

EXECUTIVE SUMMARY

Thank you for your continued hard work sampling **Pleasant Lake, New London** this year! Your monitoring group sampled the deep spot **four** times this year and has done so for many years. As you know, conducting multiple sampling events each year enables DES to more accurately detect water quality changes. Keep up the great work!

A Weed Watcher training was conducted at **Pleasant Lake** during **2008**. Volunteers were trained to survey the lake once a month from **May** through **September**. To survey, volunteers slowly boat, or even snorkel, around the perimeter of the lake and any islands it may contain. Using the materials provided in the Weed Watcher kit, volunteers look for any species that are suspicious. After a trip or two around the lake, volunteers will have a good knowledge of its plant community and will immediately notice even the most subtle changes. If a suspicious plant is found, the volunteers immediately send a specimen to DES for identification. If the plant specimen is an exotic species, a biologist will visit the site to determine the extent of the problem and to formulate a management plan to control the nuisance infestation. Remember that early detection is the key to controlling the spread of exotic plants.

Since your lake is located in the Lake Sunapee Watershed, we are providing an update detailing the activities of The Sunapee Area Watershed Coalition (SAWC). SAWC was organized in January, 2005, to promote local efforts to protect water quality, raise community awareness of important watershed issues, formulate clear guidelines for responsible, long-term stewardship of water resources, and encourage cooperation among Sunapee watershed towns to manage and protect water resources for the common benefit of the area communities.

SAWC is made up of representatives from each watershed town (Goshen, Newbury, New London, Springfield, Sunapee and Sutton), the Lake Sunapee Protective Association, Colby Sawyer College, Upper Valley Lake Sunapee Regional Planning Commission, several lake and pond associations and interested watershed residents. The inter-town Coalition was formed to develop a long-term watershed management plan for the Lake Sunapee watershed. When completed, a watershed management plan will be developed under the NH Department of Environmental Services "watershed approach." It is anticipated that the Watershed Plan and recommendations, will be accepted by the towns and adopted into their Master Plans. As recommendations are implemented, watershed resources will be protected and enhanced in future years.

The Watershed Management Plan for the Lake Sunapee Area is complete. The management plan contains information regarding watersheds in the Sunapee area, water quality data, current Federal and State regulations, descriptive model, watershed protection, watershed threats, and watershed priorities. To view and download copies of the Watershed Management Plan, go to

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www.sunapeewatershed.org. Copies are also available at the SAWC town offices and libraries as well as the NH State Library and Colby Sawyer College Library.

For more information, contact June Fichter, Executive Director of the Lake Sunapee Protective Association at 763-2210.

OBSERVATIONS & RECOMMENDATIONS

DEEP SPOT

➤ **Chlorophyll-a**

Chlorophyll-a, a pigment found in plants, is an indicator of algal or cyanobacteria abundance. Algae are typically microscopic plants that are naturally found in the lake ecosystem. The measurement of chlorophyll-a in the water gives biologists an estimation of the algal concentration or lake productivity. Table 14 in Appendix A lists the current year chlorophyll-a data.

Figure 1 depicts the historical and current year chlorophyll-a concentration in the water column.

The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m³.

The current year data (the top graph) show that the chlorophyll-a concentration **decreased** from **June** to **July**, and then **increased** from **July** to **August**.

The historical data (the bottom graph) show that the **2008** chlorophyll-a mean is **slightly less than** the state median and is **slightly greater than** the similar lake median. For more information on the similar lake median, refer to Appendix D.

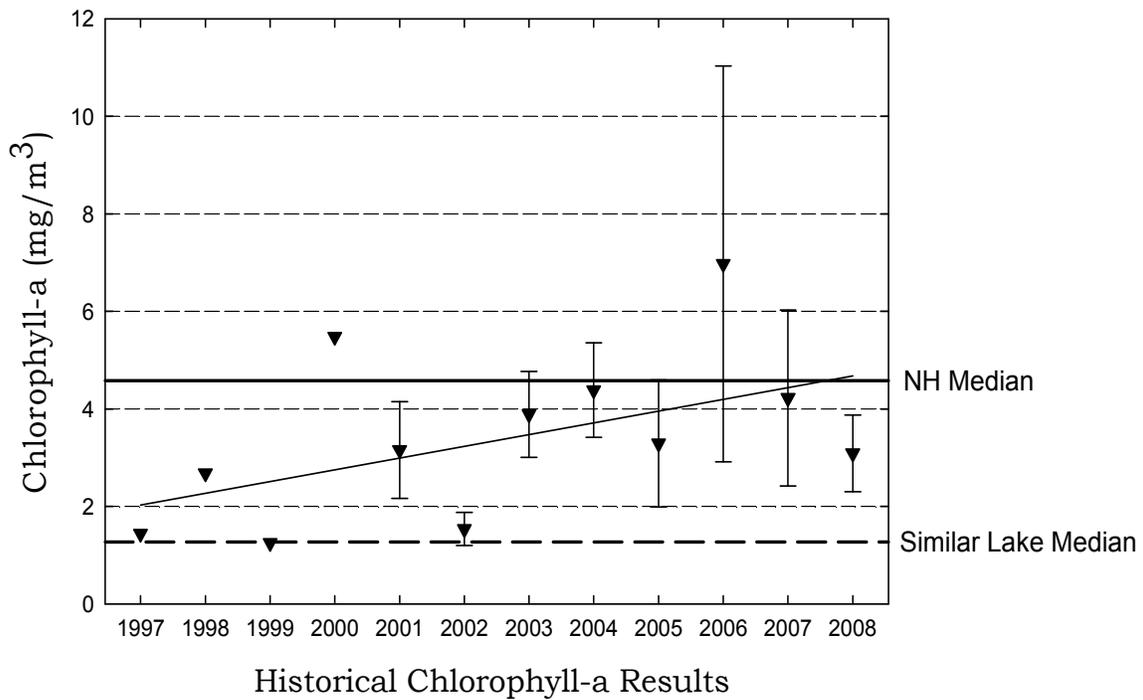
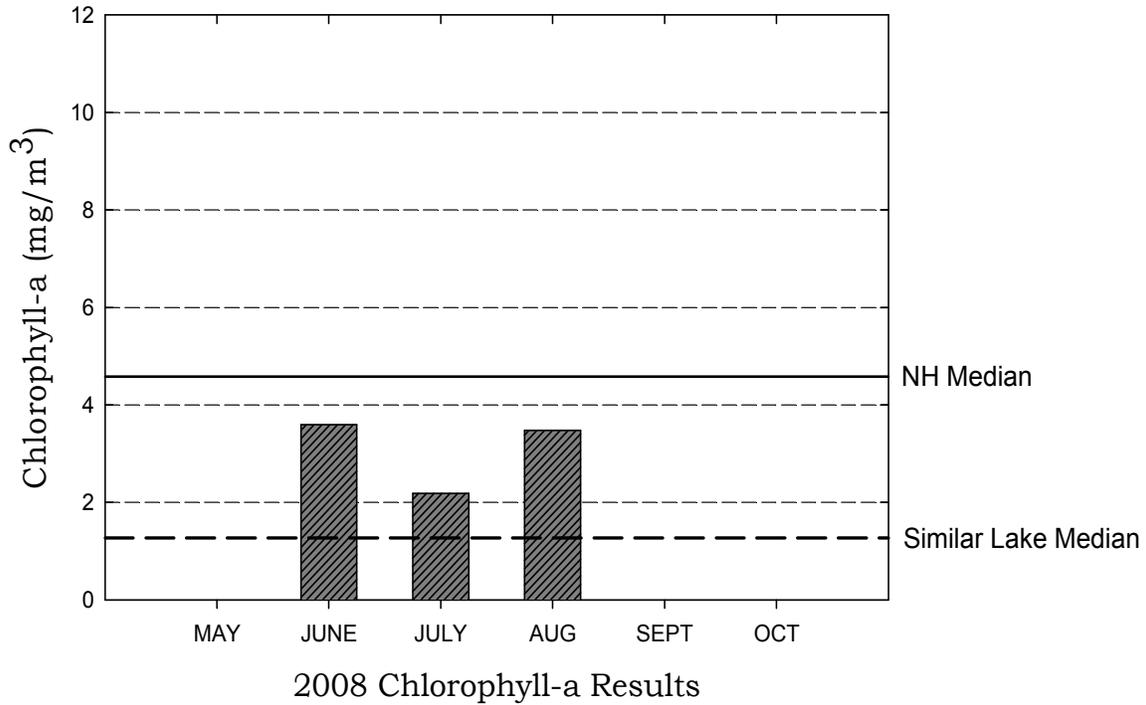
Overall, visual inspection of the historical data trend line (the bottom graph) shows a **variable** in-lake chlorophyll-a trend since monitoring began. Specifically the mean chlorophyll concentration has **fluctuated between approximately 1.25 and 6.98 mg/m³** since **1997**.

While algae are naturally present in all waterbodies, an excessive or increasing amount of any type is not welcomed. Phosphorus is the nutrient that algae typically depend upon for growth in New Hampshire lakes and ponds. Algal concentrations increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase. Increased Chlorophyll-a concentrations can also affect water clarity, causing Secchi-disk transparency to decrease (worsen) and turbidity to increase (worsen).

Therefore, it is extremely important for volunteer monitors to continually educate all watershed residents about management practices that can be implemented to minimize phosphorus loading to surface waters.

Pleasant Lake, New London

Figure 1. Monthly and Historical Chlorophyll-a Results



➤ **Phytoplankton and Cyanobacteria**

Table 1 lists the phytoplankton (algae) and/or cyanobacteria observed in the pond in **2008**. Specifically, this table lists the three most dominant phytoplankton and/or cyanobacteria observed and their relative dominance in the sample.

Table 1. Dominant Phytoplankton/Cyanobacteria (July 2008)

Division	Genus	% Dominance
Bacillariophyta	Asterionella	65.8
Bacillariophyta	Rhizosolenia	8.3
Chrysophyta	Mallomonas	6.6

Phytoplankton populations undergo a natural succession during the growing season. Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession. Diatoms and golden-brown algae populations are typical in New Hampshire’s less productive lakes and ponds.

➤ **Secchi Disk Transparency**

Volunteer monitors use the Secchi disk, a 20 cm disk with alternating black and white quadrants, to measure how far a person can see into the water. Transparency, a measure of water clarity, can be affected by the amount of algae and sediment in the water, as well as the natural color of the water. Table 14 in Appendix A lists the current year transparency data. **The median summer transparency for New Hampshire’s lakes and ponds is 3.2 meters.**

Figure 2 depicts the historical and current year transparency *with and without* the use of a viewscope.

The current year *non-viewscope* in-lake transparency *decreased* from **May** to **June**, and then *increased gradually* from **June** to **August**.

The current year *viewscope* in-lake transparency *decreased* from **May** to **June** and then *increased gradually* from **June** to **August**.

The transparency measured with the viewscope was generally *greater than* the transparency measured without the viewscope this summer. As discussed previously, a comparison of the transparency readings taken with and without the use of a viewscope shows that the viewscope typically increases the depth to which the Secchi disk can be seen into the lake, particularly on sunny and windy days. We recommend that your group measure Secchi disk transparency with and without the viewscope on each sampling event.

It is important to note that viewscope transparency data are not compared to a New Hampshire median or similar lake median. This is because lake transparency with the use of a viewscope has not been historically measured by DES. In the future, the New Hampshire and similar lake medians for viewscope transparency will be calculated and added to the appropriate graphs.

The historical data (the bottom graph) show that the **2008** mean non-viewscope transparency is ***much greater than*** the state median and is ***slightly less than*** the similar lake median. Please refer to Appendix D for more information about the similar lake median.

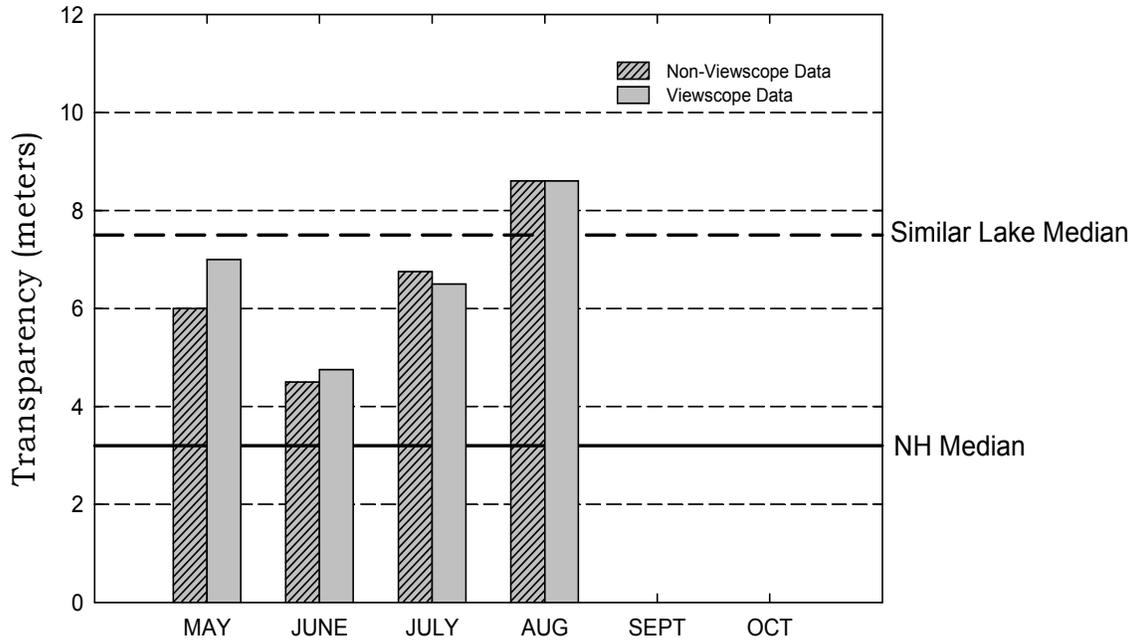
Visual inspection of the historical data trend line (the bottom graph) shows a ***decreasing*** trend, meaning that the transparency has ***worsened*** since monitoring began in **1997**.

Typically, high intensity rainfall causes sediment-laden stormwater runoff to flow into surface waters, thus increasing turbidity and decreasing clarity. Efforts should continually be made to stabilize stream banks, pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the pond. Guides to best management practices that can be implemented to reduce, and possibly even eliminate, nonpoint source pollutants, are available from DES upon request.

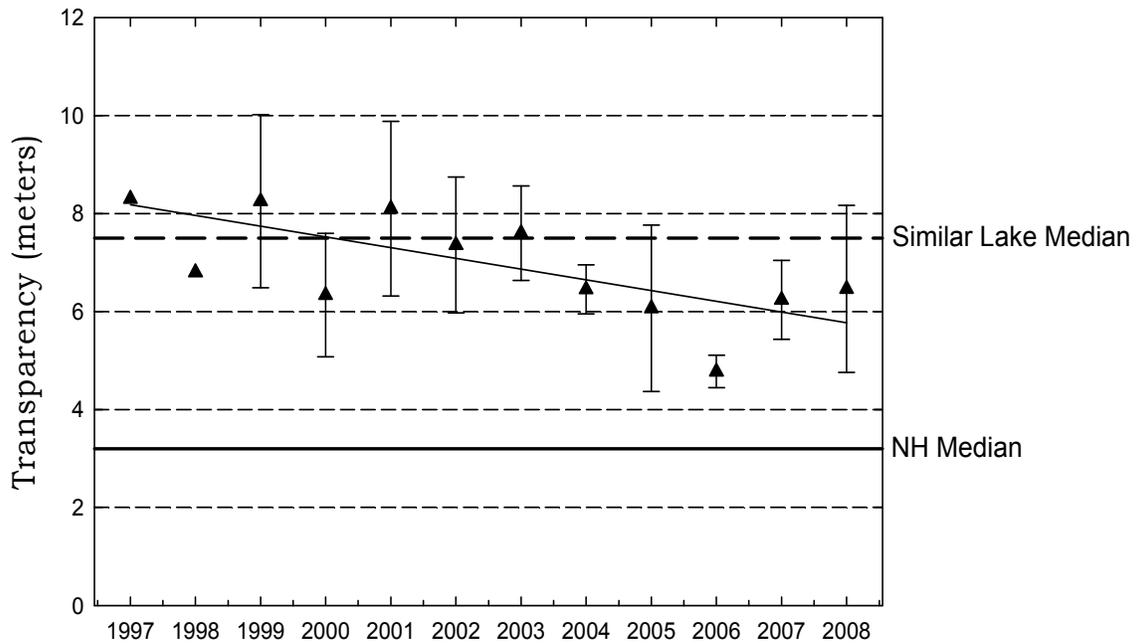
We recommend that your group continue to measure the transparency with and without the use of the viewscope on each sampling event. Ultimately, we would like all monitoring groups to use a viewscope to take Secchi disk readings as the use of the viewscope results in less variability in transparency readings between monitors and sampling events. At some point in the future, when we have sufficient data to determine a statistical relationship between transparency readings collected with and without the use of a viewscope, it may only be necessary to collect transparency readings with the use of a viewscope.

Pleasant Lake, New London

Figure 2. Monthly and Historical Transparency Results



2008 Transparency Viewscope and Non-Viewscope Results



Historical Transparency Non-Viewscope Results

➤ **Total Phosphorus**

Phosphorus is typically the limiting nutrient for vascular plant and algae growth in New Hampshire's lakes and ponds. Excessive phosphorus in a pond can lead to increased plant and algal growth over time. Table 14 in Appendix A lists the current year total phosphorus data for in-lake and tributary stations. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The graphs in Figure 3 depict the historical amount of epilimnetic (upper layer) and hypolimnetic (lower layer) total phosphorus concentrations; the inset graphs depict current year total phosphorus data.

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration **remained stable** from **May** to **June**, **decreased** from **June** to **July**, and then **increased** from **July** to **August**.

The historical data show that the **2008** mean epilimnetic phosphorus concentration is **much less than** the state median and is **slightly greater than** the similar lake median. Refer to Appendix D for more information about the similar lake median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration **increased slightly** from **May** to **June**, **decreased slightly** from **June** to **July**, and then **increased** from **July** to **August**.

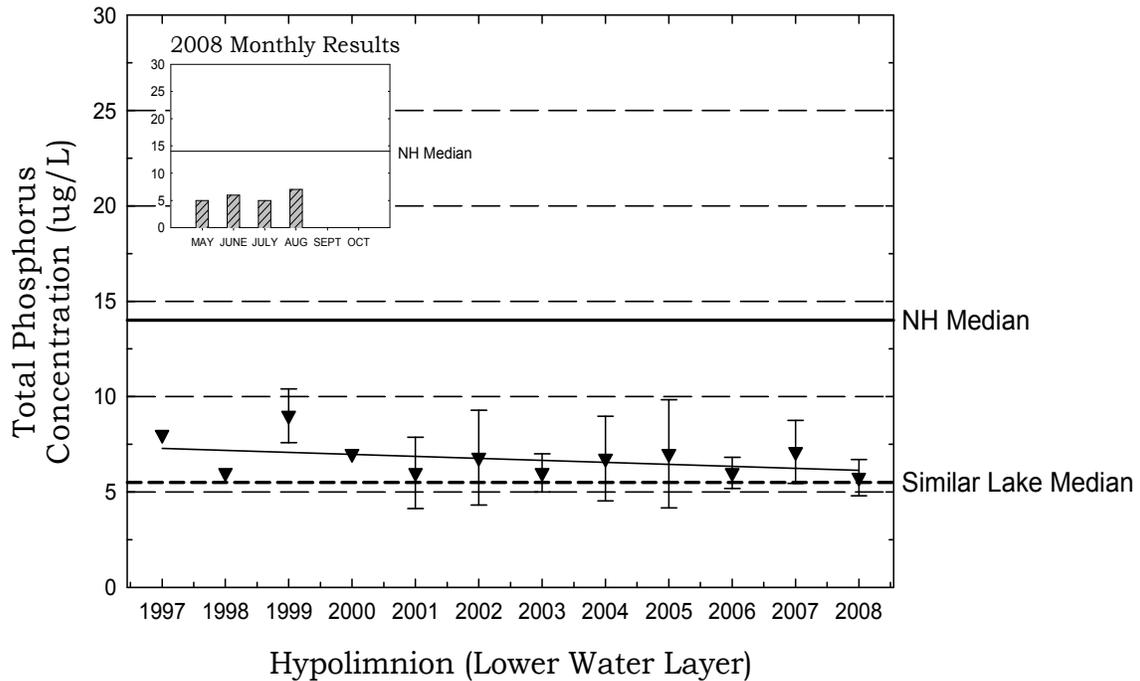
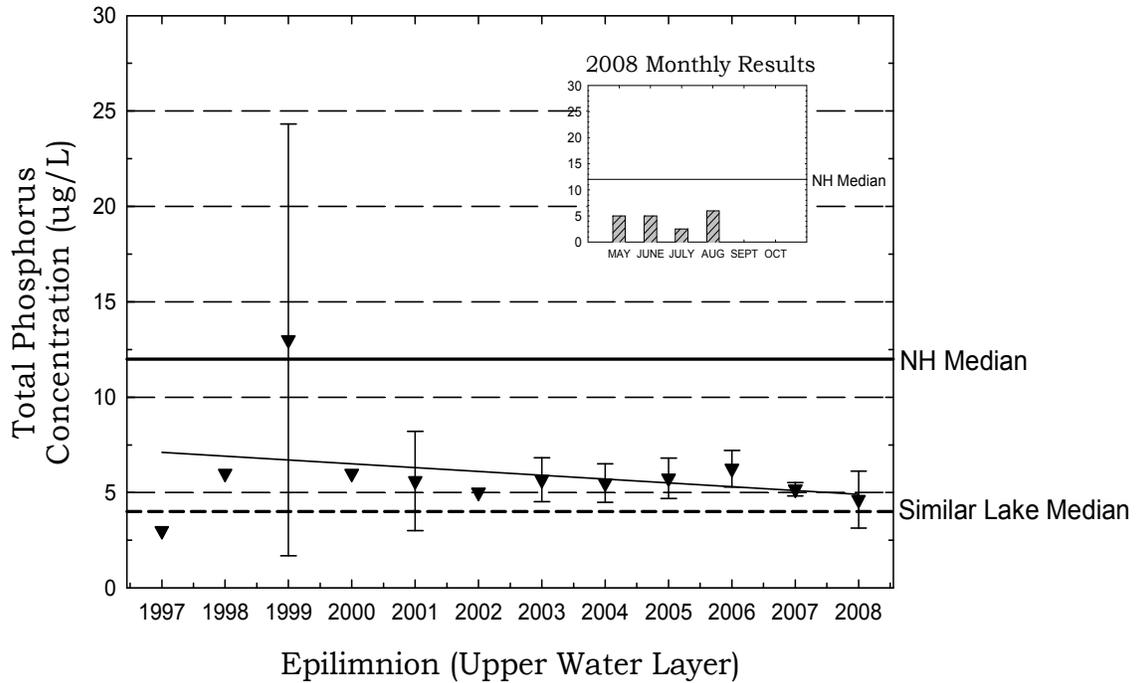
The historical data show that the **2008** mean hypolimnetic phosphorus concentration is **much less than** the state median and is **approximately equal to** the similar lake median. Please refer to Appendix D for more information about the similar lake median.

Overall, visual inspection of the historical data trend line for the epilimnion and hypolimnion shows a **stable** phosphorus trend since monitoring began. Specifically the mean annual epilimnetic and hypolimnetic phosphorus concentration has **remained approximately the same** since monitoring began in **1997**.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about the watershed sources of phosphorus and how excessive phosphorus loading can negatively affect the ecology and the recreational, economical, and ecological value of lakes and ponds.

Pleasant Lake, New London

Figure 3. Monthly and Historical Total Phosphorus Data



➤ pH

Table 14 in Appendix A presents the current year pH data for the in-lake stations.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 typically limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the state surface waters are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The pH at the deep spot this year ranged from **6.06 to 6.87** in the epilimnion and from **6.14 to 6.48** in the hypolimnion, which means that the water is **slightly acidic**.

It is important to point out that the hypolimnetic (lower layer) pH was **lower (more acidic)** than in the epilimnion (upper layer). This increase in acidity near the bottom is likely due to the decomposition of organic matter and the release of acidic by-products into the water column.

Due to the state's abundance of granite bedrock and acid deposition received from snowmelt, rainfall, and atmospheric particulates, there is little that can be feasibly done to effectively increase pond pH. The pH at the deep spot, however, is sufficient to support aquatic life.

➤ Acid Neutralizing Capacity (ANC)

Table 14 in Appendix A presents the current year epilimnetic ANC for the deep spot.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation about ANC, please refer to the "Chemical Monitoring Parameters" section of this report.

The acid neutralizing capacity (ANC) of the epilimnion (upper layer) ranged from **3.8 mg/L to 4.5 mg/L**. This indicates that the lake is **moderately vulnerable** to acidic inputs.

➤ **Conductivity**

Table 14 in Appendix A presents the current conductivity data for in-lake stations.

Conductivity is the numerical expression of the ability of water to carry an electric current, which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column. The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The conductivity in the lake is relatively **stable**. Typically conductivity levels greater than 100 uMhos/cm indicate the influence of pollutant sources associated with human activities. These sources include septic system leachate, agricultural runoff, and road runoff which contains road salt during the spring snow-melt. We hope this trend continues!

It is possible that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity in the lake. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

*A limited amount of chloride sampling was conducted during **2008**. Please refer to the chloride discussion for more information.*

Therefore, we recommend that the **epilimnion** (upper layer) be sampled for chloride next year. This additional sampling may help us identify what areas of the watershed are contributing to the increasing in-lake conductivity.

Please note that the DES Limnology Center in Concord is able to conduct chloride analyses, free of charge. As a reminder, it is best to conduct chloride sampling in the spring as the snow is melting and during rain events.

➤ **Dissolved Oxygen and Temperature**

Table 9 in Appendix A depicts the dissolved oxygen/temperature profile(s) collected during **2008**.

The presence of sufficient amounts of dissolved oxygen in the water column is vital to fish and amphibians and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The dissolved oxygen concentration was **high** at all deep spot depths sampled at the lake on the **April, June, July, and August** sampling events. As thermally stratified lakes age, and as the summer progresses, oxygen typically becomes **depleted** in the hypolimnion (lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from biological organisms using oxygen to break down organic matter,

both in the water column and particularly at the bottom of the lake where the water meets the sediment. The **high** oxygen level in the hypolimnion is a sign of the lake's overall good health. We hope this continues!

The dissolved oxygen concentration was greater than **100 percent** saturation between the **surface** and **seven** meters at the deep spot on the **June** sampling event. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column. Layers of algae can also increase the dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis. Considering that the depth to which sunlight could penetrate into the water column was approximately **6.0** meters on this sampling event, as shown by the Secchi disk transparency depth, and that the metalimnion, the layer of rapid decrease in water temperature and increase in water density where algae typically congregate, was located between approximately **5.0** and **9.0** meters, we suspect that an abundance of algae in the epilimnion and metalimnion caused the oxygen super-saturation.

➤ **Turbidity**

Table 14 in Appendix A presents the current year data for in-lake turbidity.

Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

The deep spot turbidity was **relatively low** this year, which is good news.

However, we recommend that your group sample the pond and any surface water runoff areas during significant rain events to determine if stormwater runoff contributes turbidity and phosphorus to the lake/pond.

For a detailed explanation on how to conduct rain event sampling, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at

<http://www.des.nh.gov/organization/divisions/water/wmb/vlap/categories/publications.htm>, or contact the VLAP Coordinator.

TRIBUTARY SAMPLING

➤ **Total Phosphorus**

Table 14 in Appendix A presents the current year total phosphorus data for tributary stations. Please refer to the “Chemical Monitoring Parameters” section of the report for a detailed explanation of total phosphorus.

Overall, tributary phosphorus concentration(s) were **very low** in **2008** indicating that potentially damaging land use activities as a result of human disturbances in the watershed did not affect the lake quality this year. This is great news considering the significant stormwater runoff received this summer.

➤ **pH**

Table 14 in Appendix A presents the current year pH data for the tributary stations. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation of pH.

The pH of the tributary stations ranged from **5.93 to 7.06 (> 6)** and is sufficient to support aquatic life.

➤ **Conductivity**

Table 14 in Appendix A presents the current conductivity data for the tributary stations. Please refer to the “Chemical Monitoring Parameters” section of the report for a more detailed explanation of conductivity.

Overall, the conductivity has **remained relatively stable** in the tributaries since monitoring began.

A new station, **PL 7A**, was sampled on the **April** sampling event. The conductivity was **elevated (118 uMhos/cm)**. We recommend that your monitoring group conduct a conductivity survey of tributaries with **elevated** conductivity and along the shoreline of the pond to help identify the sources of conductivity. As previously mentioned increasing conductivity typically indicates the influence of pollutant sources associated with human activities.

We recommend that your monitoring group conduct stream surveys and rain event sampling along the tributaries with **elevated** conductivity so that we can determine potential sources to the lake.

For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at
<http://www.des.nh.gov/organization/divisions/water/wmb/vlap/categories/>

publications.htm, or contact the VLAP Coordinator.

➤ **Turbidity**

Table 14 in Appendix A presents the current year turbidity data for the tributary stations. Please refer to the “Other Monitoring Parameters” section of the report for a more detailed explanation of turbidity.

The tributaries experienced slightly turbid conditions in **April**, likely the result of stormwater runoff from significant rain events prior to sampling. Rainfall creates runoff that washes sediment and organic materials into tributaries causing turbid water conditions. Eventually, the suspended solids settle out once the flow is reduced or the tributary flow enters the lake.

➤ **Bacteria (*E. coli*)**

Table 14 in Appendix A lists the current year data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **may** be present. If sewage is present in the water, potentially harmful disease-causing organisms **may** also be present. Please refer to the “Other Monitoring Parameters” section of the report for a more detailed explanation.

The *E. coli* concentration was **very low** at each station sampled on the **July** sampling event. Specifically, each result was **10 counts or less**, which is **much less than** the state standard of 406 counts per 100 mL for recreational surface waters that are not designated public beaches and 88 counts per 100 mL for surface waters that are designated public beaches.

➤ **Chlorides**

Table 14 in Appendix A lists the current year data for chloride sampling. The chloride ion (Cl-) is found naturally in some surface waters and groundwaters and in high concentrations in seawater. Research has shown that elevated chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life in New Hampshire, the state has adopted **acute and chronic** chloride criteria of **860 and 230 mg/L** respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Station **PL 8** was sampled for chloride during the **July** sampling event. The result was **7.1 mg/L**, which is **much less than** the state acute and chronic

chloride criteria. However, this concentration is **greater than** what we would normally expect to measure in undisturbed New Hampshire surface waters.

We recommend that your monitoring group continue to conduct chloride sampling in the epilimnion at the deep spot, particularly in the spring during snow-melt and during rain events during the summer. This will establish a baseline of data that will assist your monitoring group and DES to determine lake quality trends in the future.

Please note that chloride analyses can be run free of charge at the DES Limnology Center. Please contact the VLAP Coordinator if you are interested in chloride monitoring.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your pond, the biologist conducted a sampling procedures assessment audit for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled-out an assessment audit sheet to document the volunteer monitors' ability to follow the proper field sampling procedures, as outlined in the VLAP Monitor's Field Manual. This assessment is used to identify any aspects of sample collection in which volunteer monitors failed to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this year! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

Sample Receipt Checklist

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if your group followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an **excellent** job when collecting samples and submitting them to the laboratory this year! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis.

USEFUL RESOURCES

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, DES Booklet WD-03-42, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-03-42.pdf.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, DES fact sheet WD-SP-1, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-1.pdf.

Impacts of Development Upon Stormwater Runoff, DES fact sheet WD-WQE-7, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/aot/documents/wqe-7.pdf.

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, DES fact sheet WD-BB-9, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-9.pdf.

Low Impact Development Hydrologic Analysis. Manual prepared by Prince George's County, Maryland, Department of Environmental Resources. July 1999. To access this document, visit www.epa.gov/owow/nps/lid_hydr.pdf or call the EPA Water Resource Center at (202) 566-1736.

Low Impact Development: Taking Steps to Protect New Hampshire's Surface Waters, DES fact sheet WD-WMB-17, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-17.pdf.

Road Salt and Water Quality, DES fact sheet WD-WMB-4, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-4.pdf.

Shorelands Under the Jurisdiction of the Comprehensive Shoreland Protection Act, DES fact sheet SP-4, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-4.pdf.

Through the Looking Glass: A Field Guide to Aquatic Plants, North American Lake Management Society, 1988, (608) 233-2836 or www.nalms.org.

Watershed Districts and Ordinances, DES fact sheet WD-WMB-16, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-16.pdf.