After reviewing data collected from **CENTER POND, STODDARD**, the program coordinators have made the following observations and recommendations.

We congratulate your group on sampling twice this season! However, we encourage your group to conduct more sampling events in the future. Typically, we recommend that monitoring groups sample three times per summer (once in **June, July, and August**). We understand that the number of sampling events you decide to conduct per summer will depend upon volunteer availability, and your group’s goals and funding availability. However, with a limited amount of data it is difficult to determine accurate and representative water quality trends. Since weather patterns and activity in the watershed can change throughout the summer, from year to year, and even from hour to hour during a rain event, it is a good idea to sample the pond at least once per month during the summer.

If you are having difficulty finding volunteers to help sample or to travel to one of the laboratories, please call the VLAP Coordinator and DES will help you work out an arrangement.

**Figure Interpretation**

- **Figure 1 and Table 1**: Figure 1 in Appendix A shows the historical and current year chlorophyll-a concentration in the water column. Table 1 in Appendix B lists the maximum, minimum, and mean concentration for each sampling season that the pond has been monitored through VLAP.

Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **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 July to August.

The historical data (the bottom graph) show that the 2006 chlorophyll-a mean is greater than the state median and the similar lake median. For more information on the similar lake median, refer to Appendix F.

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual chlorophyll-a concentration has not significantly changed since monitoring began. Specifically, the chlorophyll-a concentration has fluctuated between approximately 3.5 and 11.2 mg/m$^3$, but has not continually increased or decreased since 1988. Please refer to Appendix E for a detailed statistical analysis explanation and data print-out.

While algae are naturally present in all ponds, an excessive or increasing amount of any type is not welcomed. In freshwater ponds, phosphorus is the nutrient that algae typically depend upon for growth in New Hampshire lakes. Algal concentrations may increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase. 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.

Figures 2a and 2b and Tables 3a and 3b: Figure 2a in Appendix A shows the historical and current year data for transparency without the use of a viewscope and Figure 2b shows the current year data for transparency with the use of a viewscope. Table 3a in Appendix B lists the maximum, minimum and mean transparency data without the use of a viewscope and Table 3b lists the maximum, minimum and mean transparency data with the use of a viewscope for each sampling season that the pond has been monitored through VLAP.

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. The median summer transparency for New Hampshire's lakes and ponds is 3.2 meters.

The current year data (the top graph) show that the non-viewscope in-lake transparency increased slightly from July to August.
It is important to note that as the chlorophyll concentration decreased from July to August, the transparency increased. We typically expect this inverse relationship in lakes. As the amount of algal cells in the water decreases, the depth to which one can see into the water column typically increases.

The historical data (the bottom graph) show that the 2006 mean non-viewscope transparency is less than the state median and is approximately equal to the similar lake median. Please refer to Appendix F for more information about the similar lake median.

The current year data (the top graph) show that the viewscope in-lake transparency increased from July to August, as did the transparency measured without the viewscope. On both sampling events, the transparency measured with the viewscope was greater than the transparency measured without the viewscope. 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.

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual non-viewscope transparency has not significantly changed since monitoring began. Specifically, the transparency has fluctuated between approximately 2.2 and 3.9 meters, but has not continually increased or decreased since 1988. Please refer to Appendix E for the detailed statistical analysis explanation and data print-out.)

Since the viewscope has only been used for one year to measure the transparency of the pond, it is not possible to determine historical trends for viewscope transparency. 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.
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.

Figure 3 and Table 8: The graphs in Figure 3 in Appendix A show the amount of epilimnetic (upper layer) phosphorus and hypolimnetic (lower layer) phosphorus; the inset graphs show current year data. Table 8 in Appendix B lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the pond has been sampled through VLAP.

Phosphorus is typically the limiting nutrient for 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. 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 current year data for the epilimnion (the top inset graph) show that the phosphorus concentration decreased from July to August.

The historical data show that the 2006 mean epilimnetic phosphorus concentration is less than the state median and the similar lake median. Refer to Appendix F 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 from July to August.

The turbidity of the hypolimnion (lower layer) sample was elevated (4.4 NTUs) on the August sampling event. This suggests that the pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling and/or that the lake bottom is covered by a thick organic layer of sediment which is easily disturbed. When the pond bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the hypolimnion sample, make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.
The historical data show that the 2006 mean hypolimnetic phosphorus concentration is greater than the state median and the similar lake median. Please refer to Appendix F for more information about the similar lake median.

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the epilimnion (upper layer) has significantly decreased (meaning improved) on average by approximately 2.8 percent per sampling season during the sampling period 1988 to 2006. Please refer to Appendix E for the statistical analysis explanation and data print-out. We hope this improving trend continues!

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the hypolimnion (lower layer) has not significantly changed since monitoring began. Specifically, the hypolimnetic phosphorus concentration has fluctuated between approximately 14 and 32 ug/L, but has not continually increased or decreased since 1988.

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

**Table Interpretation**

- **Table 2: Phytoplankton**
  Table 2 in Appendix B lists the current and historical phytoplankton species observed in the pond. Specifically, this table lists the three most dominant phytoplankton species observed in the sample and their relative abundance in the sample.

The dominant phytoplankton species observed in the August sample were *Chrysosphaerella* (golden-brown), *Mallomonas* (golden-brown), and an unidentifiable filamentous blue-green algae.

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 are typical in New Hampshire’s less productive lakes and ponds.
Table 4: pH

Table 4 in Appendix B presents the in-lake and tributary current year and historical pH data.

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 surface waters in the state are slightly acidic. For a more detailed explanation regarding pH, please refer to the “Chemical Monitoring Parameters” section of this report.

The mean pH at the deep spot this season ranged from 5.83 in the hypolimnion to 6.04 in the epilimnion, which means that the water is slightly acidic.

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

Due to the presence of granite bedrock in the state and acid deposition received from snowmelt, rainfall, and atmospheric particulates, there is not much that can be feasibly done to effectively increase pond pH.

Table 5: Acid Neutralizing Capacity

Table 5 in Appendix B presents the current year and historical epilimnetic ANC for each year the pond has been monitored through VLAP.

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 mean acid neutralizing capacity (ANC) of the epilimnion (upper layer) was 1.1 mg/L this season, which is much less than the state median. In addition, this indicates that the pond is extremely vulnerable to acidic inputs.
Table 6: Conductivity
Table 6 in Appendix B presents the current and historical conductivity values for tributaries and in-lake data. 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 mean annual epilimnetic conductivity at the deep spot this season was 15.71 uMhos/cm, which is much less than the state median.

The conductivity in the pond is relatively stable and low. 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. The low conductivity level in the pond is an indication of the low amount of pollutants and erosion in the watershed. We hope this trend continues!

Table 7a and Table 7b: Total Kjeldahl Nitrogen and Nitrite+Nitrate Nitrogen
Table 7a in Appendix B presents the current year and historical Total Kjeldahl Nitrogen and Table 7b presents the current year and historical nitrite and nitrate nitrogen. Nitrogen is another nutrient that is essential for the growth of plants and algae. Nitrogen is typically the limiting nutrient in estuaries and coastal ecosystems. However, in freshwater, nitrogen is not typically the limiting nutrient. Therefore, nitrogen is not typically sampled through VLAP. However, if phosphorus concentrations in freshwater are elevated, then nitrogen loading may stimulate additional plant and algal growth. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The pond is likely phosphorus-limited. Therefore, it is not critical to conduct nitrogen sampling.

Table 8: Total Phosphorus
Table 8 in Appendix B presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae’s ability to grow and reproduce. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.
The phosphorus concentration in the tributaries was *relatively low* this season, which is good news. However, we recommend that your monitoring group sample the major tributaries to the pond soon after snow-melt and periodically during rain storms to determine if the phosphorus concentration is *elevated* in the tributaries during these times. Typically, the majority of nutrient loading to a pond occurs in the spring during snow-melt and during intense rain storms that cause soil erosion and surface runoff and within the watershed.


➢ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) collected during 2006. Table 10 in Appendix B shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column 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 *much lower in the metalimnion (middle layer) and hypolimnion (lower layer) than in the epilimnion (upper layer)* at the deep spot on the August sampling event. As stratified ponds age, and as the summer progresses, oxygen typically becomes *depleted* in the hypolimnion by the process of decomposition. Specifically, the reduction of hypolimnetic oxygen is primarily a result of biological organisms using oxygen to break down organic matter, both in the water column and particularly at the bottom of the pond where the water meets the sediment. When hypolimnetic oxygen concentration is depleted to less than 1 mg/L, *as it was this season and in past seasons*, the phosphorus that is normally bound up in the sediment may be re-released into the water column, a process referred to as *internal phosphorus loading*.

Since an internal source of phosphorus in the pond may be present, it is even more important that watershed residents act proactively to minimize phosphorus loading from the watershed.
Table 11: Turbidity
Table 11 in Appendix B lists the current year and historical data for in-lake and tributary 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.

As discussed previously, the turbidity of the hypolimnion (lower layer) sample was elevated (4.4 NTUs) on the August sampling event. The hypolimnetic turbidity has been at least slightly elevated on most sampling events during previous sampling seasons. This suggests that the pond bottom is covered by a thick organic layer of sediment that is easily disturbed.

Table 12: Bacteria (E.coli)
Table 12 in Appendix B lists the current year and historical 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.

The E. coli concentration at the Boat Landing and the Outlet was elevated (110 and 210 counts per 100 mL) on the July sampling event. However, the concentrations were not greater than the state standard of 406 counts per 100 mL for recreational waters that are not designated public beaches.

If you are concerned about E. coli levels at these stations, your monitoring group should conduct rain event sampling and bracket sampling in this area. This additional sampling may help us determine the source of the bacteria.

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/wmb/vlap/2002/documents/Appndxd_monitoring.pdf, or contact the VLAP Coordinator.

Table 13: Chloride
Table 13 in Appendix B lists the current year and the historical data for chloride sampling. The chloride ion (Cl⁻) is found naturally in some surfacewaters 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.

Chloride sampling was not conducted during 2006.

- **Table 14: Current Year Biological and Chemical Raw Data**
  Table 14 in Appendix B lists the most current sampling season results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current year “raw,” meaning unprocessed, data. The results are sorted by station, depth, and then parameter.

- **Table 15: Station Table**
  As of the spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past and are most familiar with, an EMD station name also exists for each VLAP sampling location. Table 15 in Appendix B identifies what EMD station name corresponds to the station names you have used in the past and will continue to use in the future.

**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 ability of the volunteer monitors 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 that the
ever 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 season! 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, future re-occurrences of
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 season! 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**

*Acid Deposition Impacting New Hampshire’s Ecosystems*, DES fact sheet

*Best Management Practices to Control Nonpoint Source Pollution: A Guide

WD-WSEB-21-4, (603) 271-2975 or www.des.nh.gov/factsheets/ws/ws-
21-4.htm.

*Biodegradable Soaps and Water Quality*, DES fact sheet BB-54, (603)

*Canada Geese Facts and Management Options*, DES fact sheet BB-53,

*Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green
Algae Blooms*, DES fact sheet WMB-10, (603) 271-2975 or


