Star Duckweed	*Northern Watermilfoil*
Water Stargrass	*Sago Pondweed*
Watermeal	*Spadderdock*
White Water Lily	*Spiny Naiad*
	Star Duckweed
	Whitewater Crowfoot
	Watermeal
	Water Stargrass
	White Water Lily

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 lay flat on the water surface.

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

AQUATIC PLANTS AND FISH

Fish depend on aquatic plants to provide habitat and forage for food and most freshwater fish rely on aquatic plants at some point during their life stage. The plant composition and density can play an important role in the nesting, growth, and foraging success of these fish. While many fish require some aquatic vegetation for growth, excessive amounts of aquatic vegetation can negatively impact growth by reducing foraging success. The parameters of an ideal fish habitat change base on the size and species of fish, the type of lake, structures present in the lake and man other factors. The Illinois Department of Natural Resources (IDNR) last conducted a fish survey on Honey Lake in 1999. The survey consisted of 60 minutes of electrofishing and overnight sets of two trapnets. A total of 143 fish representing nine species were collected (Table 6).

How do plants impact fish?

- *Plants provide critical structure to aquatic habitats.*
- *Plants influence growth of fish by enhancing fish diversity, feeding, growth, and reproduction.*
- *Plants influence spawning. The structure provided by plant beds is important to fish reproduction.*
- *Plants influence the physical environment. Aquatic plants can change water temperatures and available oxygen in habitats.*

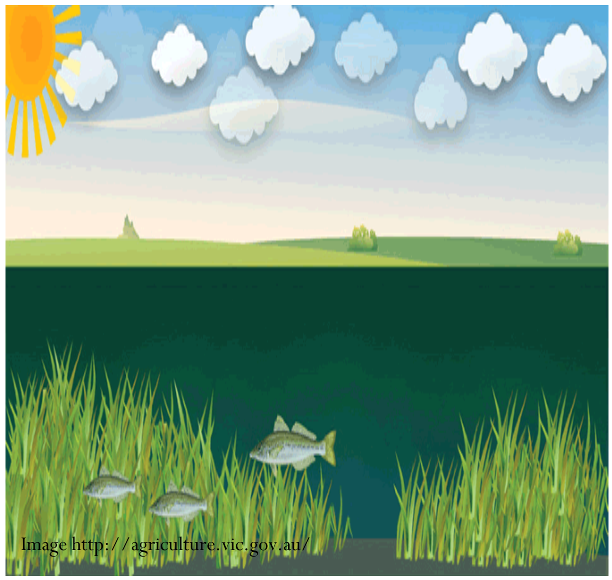


Table 6: IDNR Survey

Fish Species	%
Bluegill	67%
Pumpkinseed	8%
Largemouth Bass	7%
Brown Bullhead	6%
Black Crappie	6%
Yellow Bullhead	3%
Northern Pike	1%
Common Carp	1%
Walleye	1%

Table 7. Common fish and their plant affinity during various life stages and their relationship with plants

		Life Stage				Relationship	
Fish	**Plant Affinity**	**Larvae**	**Juvenile**	**Adult**	**Spawn**	**Forage**	**Predator avoidance**
Bluegill sunfish	High	X	X	X	X	X	X
Common carp	High	X	X	X	X	X	X
Largemouth bass	High	X	X	X	X	X	X
Musky	High	X	X	X	X	X	X
Northern Pike	High	X	X	X	X	X	X
Black crappie	Moderate		X	X	X	X	X
Smallmouth bass	Moderate		X	X		X	X
Yellow perch	Moderate	X	X			X	X
White crappie	Low		X			X	
Salmon, trout	Low		X				X
Shad	Low	X					
Walleye	Low			X		X	

Table adapted from Gettys, Lynn, William T. Haller and Marc Bellaud. “Biology and Control of Aquatic Plants: A Best Management Practices Handbook”. 2009

FLORISTIC QUALITY INDEX

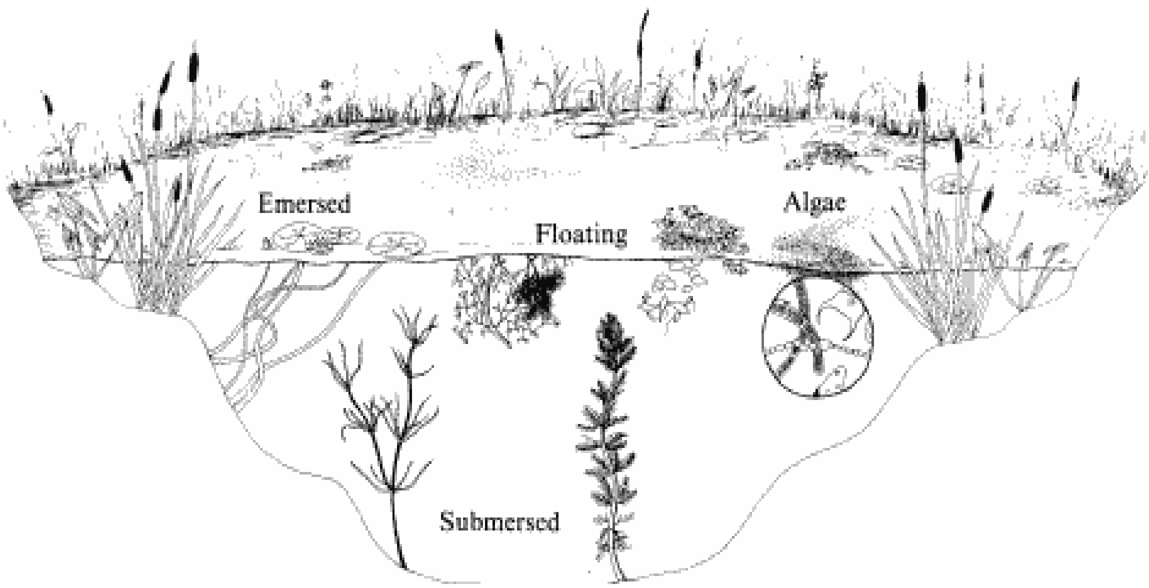
Floristic quality index (FQI) is an assessment tool designed to evaluate how close the flora of an area is compared to one of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site 3) monitor long-term 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 submerged plant species found in the lake. The 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 are present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The median FQI for Lake County lakes from 2000-2015 was 13.4. Honey Lake had an FQI value of 20.0 ranking 35 out of 170 lakes in Lake County (Appendix A) which shows high plant diversity for the county. 9 aquatic plant species were observed and Chara (a macro-algae). Development of an Aquatic Plant Management Plan (APMP) should take into consideration maintaining high level of aquatic biodiversity and controlling invasive species.

Lake county Average
FQI = 13.4

Honey lake
FQI = 20.0

Rank = 35/170

Aquatic Plants Species Observed = 9



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.
- Aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available nutrients.

AQUATIC HERBICIDES

Aquatic herbicides are used to reduce the abundance of invasive species, help maintain a healthy native plant community that is beneficial for fish and other aquatic organisms, to improve navigational access to lakes and rivers to make boat navigation safe, and to control nuisance plant and algae growth that can pose a hazard to swimmers. Herbicides are chemical pesticides used to disrupt the growth cycle of plants, and typically work by inhibiting photosynthesis from occurring within the plant. Each herbicides will impact vegetation differently. In 2015, Honey Lake treated in late April in the beach and channel area of the lake with Aquathol K and Cutrine Plus. Additionally, the lake was treated in the same areas in May with Cutrine Plus. Understanding herbicide use is essential for beneficial results in lake management. For more information about common herbicides, refer to the Wisconsin of DNR Fact Sheets located in Appendix D. Below is a brief summary of the two chemicals used in 2015.

Aquathol K is an endothall dipotassium salt. Endothall is considered a contact herbicide and works by preventing certain plants from making the proteins they need. Endothall products vary somewhat in the target species they control so it is important to always check the product label for the list of species that it may affect. Endothall is effective on Eurasian watermilfoil and also kills desirable native species such as pondweeds and coontail. Since Endothall may impact desirable native species, careful identification of plants before treatment and application of endothall products is necessary. At the recommended rats, there is no apparent short-term effects on the fish species that have been tested.

Cutrine– Plus is copper compound product that is primarily used to treat algae. Large scale algae die-off can deplete oxygen levels in the water, which can be lethal to fish and other aquatic life. If more than 1/3 of the total water area is covered in algae, treatments should be done in sections. Copper products will treat blue-green (free-floating) algae and filamentous (mat-forming) algae as well as larger algae species that look like plants such as Chara. All copper formulations can be toxic to some species of fish at recommended application rates– especially if the water has less than 50 ppm of carbonate hardness, however toxicity generally decreases as water hardness increases.

Systemic herbicides:
absorbed and transported throughout the plant, killing the entire plant including the roots.

Contact herbicides:
only kill the portions of the plant in which the chemical comes into contact with.

Non-selective:
will kill or injure a wide variety of plant species

Selective:
effective on only certain plant species

Table 8 shows plant susceptibility to Aquathol K. For a complete table of plant susceptibility, refer to Appendix D.

Plant Susceptibility	Endothall Dipotassium Salt
FLOATING LEAF	
Waterlily	Good
Spattderdock	Good
Watershield	Good
FREE FLOATING	
Duckweed	Fair
Giant Duckweed	
Watermeal	

Plant Susceptibility	Endothall Dipotassium Salt
SUBMERSED	
Bladderworts	
Coontail	Excellent
Elodea	Excellent
Eurasian Watermilfoil	Excellent
Hydrilla	Good
Naiads	Excellent
Pondweeds	Excellent
Water Celery	

AQUATIC HERBICIDES

NEW PERMIT REQUIREMENTS FOR APPLYING PESTICIDES IN WATERS

A National Pesticide Elimination System (NPDES) permit is required when pesticides are applied to, over or near the waters of the State. This permit applies to all public waters that have an outflow to the State waters. If an individual is applying the herbicide, they must fill it out. If you contract with an applicator, they can apply for NPDES coverage. A Notice of Intent (NOI) must be filled and submitted electronically to the Illinois Environmental Protection Agency (IEPA) at least 14 days prior to any application of pesticides. You can find the application at the website listed on the right.

FOR FULL DETAILS OF THE RULE SEE:

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

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

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

Is anything else needed besides the permit?

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

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

REQUEST FOR SERVICE (RFP)

A key to a healthy lake is a well-balanced aquatic plant population. Aquatic plants compete with algae for nutrients and stabilize bottom substrate, which in turn improves water clarity. Putting together a good aquatic plant management plan should not be rushed. The plan should be based on the management goals of the lake and involve usage issues, habitat maintenance/restoration, and limitations of the lake. Follow up is critical for an aquatic plant management plan to achieve long-term success. A good aquatic plant management plan considers both the short and long-term needs of the lake.

Putting together a good aquatic plant management plan should include a Request for Proposal (RFP). The RPF for aquatic plants ensures lake managers are able simultaneously distribute bids to qualified vendors with type of services, the frequency of needs, budget allocation and the length of the contract terms to get competitive prices.

In order to establish a plant management goal, a pre-treatment survey is necessary to identify the location, density and diversity of the aquatic plants in your lake. Set your goals within your budget and targeting areas that meets recommendations for maintaining the viability of the lake.

A pretreatment survey of your lakes aquatic plants is necessary prior to sending out a bid for your lakes survey. This will help determine success of controls and locate potential treatment areas.

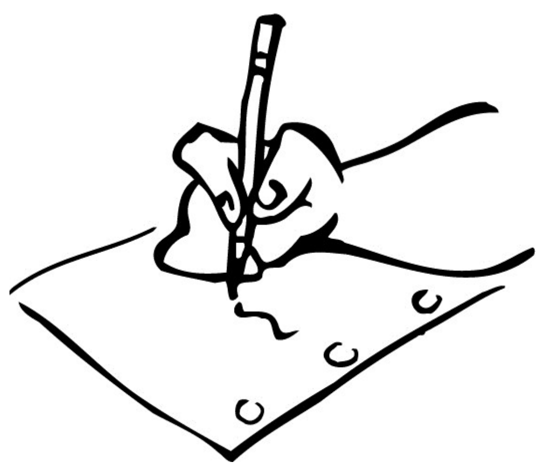
LAKE MANAGEMENT PLANS

It is recommended that a long term Lake Management Plans be developed to effectively manage lake issues. All stakeholders should participate in the development of the plan and include homeowners, recreational users, lake management associations, park districts, townships or any other entity involved in managing Honey Lake. Lake Management plans should educate the public about specific lake issues, provide a concise assessment of the problem, outline methods and techniques that will be employed to control the problems and clearly define the goals of the program. Mechanisms for monitoring and evaluation should be developed as well and information gathered during these efforts should be used to implement management efforts (Biology and Control of Aquatic Plants, Gettys et al., 2009)

What are the steps in creating a Lake Management Plan?

1. **Getting Started**: Identify lake stakeholders and communication pathways
2. **Setting Goals:** Getting the effort organized, identifying problems to be addressed, and agreeing on the goals
3. **Problem Assessment & Analysis**: collecting baseline information to define the past and existing conditions. Synthesize the information, quantifying and comparing the current conditions to desired conditions, researching opportunities and constraints and setting direction to achieve goals.
4. **Alternatives:** List all possible management alternatives and evaluate their strengths, weakness, and general feasibility.
5. **Recommendations:** Prioritize management options, setting objectives and drafting the plan
6. **Project Management:** Management of assets, detailed records of expenses and time
7. **Implementation:** adopting the plan, lining up funding, and scheduling activities for taking action to achieve goals.
8. **Monitor & Modify:** Develop a mechanism for tracking activities and adjusting the plan as it evolves.

Follow these steps when getting started with writing Lake Management Plans. While each step is necessary, the level of effort and detail for each step will vary depending on the project's goals, size of the lake, and number of stakeholders.



Aquatic invasive species

Aquatic invasive species (AIS) are species that are typically not native to Illinois and cause economic or environmental harm, or harm to human health. Illinois has a number of invasive species with the most common including: common carp, grass carp, and zebra mussels. The most common aquatic invasive plants include Curlyleaf Pondweed and Eurasian Watermilfoil. Water recreation is a main transport of AIS, as these species can get transported from boats or trailers and then introduced into the water. Exotic species usually outcompete habitat of native species and are more tolerant to variations in water quality. Honey lake has had issues with Curlyleaf Pondweed in the past and the last fish survey has noted carp. Lake users should keep an eye out for presence of these other invasive.

Zebra mussels are small, fingernail-sized mollusks originally native to eastern Europe and western Asia. Zebra mussels were most likely introduced to North America in 1985 or 1986 by ballast water of ships that traveled across the Atlantic and emptied their ballast in the Great Lakes ports. Zebra mussels spread by attaching to boats, nets, docks, swim platforms, boat lifts, and can be moved on any of these objects. They also can attach to aquatic plants which are often transported accidently when they become entangled on the boat parts. Microscopic larvae (called veligers) can also be carried in water contained in bait buckets, bilges, or any other water removed from an infested lake. Zebra mussels have damaged natural ecosystems, industrial infrastructure and recreational equipment including boats and motors.

Curlyleaf pondweed (CLP) is an invasive aquatic perennial that is native to Eurasia, Africa, and Australia. It was accidently introduced to the United States water in the mid-1880's by hobbyists who use it as an aquarium plant. Unlike our native pondweeds, Curlyleaf Pondweed begins growing in the early spring. The vegetative part of the plant dies back completely in early summer and only seeds and turions remain over summer. The turions (which are the main source of reproduction in CLP) sprout in fall, and are rapidly able to elongate in spring after ice melts as temperatures reach 5°C. 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 mid-summer, CLP plants usually die back which is typically followed by an increase in phosphorus availability that may fuel nuisance algal blooms.

Eurasian Watermilfoil (EWM) is an invasive, submersed aquatic plant accidently introduced in the 1940s to North America from Europe from the aquarium trade. Eurasian watermilfoil can reproduce through stem fragmentation and runners meaning a single segment of stem and leaves can take root and form an entire new colony. Removing native vegetation allows for EWM to overtake a lake. EWM can have a difficult time becoming established in lakes with well established populations of native plants. EWM can be controlled using aquatically approved herbicides, mechanical (i.e. harvester or cutter) methods, or biological controls (i.e. weevil). In the Fox Chain O'Lakes, a Letter Of Permission (LOP) from the IDNR is required for any aquatic plant management (see Pesticides section). Aquatic management methods for EWM that cause as little damage to native aquatic plants as possible are encouraged and early season treatments will have the least impact on native populations.

AQUATIC INVASIVE SPECIES (CONTINUED)

CARP (CYPRINUS CARPIO)

The last fish survey conducted by the IDNR in 1999 identified carp in Honey Lake at <1% of the fish species present. Carp are considered to be one of the most damaging invasive fish species. Originally introduced to the Midwest waters in the 1800's as a food fish, carp can now be found in 48 States. In the U.S., the common carp is more abundant in manmade impoundments, lakes, and turbid sluggish streams and less abundant in clear waters or streams with a high gradient. They are also highly tolerant of poor water quality.

The common carp has a dark copper-gold back with sides that are lighter, a yellowish belly and olive fins. They have 2 pairs of short barbells on their upper lip and their dorsal and anal fins have a leading spine that are serrated. They spawn from early spring to late summer in water ranging from 15 – 28 C and prefer freshly flooded vegetation as spawning substrate. They prefer to spawn in shallow weedy areas in groups consisting of one female and several males. A single female can produce up to 100,000-500,000 which hatch in 5-8 days. The spawning ritual involves a lot of thrashing in shallow water contributing to turbidity problems. Many eggs succumb to predation, fungus, and bacteria.

Carp are omnivorous and feed over soft bottom substrate where they suck up silt and filter out crustaceans, insect larvae and other desirable food items. Carp are very active when feeding and can be observed around shallow areas where they uproot plants which increases turbidity and nutrient concentrations. Increase in nutrients causes algal blooms and reduction in light penetration that impacts aquatic plants. This can be particularly a problem in shallow lakes, or lakes that do not stratify, allowing nutrients to easily cycle throughout the water column.

Carp spawning and feeding can both cause increase in turbidity, especially in shallow waters where they uproot plants, and resuspend bottom sediments

Actions you take as a responsible boater are critical in preventing the spread of invasive species in Lake County. Remember, before leaving a lake or river:

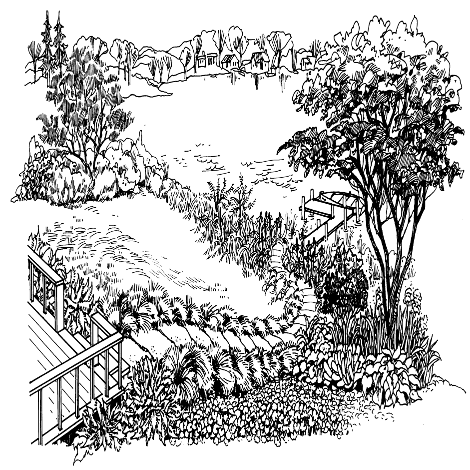
- INSPECT and REMOVE all aquatic plants and animals
- DRAIN water from motors, live wells, and bait containers
- DISPOSE of unwanted live bait on land
- RINSE your boat and equipment with hot (104°F) high pressure tap water or
- DRY your boat and equipment for at least 5 days

LAKE RECOMMENDATIONS

Honey Lake's water quality has declined since the 2008 sampling and is now considered impaired for total phosphorus.

To improve the overall quality of Honey Lake the ES (Ecological Services) has the following recommendations:

- Continue to participate in the Volunteer Lake Monitoring Program to give yearly data on water clarity for Honey Lake and observe changes in the lakes water clarity over time. Contact the LCHD-ES at 847-377-8009 to get involved in the VLMP program.
- Development of a Lake Management Plan based on the management goals of the lake. Lake management plans should incorporate usage issues, habitat maintenance/restoration, and limitations of the lake. A good lake management plan considers both the short and long term needs of the lake.
- Develop an Aquatic Plant Management Plan that targets the reduction of invasive species and promotes native plant diversity. Aquatic plant management plans should consider timing of pesticide applications and quantity of pesticide use. Early season herbicide use is better for the native plant community. APMP can also include developing requests for proposals (RFPs) for herbicide application; which can better help associations properly manage their lake.



- Conductivity and chloride concentrations are a significant problem on Honey Lake. Chloride concentrations are high enough to potentially have impacts on aquatic life. The use of road salts for winter road management is a major contributor to chloride concentrations and conductivity. Although roads only make up 9% of the landuse within the watershed, they contribute 27% of the estimate runoff. Proper application procedures and alternative methods can be used to keep these concentrations under control. Practicing best management practices for salt and de-icing of roads, sidewalks, and driveways in the Honey Lake Watershed is recommended. Consider the benefit of attending one of Lake County Health Departments De-Icing workshops held annually in October to learn about these best management practices.
- The last fisheries survey was conducted in 1999 on Honey Lake. An updated fish survey should be conducted to determine the diversity and health of the fish community.

- Currently, Honey Lake has 40% poor buffer around the shoreline. Consider installing Best Management Practices (BMPs) to minimize phosphorus and sediment runoff into Honey Lake. This can include: rain gardens, native buffers between shoreline and homeowner property, and increasing native plantings around the lake.
- Become familiar with the appearance of harmful algal blooms and report any blooms to the LCHD-ES by calling 847-837-8030.

ECOLOGICAL SERVICES

Senior Biologist: Mike Adam

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Population Health Services
500 W. Winchester Road
Libertyville, Illinois 60048-1331

Phone: 847-377-8030
Fax: 847-984-5622

For more information visit us at:

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

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

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

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

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

2015 Sampling Location on Honey Lake