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## Water Monitoring Report

### 2006-2008

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# Acadia National Park Water Monitoring Report: 2006 through 2008

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## **ABSTRACT**

In previous years, the goals, objectives, methods, and results of Acadia National Park (ANP) water monitoring programs were documented in program-specific reports. Significant changes in all aquatic monitoring programs occurred in 2006, which suggested taking a consolidated approach to reporting. Monthly field measurements and water samples were taken in twelve park lakes and eleven streams from May through October each year following “Vital Signs” monitoring protocols of the National Park Service (NPS) Inventory and Monitoring Program. Data from stream benthic macroinvertebrate monitoring and invasive aquatic plant monitoring, conducted in cooperation with the Maine Department of Environmental Protection (MDEP) and the Volunteer Lake Monitoring Program (VLMP) respectively, were also shared with the Vital Signs program. This integrated monitoring approach provides data for a variety of water quality parameters that can serve as indicators for the effects of atmospheric deposition, cultural eutrophication, and climate change.

The monitoring data indicate that the lake Secchi transparency and water levels, and stream discharge were strongly influenced by seasonal precipitation trends. Dissolved oxygen, temperature, pH, acid neutralizing capacity, and nutrients appeared to be relatively stable, with concentrations generally within the historical range of variability for these water bodies, although a slight increase in nutrient levels and indicators of biological productivity became evident. Benthic macroinvertebrate data analysis indicated that all monitored streams retained their legislative classification, and no invasive aquatic plant species were encountered in any of the surveys over the three years.

Although no statistical analyses were performed in this report to determine long-term data trends, an analysis of trends in lake water quality is expected to be completed by the NPS Northeast Regional Hydrologist by the time this report is available.

## **INTRODUCTION**

ANP freshwater resources include 24 named lakes, 34 named streams, and numerous wetlands within or adjacent to the park boundary (Figure 1). A lake monitoring program, developed from recommendations of a 1997 workshop seeking long-term aquatic monitoring strategies (Kahl and Manski, 1997), and guidance outlined in the park’s Water Resources Management Plan (WRMP) (National Park Service, 2000) had long been the core of the freshwater monitoring program at ANP. Data on park streams came largely from several University of Maine and US Geological Survey (USGS) research projects, dating from the early 1980s to the present. The park lacked a structured program for monitoring stream water quality and quantity, although MDEP protocols were adopted in 1997 to obtain baseline information on the abundance and diversity of stream invertebrates, which can be used as water quality indicators.

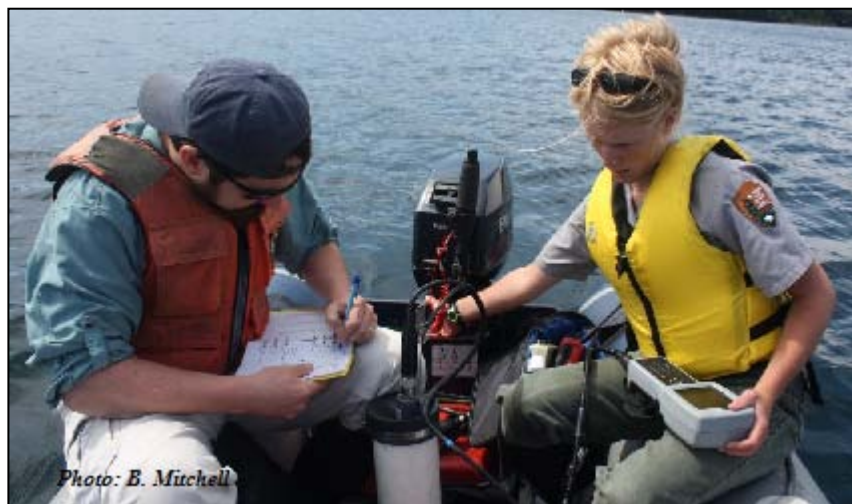
ANP is one of 13 NPS units in the Northeast Temperate Network (NETN), which in turn, is one of 32 networks comprising the NPS Inventory and Monitoring Program. The NETN has developed a series of protocols to monitor “Vital Signs”- indicators of the health of the ecological systems within the parks and their response to natural and anthropogenic stressors at different ecological scales. Vital signs monitoring at ANP began in 2006, with the adoption of the NETN Water-Quality Monitoring Protocols in Lakes, Ponds and Streams (Lombard, et al., 2006) as the backbone of the parks freshwater monitoring program.

The protocol calls for a total of 37 park lakes and streams to be sampled monthly from May through October, with 14 sites monitored annually and the remainder visited on a 2 or 3-year rotation schedule. Park staff measure physical and in-situ water chemistry parameters each month, and gather water samples in May, June, and August, which are analyzed at the University of Maine’s Sawyer Environmental Chemistry Research Laboratory. Stream discharge (flow) is measured at each monthly monitoring visit, and stage height (water level) is recorded weekly at 17 lakes during the open-water season. All monitoring data are incorporated into a series of comprehensive databases that ultimately feed the U.S. Environmental Protection Agency’s “STORET” data system, the repository for all NPS water quality and quantity data.

## MONITORING GOALS

The primary goal of the ANP water monitoring program is to detect changes in aquatic ecosystem structure and function; and determine if, and to what degree, human-induced factors are contributing to these changes. In order to measure human-induced changes it is necessary to determine the normal variability inherent in natural aquatic systems, and to establish baseline conditions from which future changes can be detected.

The major stressors that could affect ANP water resources include atmospheric deposition, toxic contaminants within the watershed, input of nitrogen and other nutrients, introduction of exotic species, and climate change. Consequently, the vital signs identified in the NETN protocol are water chemistry, nutrient enrichment, water quantity, and the detection of invasive plant species. Monitoring these vital signs directly addresses both the ANP and NETN goals of detecting change in the status of physical, chemical, or biological attributes of the ecosystem.



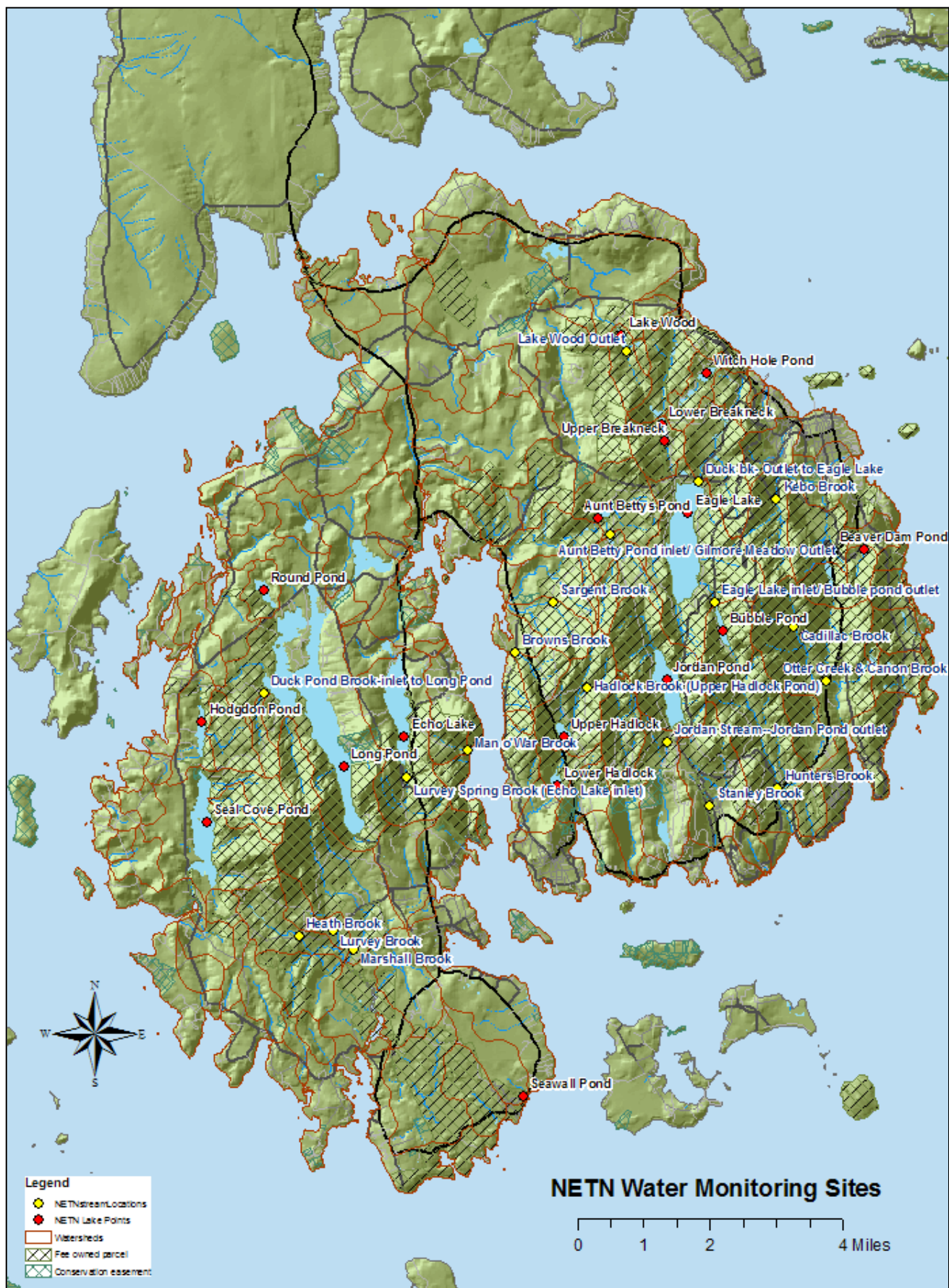


**Figure 1:** Acadia National Park Water Monitoring Locations

## METHODS

Detailed explanations of the various water monitoring techniques are available in the NETN protocol (Lombard, et. al., 2006) and MDEP's "Methods for Biological Sampling and Analysis of Maine's Inland Waters" (Davies and Tsomides, 2002). Further information on invasive aquatic plant survey techniques and species identification for Maine waters can be obtained from the Maine Center for Invasive Aquatic Plants (MCIAP).

### **Site selection:**

Because of funding and staff limitations, annual comprehensive monitoring of all ANP lakes, streams and other surface waters is not realistic. However, an alternating sampling design, in which a subset of water bodies are sampled every x number of years, gives more power to detect trends over the long term than does an annual revisit design in which the same subset of lakes is visited every year (Larsen, Urquhart and Kugler, 1995). The protocol calls for eight lake sites (traditionally sampled each year as a part of the ANP lake program) to continue to be sampled at the same frequency, while nine additional lakes are to be monitored as a part of a rotating design where they are sampled every third year. The three continuous-record stream sites (that have streamflow gages in which data are collected with automated dataloggers) are to be sampled annually, and the seventeen partial-record sites (monthly streamflow data collection) are scheduled for sampling every other year (sampling a maximum of nine partial-record sites and three continuous-record sites each year).

| YEARLY MONITORING                                                 |                                                                  |                                                                 |
|-------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------|
| <i>Permanent sites</i>                                            |                                                                  |                                                                 |
| LAKE                                                              | MIDAS #                                                          | SITE LAT/LONG                                                   |
| Eagle Lake                                                        | 4606                                                             | 44° 21' 48.6"<br>68° 15' 01.5"                                  |
| Bubble Pond                                                       | 4452                                                             | 44° 20' 42.2"<br>68° 14' 19.9"                                  |
| Witch Hole Pond                                                   | 4458                                                             | 44° 24' 0"<br>68° 14' 34.6"                                     |
| Jordan Pond                                                       | 4608                                                             | 44° 19' 52"<br>68° 15' 18.9"                                    |
| Upper Hadlock Pond                                                | 4612                                                             | 44° 19' 16.9"<br>68° 17' 14.8"                                  |
| Long Pond                                                         | 4622                                                             | 44° 19' 39.1"<br>68° 21' 48"                                    |
| Seal Cove Pond                                                    | 4630                                                             | 44° 18' 5.3"<br>68° 23' 49.9"                                   |
| Echo Lake                                                         | 4624                                                             | 44° 19' 37.3"<br>68° 20' 15.8"                                  |
| <i>Rotating sites</i>                                             |                                                                  |                                                                 |
| YEAR 1                                                            | YEAR 2                                                           | YEAR 3                                                          |
| <b>Aunt Betty's Pond (4588)</b><br>44° 22' 13.4"<br>68° 16' 28.8" | <b>Lower Hadlock Pond (4610)</b><br>44° 18' 41"<br>68° 17' 21.5" | <b>Round Pond (4620)</b><br>44° 21' 10"<br>68° 22' 39.7"        |
| <b>Lower Breakneck (9655)</b><br>44° 23' 26.7"<br>68° 15' 28.3"   | <b>Hodgdon Pond (4628)</b><br>44° 19' 20"<br>68° 23' 52.1"       | <b>Lake Wood (0435)</b><br>44° 24' 28"<br>68° 16' 6.4"          |
| <b>Bear Brook Pond (8567)</b><br>44° 21' 40.1"<br>68° 11' 42.9"   | <b>Seawall Pond (2901)</b><br>44° 14' 33.5"<br>68° 18' 2.7"      | <b>Upper Breakneck (9657)</b><br>44° 23' 11.6"<br>68° 15' 19.6" |

**Table 1:** Lake and pond monitoring sites

| <b>WATERBODY</b>                                | <b>USGS station number</b> | <b>LATITUDE</b> | <b>LONGITUDE</b> |
|-------------------------------------------------|----------------------------|-----------------|------------------|
| <b><i>Permanent continuous-record sites</i></b> |                            |                 |                  |
| Cadillac Brook                                  | 01022835                   | 44° 20' 40.9"   | 68° 13' 01.2"    |
| Hadlock Brook                                   | 01022860                   | 44° 19' 54"     | 68° 16' 48"      |
| Otter Creek                                     | 01022840                   | 44° 19' 58"     | 68° 12' 26"      |
| <b><i>Rotating partial-record sites</i></b>     |                            |                 |                  |
| <b>YEAR 1</b>                                   |                            |                 |                  |
| Hunters Brook                                   | 01022845                   | 44° 18' 33.8"   | 68° 13' 20.5"    |
| Kebo Brook                                      | 01022829                   | 44° 22' 20.7"   | 68° 13' 18.6"    |
| Sargent Brook                                   | 10228665                   | 44° 21' 01.1"   | 68° 29' 02"      |
| Jordan Stream                                   | 01022852                   | 44° 19' 10"     | 68° 15' 21"      |
| Breakneck Brook                                 | 01022825                   | 44° 24' 40.4"   | 68° 15' 07.4"    |
| Aunt Bettys Pond inlet                          | 01022869                   | 44° 21' 54.4"   | 68° 16' 20.7"    |
| Marshall Brook                                  | 01022890                   | 44° 16' 29.1"   | 68° 21' 05.4"    |
| Heath Brook                                     | 01022895                   | 44° 16' 40.1"   | 68° 22' 05.4"    |
| Lurvey Spring-inlet to Echo Lake                | 01022878                   | 44° 18' 44.7"   | 68° 20' 06.8"    |
| <b>YEAR 2</b>                                   |                            |                 |                  |
| Browns Brook                                    | 01022866                   | 44° 20' 22.0"   | 68° 18' 6.1"     |
| Man o'War Brook                                 | 01022880                   | 44° 19' 6"      | 68° 19' 0"       |
| Stanley Brook                                   | 01022850                   | 44° 18' 20"     | 68° 14' 35"      |
| Eagle Lake inlet                                | 01022826                   | 44° 21' 0.7"    | 68° 14' 27.9"    |
| Duck Pond Brook-inlet to Long Pond              | 10228755                   | 44° 19' 51.9"   | 68° 22' 42.5"    |
| Lake Wood Outlet                                | 01022808                   | 44° 24' 18.1"   | 68° 16' 01.4"    |
| Duck bk- Outlet to Eagle Lake                   | 01022827                   | 44° 22' 35.5"   | 68° 14' 44.1"    |
| Lurvey Brook                                    | 1022892                    | 44° 16' 44.0"   | 68° 21' 28.0"    |

**Table 2:** Stream monitoring locations

### ***Field measurements and sample collection:***

#### **Lakes:**

Seventeen lakes were sampled monthly from May through October following the rotation schedule listed in Table 1. Monthly NETN sampling parameters included all basic water-chemistry measures determined with a YSI 600XL water-quality sonde, as well as Secchi transparency, weather, and lake stage. In June and August, in addition to in-situ water chemistry, depth-integrated epilimnetic samples were obtained for ANC, color, nutrients, and chlorophyll *a*. If a lake or pond was too shallow to obtain a Secchi disk transparency reading (because the disk hits the lake bottom before disappearing from view, a water column light extinction/attenuation profile was taken using a LI-COR radiation sensor. Additional water samples were analyzed for acidification parameters in April and October, during spring and fall turnover. The schedule for all lake monitoring measures is found in Table 3.

| April                                                          | May                                              | June                                             | July                                             | August                                           | September                                        | October                                          |
|----------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|
| Lake stage                                                     | Lake stage                                       | Lake stage                                       | Lake stage                                       | Lake stage                                       | Lake stage                                       | Lake stage                                       |
| Secchi depth*                                                  | Secchi depth                                     | Secchi depth                                     | Secchi depth                                     | Secchi depth                                     | Secchi depth                                     | Secchi depth                                     |
| YSI profile*:<br>Temp, DO,<br>pH,<br>conductivity              | YSI profile:<br>Temp, DO,<br>pH,<br>conductivity | YSI profile:<br>Temp, DO,<br>pH,<br>conductivity | YSI profile:<br>Temp, DO,<br>pH,<br>conductivity | YSI profile:<br>Temp, DO,<br>pH,<br>conductivity | YSI profile:<br>Temp, DO,<br>pH,<br>conductivity | YSI profile:<br>Temp, DO,<br>pH,<br>conductivity |
| Acidification<br>chemistry**                                   |                                                  | NETN<br>nutrient<br>chemistry**                  | Invasive<br>aquatic<br>plants                    | NETN<br>nutrient<br>chemistry**                  |                                                  | Acidification<br>chemistry**                     |
| *weather conditions permitting<br>**analytes listed in Table 5 |                                                  |                                                  |                                                  |                                                  |                                                  |                                                  |

**Table 3:** Lake monitoring parameter schedule

The lake sampling procedure entailed collecting all in-situ measurements and water samples from the deep hole (or center, in the case of lakes with uniform depth) of the lake. Half-meter deep grab samples were collected for acidification chemistry, based on the assumption that early spring and late fall water columns are relatively homogeneous. For lakes with poor accessibility by boat, a throw bottle was used to collect these epilimnion grab samples. The throw bottle took samples at a depth of 0.6 meters, at a distance of about 9 meters from shore. Nutrient chemistry parameters were analyzed from a series of epilimnion core samples (4-10 meter depth) integrated in a churn splitter if the lake was stratified, or a half-meter grab sample if unstratified.

Transparency was measured using a standard limnological Secchi disk (black and white) and a viewing scope with slanted glass and face mask. LI-COR spherical PAR and deck cells measured light penetration. Light attenuation coefficients were calculated using methods developed for the NPS North Atlantic Coastal Parks (Kopp and Neckles, 2004). In addition to daily lab calibrations, the YSI 600XL sonde was calibrated for dissolved oxygen and depth in the field before taking

readings at each site. A one-point field pH calibration (pH 7) was performed if water temperature was less than 10°C. Lake stage was measured from a drilled hole ("tape down point") in a large rock in each pond using a wooden leveling stick and folding ruler.

### Streams:

Twenty streams were sampled monthly from May through October following the rotation schedule listed in Table 2. Similar to lake monitoring, monthly sampling parameters included in-situ water-chemistry measures determined with a YSI 600XL water-quality sonde, weather, and stream flow (discharge), usually measured with a current meter. Grab samples were collected in May and August for ANC, color, nutrient, and chlorophyll *a* analysis. The stream monitoring schedule can be found in Table 4.

| May                                             | June                                  | July                                  | August                                                  | September                             | October                               |
|-------------------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------------------------|---------------------------------------|---------------------------------------|
| Discharge                                       | Discharge                             | Discharge                             | Discharge                                               | Discharge                             | Discharge                             |
| Habitat assessment*                             | Habitat assessment*                   | Habitat assessment*                   | Habitat assessment*                                     | Habitat assessment*                   | Habitat assessment*                   |
| YSI chem.: Temp, DO, pH, conductivity           | YSI chem.: Temp, DO, pH, conductivity | YSI chem.: Temp, DO, pH, conductivity | YSI chem.: Temp, DO, pH, conductivity                   | YSI chem.: Temp, DO, pH, conductivity | YSI chem.: Temp, DO, pH, conductivity |
| NETN nutrient chemistry**                       |                                       |                                       | NETN nutrient chemistry**<br>Benthic macroinvertebrates |                                       |                                       |
| *beginning 2008<br>**analytes listed in Table 5 |                                       |                                       |                                                         |                                       |                                       |

**Table 4:** Stream monitoring parameter schedule

Stream discharge was measured at the partial record sites using USGS protocols, generally employing a measuring tape, wading rod, and Price Pygmy™ current meter to measure a particular cross-sectional area of the stream and the velocity of the water past that cross section. Direct flow measurements, such as volumetric method (determining the time it takes to obtain a known volume of water from the stream), were employed when the stream flow could be completely contained, as in a perched culvert. These measurements are more accurate than metered discharge measurements, and were often useful during very low flow conditions, although they were not possible to obtain at all sites.

Three continuous record sites relied on automated meters to collect stream stage data in near real-time, from which discharge is calculated using a rating table. Cadillac and Hadlock Brooks each had USGS pressure-sensing gaging stations established in 1999. The USGS equipment was removed in September 2006 due to lack of funding. The reference benchmarks remain at each site, enabling discrete manual stage measurements, and subsequent discharge calculations. Global Water WL-16 level loggers were installed at both sites in July 2006 by University of Maine researchers, providing replicate data of the USGS gage for several months. The Global loggers have been reinstalled and maintained in 2007 and 2008 by park staff, retaining the continuous

record capability of the Cadillac and Hadlock sites. Although the WL-16s are unable to withstand solid freezing conditions, they have been successfully deployed from April through December.

A USGS permanent record gaging station was established at Otter Creek in May 2006, funded by the NETN. This site serves as an index gage for all the streams in the park to provide detailed streamflow information about one stream, allow for estimates of loads of constituents at this site, and provide data to make estimates of streamflow at hydrologically similar ungaged sites or partial-record sites. Otter Creek was chosen by USGS scientists for this purpose because it had instantaneous flows that correlated well with other measured sites (a property the Cadillac and Hadlock sites lacked), had good access at low, medium, and high flows, and had a suitable site for a gaging house. Data from this site are available in real-time on the world wide web ([http://waterdata.usgs.gov/me/nwis/uv/?site\\_no=01022840&PARAMeter\\_cd=00065,00060](http://waterdata.usgs.gov/me/nwis/uv/?site_no=01022840&PARAMeter_cd=00065,00060)), and discharge values recorded by the gage at the time of water sample collection are used in the monthly NETN monitoring data.

Stream water quality measurements and water samples were collected in close proximity to the location of the discharge measurement (preferably slightly upstream to avoid contamination, but prior to taking the discharge to avoid affecting the flow). As in lake monitoring, the YSI 600XL was calibrated for dissolved oxygen and pH (if necessary) after arrival at each site. Sonde measurements were taken in the main stream flow, with care taken that the sonde was not resting directly on the stream bottom. Grab samples were taken by submerging the sample bottle directly in the stream with a gloved hand. A peristaltic pump and Tygon® tubing were used to collect samples if water levels were too low to completely submerge a bottle.

A brief, monthly habitat assessment procedure was initiated in 2008. Habitat parameters that are likely to change on a monthly basis (channel depth, width and condition; embeddedness, canopy shading, presence of vegetation, etc.) were recorded on a field form and several photos were taken. The monthly values were compiled on an Excel spreadsheet.

### **Water chemistry:**

Laboratory analysis for acidification parameters has been conducted by the Sawyer Environmental Chemistry Research Lab (SECRL) at the University of Maine since 1996. This facility is the preferred source for the acidification analysis because of the consistency of methodology with much of the seminal acid deposition research conducted at Acadia during the 1980s, and the ability of these methods to accurately measure chemical concentrations in low ionic strength Maine waters. The suite of acidification analytes is detailed in Table 5.

The NETN nutrient samples were analyzed at the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado during the 2006 monitoring season, in accordance with the recommendation of the NETN protocol. In many cases, test results were below the reporting or detection limits of the NWQL methods (listed in Table 6), even for "low-level" methods. After the completion of several inter-lab comparison tests between NWQL and SECRL in August of 2006, it was decided that all 2007 analyses excepting nitrite, nitrite + nitrate, and ammonia would be conducted at SECRL. The NWQL was not used for any analysis during the 2008 season.

Occasional water samples were tested for pH and conductivity at the small lab located at Acadia National Park headquarters. These tests were generally conducted to verify the accuracy of the YSI

|                | Analyte                   | Method                                                                                                | Precision Objective +/- | Net Accuracy Objective +/- | Reporting Limit |
|----------------|---------------------------|-------------------------------------------------------------------------------------------------------|-------------------------|----------------------------|-----------------|
| Acidification  | pH, closed system         | Method 4500-H                                                                                         | 0.075                   | 0.025                      | na              |
|                |                           |                                                                                                       | 0.15                    | 0.05                       |                 |
|                | pH, equilibrated          | Method 4500-H                                                                                         | 0.075                   | 0.025                      | na              |
|                |                           |                                                                                                       | 0.15                    | 0.05                       |                 |
|                | ANC                       | Method 2320                                                                                           | 5 µeq/L                 | 4 µeq/L                    | na              |
|                |                           |                                                                                                       | 5%                      | 4%                         |                 |
|                | Conductivity              | Method 2510                                                                                           | 1 µS/cm                 | 1 µS/cm                    | na              |
|                |                           |                                                                                                       | 2%                      | 2%                         |                 |
|                | DOC                       | Sodium persulfate oxidation method - detected using a carbon analyzer, via infrared spectrophotometry | 0.1 mg/L                | 0.1 mg/L                   | 0.25 mg/L       |
|                |                           |                                                                                                       | 5%                      | 5%                         |                 |
|                | Al, total dissolved       | EPA Method 200.15 rev. 1.2                                                                            | ± 10%                   | ± 10%                      | 10 µg/L         |
|                | Ca                        | EPA Method 200.15 rev. 1.2                                                                            | ±10 ppb                 | ± 10%                      | 0.05 mg/L       |
|                |                           |                                                                                                       | ±10%                    |                            |                 |
|                | Mg                        | EPA Method 200.15 rev. 1.2                                                                            | ±10 ppb                 | ±10%                       | 0.05 mg/L       |
|                |                           |                                                                                                       | ±10%                    |                            |                 |
|                | Na                        | EPA Method 200.15 rev. 1.2                                                                            | ±10 ppb                 | ±10%                       | 0.05 mg/L       |
|                |                           |                                                                                                       | ±10%                    |                            |                 |
|                | K                         | EPA Method 200.15 rev. 1.2                                                                            | ±10 ppb                 | ±10%                       | 0.05 mg/L       |
|                |                           |                                                                                                       | ±10%                    |                            |                 |
|                | Ammonium: NH <sub>4</sub> | Colorimetrically at 660 nm, using an autoanalyzer                                                     | 0.02 mg/L               | 0.1                        | 0.1 mg/L        |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | Cl                        | Ion chromatography                                                                                    | 1 µeq/L                 | 0.8 µeq/L                  | 2 µeq/L         |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | Nitrate: NO <sub>3</sub>  | Ion chromatography                                                                                    | 0.5 µeq/L               | 0.4 µeq/L                  | 1 µeq/L         |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | SO <sub>4</sub>           | Ion chromatography                                                                                    | 1 µeq/L                 | 0.8 µeq/L                  | 2 µeq/L         |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | Si                        | Colorimetrically at 660 nm, using an autoanalyzer                                                     | 0.05 mg/L               | 0.1                        | 0.5 mg/L        |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | True Color                | SM Method 2120.                                                                                       | 5 NTU                   | 3 NTU                      | 5 PCU           |
|                |                           |                                                                                                       | 0.1                     |                            |                 |
| NETN Nutrients | ANC                       | Method 2320                                                                                           | 5 µeq/L                 | 4 µeq/L                    | na              |
|                |                           |                                                                                                       | 5%                      | 4%                         |                 |
|                | Apparent Color            | SM Method 2120                                                                                        | 5 NTU                   | 3 NTU                      | 5 PCU           |
|                |                           |                                                                                                       | 0.1                     |                            |                 |
|                | Total P                   | SM Methods 4500-P-B-5 and 4500-P E                                                                    | 1 µg/L                  | 0.8 µg/L                   | 1 µg/L          |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | Total Dissolved P         | SM Methods 4500-P-B-5 and 4500-P E                                                                    | 1 µg/L                  | 0.8 µg/L                   | 1 µg/L          |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | Ortho P                   | SM Methods 4500-P-B-5 and 4500-P E                                                                    | 1 µg/L                  | 0.8 µg/L                   | 1 µg/L          |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | Total N                   | Potassium persulfate digestion - detected using an autoanalyzer, colorimetrically at 540 nm           | 0.01 mg/L               | 0.1                        | 0.1 mg/L        |
|                |                           |                                                                                                       | 5%                      | 10%                        |                 |
|                | Total Dissolved N         | Potassium persulfate digestion - detected using an autoanalyzer, colorimetrically at 540 nm           | 0.01 mg/L               | 0.1                        | 0.1 mg/L        |
|                |                           |                                                                                                       | 5%                      | 10%                        |                 |
|                | Nitrite: NO <sub>2</sub>  | Colorimetrically at 540 nm, using an autoanalyzer                                                     | 1 µg/L                  | 0.1                        | 5 µg/L          |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | Ammonia: NH <sub>3</sub>  | Colorimetrically at 660 nm, using an autoanalyzer                                                     | 0.02 mg/L               | 0.1                        | 0.1 mg/L        |
|                |                           |                                                                                                       | 0.05                    |                            |                 |
|                | Nitrate + Nitrite         | Colorimetrically at 540 nm, using an autoanalyzer                                                     | 1 µg/L                  | 0.1                        | 5 µg/L          |
|                |                           |                                                                                                       | 0.05                    |                            |                 |

**Table 5:** Water chemistry analytes and analysis methods (Sawyer Environmental Chemistry Research Lab)

sonde measurements, or on samples from monitoring sites not included in the NETN or acidification schedule or budget. The pH and conductance meters used were the same instruments used for weekly National Atmospheric Deposition Program (NADP) field chemistry measurements, and all quality assurance/quality control (QA/QC) procedures and results are contained in NADP documentation and records.

| Analyte                                       | Method                                                                             | Result Unit      | Detection Limit | Reporting Limit |
|-----------------------------------------------|------------------------------------------------------------------------------------|------------------|-----------------|-----------------|
| Acid neutralizing capacity (ANC) Lab Code: 70 | Electrometric Titration,USGS Method ID: I-2030-89                                  | mg/L             | 5               | 5               |
| Apparent color Lab Code: 20                   | USGS Method ID: I-1250-89                                                          | Pt-Co unit (PCU) | 1               | 1               |
| Total phosphorus Lab Code: 2759               | Alkaline persulfate digestion, USGS Method ID: I-4650-03                           | mg/L             | 0.02            | 0.01            |
| Total phosphorus (Low Level) Lab Code: 2333   | EPA. 365.1                                                                         | mg/L             | 0.004           | 0.002           |
| Orthophosphate Lab Code: 3118                 | Colorimetry, DA, Phosphomolybdate, filtered. USGS Method ID: I-2601-90 , I-2606-89 | mg/L             | 0.006           | 0.003           |
| Total Nitrogen Lab Code: 2756                 | alkaline persulfate digest USGS Method ID: I-4650-03                               | mg/L             | 0.06            | 0.03            |
| Nitrite + Nitrate Lab Code: 1975              | Colorimetry, ASF, cadmium reduction - diazotization USGS Method ID: I-2545-90      | mg/L             | 0.06            | 0.03            |
| Nitrite + Nitrate (Low Level) Lab Code: 1979  |                                                                                    | mg/L             | 0.06            | 0.03            |
| Ammonia Lab Code:3116                         | Colorimetry, ASF, Salicylate-hypochlorite, USGS Method ID: I-2522-90, I-2525-89    | mg/L             | 0.01            | 0.005           |
| Nitrite Lab Code:3117                         | Colorimetry, DA, USGS Method ID: I-2540-90, I-2542-89                              | mg/L             | 0.002           | 0.001           |

**Table 6:** Water chemistry analytes and analysis methods (USGS National Water Quality Lab)

Samples to be analyzed for orthophosphate, total dissolved nitrogen, and total dissolved phosphorus were filtered through a 0.45-mm-pore-size capsule filter in the field, immediately after collection. Chlorophyll *a* samples were filtered through 0.47 mm membrane filters in the park laboratory, and the filters were kept frozen pending analysis. All water samples were refrigerated immediately after collection and were shipped chilled to the laboratory within 48 hours.

Field blanks and replicate samples were collected along with the regular samples each month to detect possible contamination and other potential problems with the sampling process. The laboratories also analyzed duplicate samples and other audit procedures to assess the precision of the laboratory analyses. All QA/QC procedures are documented in the NETN protocol.

### **Benthic macroinvertebrates:**

Benthic macroinvertebrates were first monitored in a subset of park streams representing a range of stream and watershed conditions (e.g. developed/undeveloped, headwater source/stream order, burned/unburned by major fire) likely to influence stream water quality and biological integrity. Duck Brook, Stanley Brook, Canon Brook, and Hunter's Brook, all located on the east-side of ANP, were sampled in 1997, the first year of macroinvertebrate monitoring at ANP (Gawley, 1998). Streams on the west side of the park were added in subsequent years, including Lurvey Spring Brook and Heath Brook in 1998, Marshall Brook in 2000. Streams and their specific monitoring locations have varied over the years both to increase sample sites to obtain a more diverse data set of macroinvertebrates in park streams, and to cut streams that had insufficient macroinvertebrate numbers (in Total Abundance and/or EPT Generic Richness categories) to satisfy the input criteria of MDEP's analytical model. Most recently, several sites were added to co-locate with NETN water monitoring activities. Sites monitored from 2005 through 2007 are shown in Figure 2.

Samples were collected using nylon mesh bags filled with stones with a uniform range of 1.5 to 3", weighing 7.25 kg +/- .50 kg that were completely submerged at each site. Three bags were spaced one to three meters apart. The preferred placement area was in a riffle (high flow) habitat, although low water conditions sometimes forced placement in pools to ensure total submergence. Habitat (depth, velocity, channel width, substrate composition, canopy coverage) and water quality (pH, specific conductance, temperature, dissolved oxygen, color) characteristics were recorded on a field data form when the rock bags were deployed. Photographs are taken to document sample location and rock bag placement at deployment and retrieval.

MDEP protocols require that all sampling be done during the low-flow period from July 1 to September 30. This period is generally considered the most stressful to aquatic organisms, due to increased water temperature and less dilution of pollutants. Because benthic macroinvertebrate community composition varies with the season, these restrictions also allow for sampling a standardized seasonal community. Selecting suitable sites during the mid-summer period can be challenging because many park streams have low flow and depth for optimal bag placement. All streams used as sampling sites must have sufficient water depth and velocity to reasonably expect adequate flow throughout the sampling period.

After being left undisturbed for 28 days (+/- 4 days), the bags were retrieved either by gently lifting into a large kick net (600 micron mesh) positioned immediately downstream, then transferring the bag contents to a sieve bucket (600 micron mesh), or quickly transferring the bag directly into a sieve bucket. The mesh bag and rocks were thoroughly inspected and hand cleaned. Organic material was retained in the bucket and the cleaned rocks were returned to the bag. The bucket contents were then transferred into wide-mouthed sample jars and preserved with 95% ethyl alcohol, and diluted with water to obtain an approximately 70% solution of alcohol to water. Preserved samples were transferred to MDEP for processing in their system. MDEP subsequently arranged for sorting (separating) of the invertebrates from the detritus and other debris, and taxonomic analysis. All specimens were identified to the lowest possible taxonomic level, preferably genus or species. In addition to the results of the taxonomic analyses, the park also obtained a specimen of each individual taxonomic identification level for incorporation into a benthic macroinvertebrate reference collection. Reference collection specimens were stored in glass vials with rubber stoppers or plastic caps and preserved in 70% ethyl alcohol with 5%

glycerin. Michael Winnell of Freshwater Benthic Services, Inc. has provided taxonomic analysis since 1997.

Since 2001, Hobo temperature loggers were deployed in three randomly selected streams, to provide data on water temperature fluctuations over the sampling period. During the 2005-2007 sampling periods, one logger was deployed at each of the five sampled streams. The data loggers were tied onto the mesh bags and record temperature at 30-minute intervals in degrees Celsius.

Taxonomic data were analyzed by MDEP using a linear discriminant model, outlined in Davies, et. al. (1995) to determine attainment of state water quality classification standards. A total of 30 indices and measures of community structure were calculated to determine one of four water quality groups corresponding to state stream classification for Class A, Class B, Class C, and Non-attainment (NA) waters.



**Figure 2:** Benthic macroinvertebrate monitoring sites 2005-2007

## Invasive aquatic plants:

Methods for invasive aquatic plant monitoring were adapted from the Maine Center for Invasive Aquatic Plants (MCIAP), a division of the Volunteer Lake Monitoring Program (VLMP). Detailed survey instructions can be found in the NETN protocols. ANP staff attend yearly Invasive Plant Patrol (IPP) trainings led by the MCIAP.

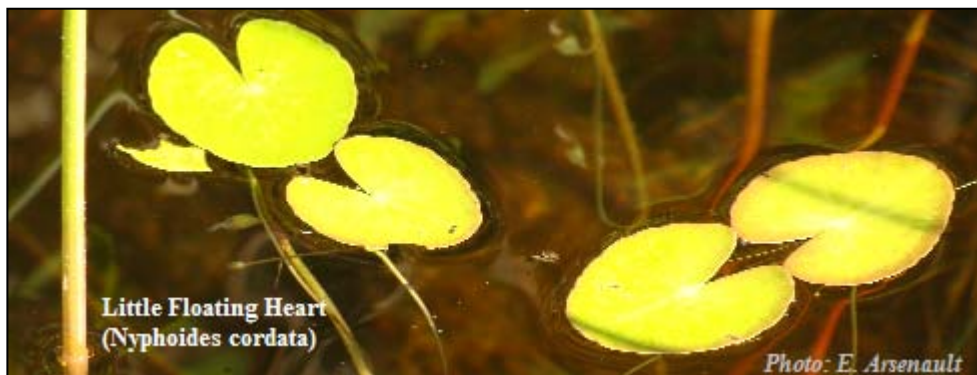
Surveys were conducted between mid-July and September so that plants were sufficiently developed to allow for identification. A three level survey approach exists. A level one survey screens a minimum of 300 ft. on each side of boat launch sites, and extends to a depth where native plants do not grow. A level two survey encompasses all of level one, and screens areas where native plant communities occur. A level three survey screens the entire littoral zone or areas in a water body where sunlight penetrates to the bottom. All ANP surveys were in the level one category. Surveys are conducted during an optimal time of day, with plenty of sun, wind is light, and there is low boat traffic.

Surveys were conducted in a small boat in teams of two, screening the area designated by the survey level. One surveyor screened the area toward the shore, and the other toward the outward extent of the littoral zone. A view scope was used to observe plants through the water, and a small rake was used to collect plant samples which were unable to be identified with viewing scope. Any samples collected were sealed in a zip top bag with water and labeled for later identification in the workroom.

If a plant was suspected of being invasive, the location was marked with a buoy, a specimen was collected and sealed in a container of water and labeled. The specimen was promptly sent to the MCIAP for professional identification.

| 2004                  | 2005                  | 2006                  | 2007                  | 2008                  |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Eagle Lake            | Eagle Lake            | Eagle Lake            | Eagle Lake            | Eagle Lake            |
| Echo Lake             | Echo Lake             | Echo Lake             | Echo Lake             | Echo Lake             |
|                       |                       |                       |                       | Hodgdon Pond          |
| Jordan Pond           |                       | Jordan Pond           | Jordan Pond           | Jordan Pond           |
|                       | Long Pond (south end) |                       | Long Pond (south end) | Long Pond (south end) |
| Long Pond (north end) | Long Pond (north end) | Long Pond (north end) | Long Pond (north end) | Long Pond (north end) |
| Lower Hadlock         | Lower Hadlock         | Lower Hadlock         | Lower Hadlock         | Lower Hadlock         |
| Seal Cove Pond        |                       | Seal Cove Pond        | Seal Cove Pond        | Seal Cove Pond        |
|                       |                       |                       |                       | The Tarn              |
| Upper Hadlock         | Upper Hadlock         | Upper Hadlock         | Upper Hadlock         | Upper Hadlock         |

**Table 7:** Lakes monitored for invasive aquatic plants



## RESULTS AND DISCUSSION

### **General:**

The 2006 through 2008 monitoring years were a transitional period, over which new sampling protocols were implemented, evaluated, and modified to address issues encountered each field season. The selection of the appropriate analytical laboratory evolved out of this process as well, and by the close of 2008 most of the field procedures and program components were considered to be in their final incarnations. Integration of the macroinvertebrate and invasive aquatic plant sampling with the NETN Vital Signs monitoring provided efficiency (through the ability to conduct both operations during one site visit) and valuable links between chemical, physical, and biological measurements.

Training was an important component of this developmental process. USGS and NETN staff conducted a two-day instructional session covering all protocol methods in May of 2006, and USGS personnel accompanied ANP staff as "mentors" during many 2006 monthly stream monitoring site visits. Park staff attended annual VLMP training and recertification sessions with Maine DEP biologists, as well as several MCIAP invasive plant identification workshops.

All field crews participated in annual post-season review sessions with NETN and USGS staff to evaluate monitoring protocol effectiveness and devise modifications, when needed. The revised protocols were tested during the subsequent field season and made permanent if the modifications were considered to be favorable. The review sessions also elicited decisions regarding site selection and addition or removal of program components.

### **Climate and precipitation trends:**

Both seasonal and annual shifts in precipitation and temperatures can have distinctive short-term and cumulative effects on lake levels, physical lake properties, and water chemistry. Mean annual precipitation measured at the McFarland Hill National Atmospheric Deposition Program (NADP) site at Acadia National Park headquarters for the period 1982-2008 was 54.32 inches. Annual precipitation trends for this period are shown in Figure 3. For the Acadia area, 2006 to 2008 annual precipitation was consistently above average (with both 2006 and 2008 exceeding this figure by more than ten inches).

Monthly precipitation during the monitoring season (plotted with temperature in Figure 4) was most consistent in 2008, with only September showing high values resulting from Hurricanes Hannah and Kyle. Spring and early summer precipitation was high in 2006 and 2007, and August was the driest month of each of the three years. Total precipitation (much of it snow) during January through March of 2008 was almost double that of totals for the same period in 2006 and 2007. November and December amounts were very consistent over the three years (totaling approximately 13 inches each year).

Summer air temperatures during 2006 -2008 were typical of conditions recorded over the past decade. July was the warmest month, with average temperatures ranging from 67 to 69.2 degrees Fahrenheit. August 2007 averaged 67.2 degrees, over three degrees higher than 2006 or 2008. Lake surface water temperature was strongly correlated with the air temperature, as well as solar radiation. The relationship between these three parameters is shown in Figure 5.

### Total Annual Precipitation (inches) 1982-2008

(data from McFarland Hill recording rain gauge)

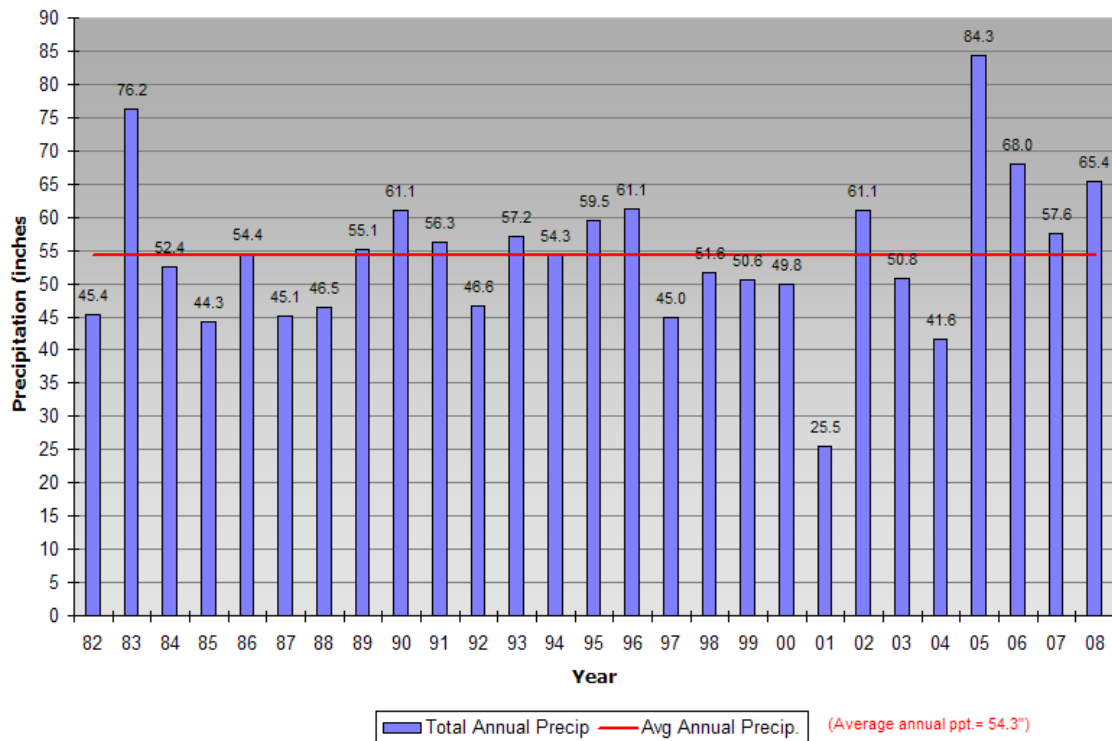


**Figure 3:** Annual precipitation (from McFarland Hill air monitoring site)

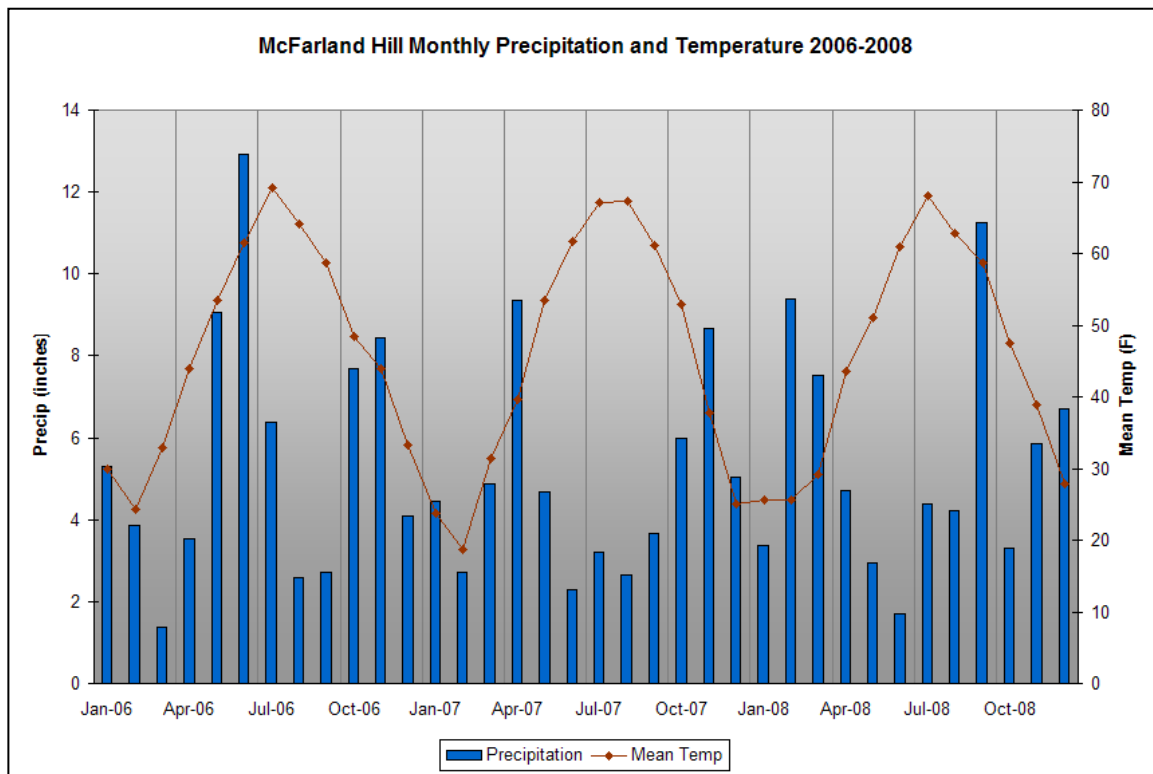


**Figure 4:** Monthly precipitation and temperature (from McFarland Hill air monitoring site)

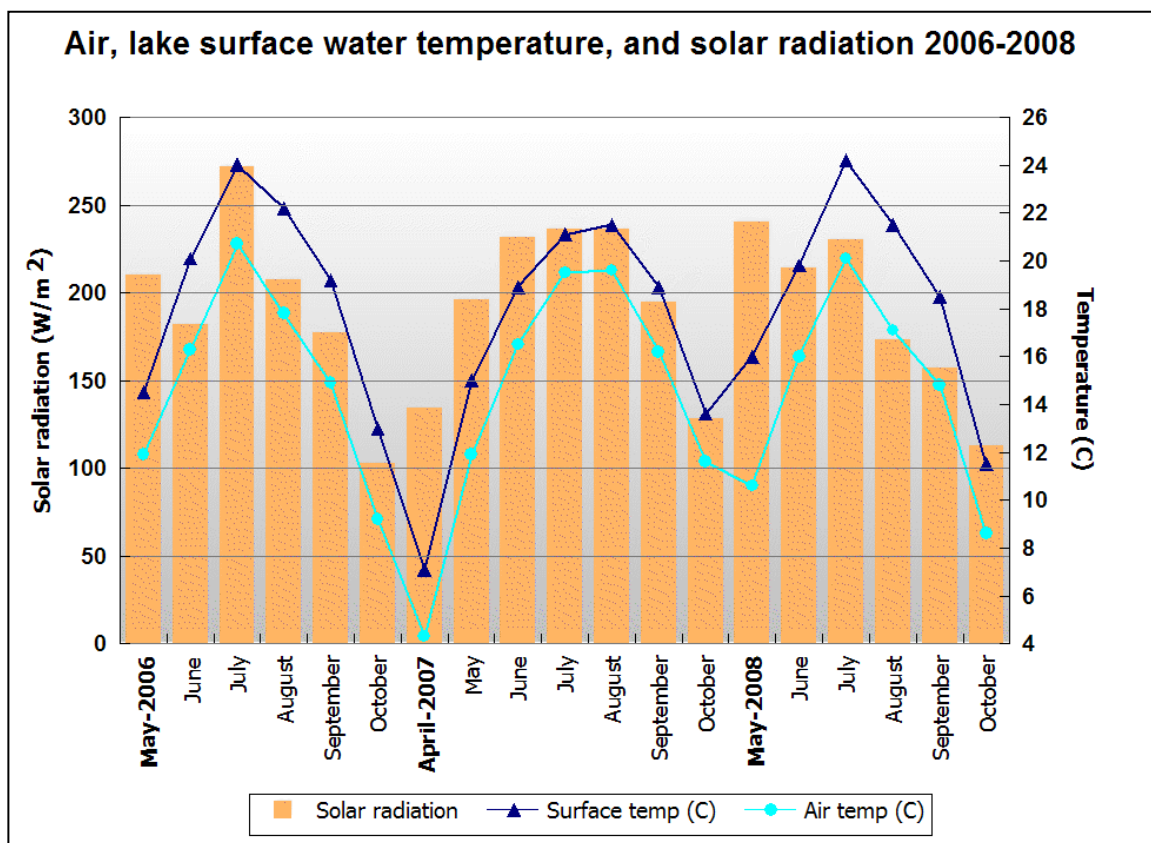


**Figure 5:** Mean monthly air temperature, solar radiation (from McFarland Hill air monitoring site), and lake surface temperature (all monitored lakes)

### Lake stage monitoring:

By the close of the 2008 monitoring season, lake levels were measured weekly at 18 sites from early May through the end of October, or later (depending on icing conditions and the ability to access the monitoring sites). As new lake monitoring sites were added to the NETN regimen, they were also added to the lake stage site list. Two of the new sites (Seawall and Hodgdon Ponds) required staff gages to be installed in the ponds themselves, since there were no boulders or other stable locations at the pond margins to install drilled benchmarks for direct measurements.

Spring lake levels are influenced by snowmelt and spring rains. Summer and fall levels are influenced by precipitation and evapoconcentration. Additional factors that can affect lake levels are drinking water demand in water district lakes (Bubble, Eagle, Long, Upper and Lower Hadlock, Jordan), use for fire control (the Tarn), and human and beaver damming activity. Some lakes are flashier in response to the timing, frequency, and duration of rainfall depending on their watershed influences and flushing rate. As noted in previous reports (Seger, 2006), lake levels reflected rainfall trends throughout the summer and into fall. Graphs of lake levels and precipitation from 2006 through 2008 are in Appendix B, along with groundwater level data from USGS wells.

Emergent vegetation at the Tarn and Aunt Betty ponds continues to be plentiful, as noticed in recent years. Both of these ponds are naturally very shallow with summer water levels between 1 and 2 meters, and have active beaver activity. These ponds appear to be slowly succeeding to freshwater wetlands as organic sediments accumulate on the pond bottom. The addition of stage data from Upper and Lower Breakneck, and Bear Brook Ponds provides an interesting contrast to the information from the Tarn and Aunt Betty Pond. The Breaknecks are similar in size and basin characteristics to the first two (though deeper), but not in as advanced state of succession, and appear to be more responsive to precipitation, and less susceptible to drought. Bear Brook Pond

was extremely low for much of the 2006 and 2007 season, although levels were higher in 2008, and installation of a staff gage would facilitate obtaining measurements in future years.

Lower Hadlock Pond is the municipal water supply for the town of Northeast Harbor. Water company personnel were engaged in extensive dam repairs during the summer of 2007, which required intentionally lowering the level of the pond. These actions resulted in a drop of nearly ten feet for several weeks during the summer season. By November, the lake had returned to levels equivalent to those in the spring.

### Secchi disk transparency:

One long-term water quality measurement available for the majority of lakes monitored at ANP is Secchi depth transparency. Monthly transparency values are available in Appendix A, along with other water quality parameters. Graphs of annual mean Secchi transparency and Trophic State Index (TSI) data from 1980s to present are included in Appendix C.

The more oligotrophic lakes appear to have slightly more variation in annual Secchi readings, suggesting that these lakes may be more responsive to precipitation and other environmental influences. The general Secchi trend in most of the lakes for which we have sufficient data showed a slight increase in transparency from the early 1980s until around 1996, when Secchi depths began to decrease- a trend continuing through 2008. Variation in precipitation is one of the major factors contributing to these shifts. Often during drier conditions, such as the extreme drought of 2001, lakes will become more clear due to less runoff of nutrient and soil inputs. In contrast, decreased Secchi readings, can often be attributed to high levels of spring and fall precipitation, and cumulative effects of high rainfall years. The relationship between precipitation and transparency is illustrated in Figure 6.

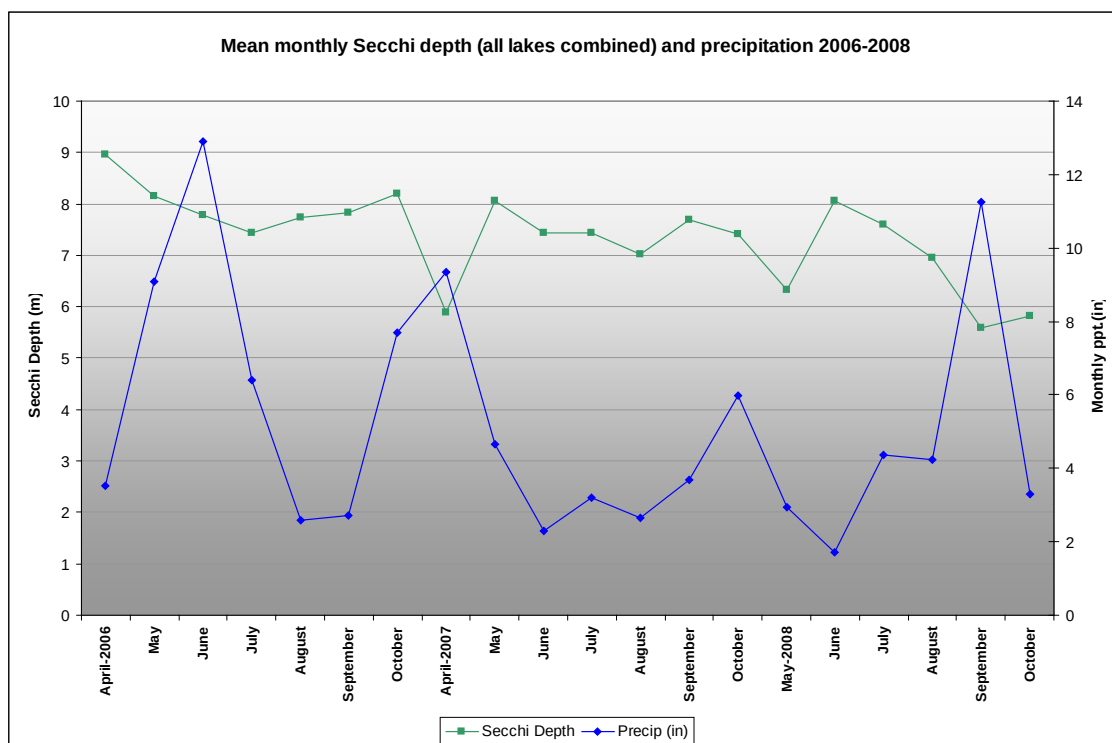


**Figure 6:** Mean monthly Secchi transparency and total monthly precipitation (from McFarland Hill air monitoring site)

### **Dissolved oxygen and temperature:**

Dissolved oxygen (DO) is the measure of the amount of oxygen occurring throughout the water column. Low oxygen rates can stress or directly kill organisms. Water with less than 1 mg/L of oxygen is considered anoxic and can promote the release of phosphorous from sediments and possibly increase algal blooms; less than 5 mg/L (hypoxia) is generally considered stressful to most coldwater fish. Temperature affects DO as well, in that increased water temperature leads to decreased oxygen solubility. Near the bottom of the water column, the more mesotrophic Seal Cove, Witch Hole, and Upper Hadlock ponds often reached below 5 mg/L or became anoxic during the months July through September. The more oligotrophic lakes sometimes reached below 1 mg/L, but only directly above the bottom sediment.

Graphs of annual mean hypolimnion depth, dissolved oxygen, and temperature for each of the lakes are found in Appendix D. Although annual mean hypolimnion depths for all lakes combined are decreasing since 2006 (indicating a greater percentage of the water column in the hypolimnion layer), both mean hypolimnion temperature and DO levels appear to be relatively stable. This indicates that the majority of the water column in park lakes continues to be well oxygenated.

Annual mean lake epilimnion temperatures appear to be fairly consistent since 1995 (the early limit of consistent data record), with variation likely being explained by varying air temperature and solar radiation levels. Without exception, all the monitored streams were well oxygenated, and temperatures varied in accordance with stream sources and seasonal weather conditions.

### **NETN nutrient chemistry:**

Results of water chemistry samples analyzed at the USGS and UMO labs from 2006 to 2008 are included in tabular form in Appendix A and are graphed in Appendix E. Although trophic levels of the monitored lakes range from oligotrophic to eutrophic (most are mesotrophic), and a similar variety of stream types are sampled, nutrient levels are generally low. In general, the data continue to indicate that values for most water quality parameters were within their historical range (when known) and meet park water quality objectives.

In the lakes, seasonal (June/August) values for total phosphorus, total nitrogen and chlorophyll *a* from 1996 to 2008 showed general patterns similar to the monitoring results of previous years. Total phosphorous (TP) and total nitrogen (TN) were generally higher in the early summer compared to late, likely due to spring runoff from snowmelt and rainfall. Chlorophyll *a* was higher in the late summer, as this is the prime growing time for phytoplankton and algae. The smaller, shallower, warmer lakes generally had higher nutrient concentrations and Seawall Pond, a shallow pond in close proximity to the ocean, was the clear outlier showing all nutrient values two to three times higher than any other lake. There are no total dissolved phosphorus (TDP) or total dissolved nitrogen (TDN) results for 2006 due to laboratory omissions.

Total phosphorus concentrations in the lakes ranged from 1.2 µg/L in Jordan Pond to 51 µg/L in Seawall Pond. Total dissolved phosphorus and orthophosphate results were proportionately lower, but followed similar trends. TN was generally below 0.5 mg/L at most sites, with Seawall Pond hitting 2.29 mg/L in August 2007. Total dissolved nitrogen ranged from 0.101 to 0.336 mg/L (excepting 2 high Seawall values). Lake concentrations of other nitrogen analytes (nitrate, nitrite, ammonia) were extremely low, with many results below laboratory reporting limits. Most lakes had chlorophyll *a* values below of 4 µg/L.

Nutrient parameters for streams were in similar ranges as those for lakes. Lurvey Brook, Marshall Brook, and Heath Brook, all draining from wetlands on the west side of Mount Desert Island, had the highest TP and TN scores. Because of the limited amount of historical water quality information available for many of the stream sites and the short current monitoring history, it will be several years before any trend analysis will be possible.

### **Acidification chemistry:**

Results for the ten lakes sampled for acidification analytes indicate pH and acid neutralizing capacity (ANC) remained relatively stable both seasonally (spring/fall) and annually within each lake from 2006 to 2008 (see Appendix G). Sargent Mountain Pond was the most acidic lake with a mean air equilibrated pH of 4.97, and mean ANC of  $-8.18 \mu\text{eq/L}$ .

Echo Lake was the most circumneutral with a mean pH value of 7.02, and mean ANC of  $79.57 \mu\text{eq/L}$ . Spring pH and ANC tended to be somewhat lower than fall values in the majority of the acidification lakes, most likely due to spring melt episodic acidification. The exception to this trend was Sargent Mountain Pond in 2007. This high elevation, headwater lake receives a smaller input from spring melt than those lower in their watersheds, and low precipitation amounts in April 2007 provided minimal direct deposition.

Dissolved organic carbon (DOC) level in lakes followed fairly predictable patterns from 2006 through 2008. Fall concentrations were generally higher than those in the spring, owing largely to increases in DOC from lake metabolic processes throughout the growing season. The Bowl, Upper Hadlock, and Witch Hole Ponds exhibited the largest differences between spring and fall DOC levels. This, along with similar seasonal trends in true color, suggests that these ponds receive a larger proportion of DOC from their surrounding watersheds via runoff from heavy rain events in September and October.

Atmospheric sulfate deposition has declined in recent years, a likely result of the emission limit provisions of the Clean Air Act. Consequently, sulfate levels in ANP lakes have tended to be steady, or slightly reduced, since deposition is considered to be the major source of sulfate input. This trend has continued from 2006 to 2008. There has been no corresponding decline in nitrate deposition, and nitrate levels in the lakes have remained steady, albeit generally low. There are several noticeable nitrate spikes in the reporting period (Sargent Mountain Pond in spring 2006, and Long & Bubble Ponds in spring 2007) which may be a result of sampling in proximity to a concentrated precipitation event.

At this point in the monitoring history there are insufficient data to infer any trends in acidification chemistry for streams. The graphs in Appendix G show the general range of values for stream pH, specific conductance, and ANC.

### **Quality Assurance/Quality Control (QA/QC):**

Transparency QA/QC protocols entailed taking replicate observations, using both one and two observers. Measurements were required to be within  $\pm 0.5$  meters to be acceptable. Over 95% of the replicate observations were within the acceptable range.

YSI sondes were checked weekly with certified check samples prior to field deployment, and replicate field samples were checked with benchtop pH and conductivity meters at approximately monthly intervals in the ANP laboratory. Excepting circumstances of traumatic sensor failure (notably the pH probe in 2007), the sonde consistently measured the standards within accuracy limits, and agreed closely with the benchtop meters.

Blanks and replicate samples provided precision and accuracy information for water chemistry sample collection and processing, and were evaluated using EPA methods (USEPA, 2004). Analysis of blank samples produced values below detection limit for most sampling parameters. There were four blank samples with apparent color concentrations that were out of acceptable range ( $> 1$  PCU). Additionally, there were four blank samples with orthophosphate ( $\text{PO}_4$ ) concentrations greater than the accuracy objective of  $1 \mu\text{g/L}$ . Two of these samples were estimated values from the NWQL, since the reported value of  $3 \mu\text{g/L}$  was well below the method reporting limit (MRL) of  $6 \mu\text{g/L}$ . The other two blank samples high in  $\text{PO}_4$  were analyzed at SECRL, and were only slightly out of range, with values of  $1.1 \mu\text{g/L}$  and  $1.4 \mu\text{g/L}$ . All of these values could have been results of analytical error, since Total P concentrations for all the samples were within acceptable range.

Replicate samples documented significant differences between apparent color analysis results from the NWQL and SECRL. During the 2007 season, one replicate from each monthly sample set was sent to each of the two labs, and only apparent color results exceeded precision objectives (as measured by percent standard deviation). Comparison with historic data indicated that the SECRL color values were closer to long-term means (also the case for most other analytical parameters), which weighed heavily in the decision to conduct all analysis at SECRL beginning in the 2008 season. Another replicate pair from 2007 (analyzed solely at the NWQL) was out of the acceptable precision range for ANC.

Tables of QA/QC results and comparisons are found in Appendix A.

### **Light penetration profiles:**

Light penetration profiles were collected monthly for several of the shallower lakes and ponds from 2006 through 2008, using a LI-COR submersible PAR cell and surface deck cell. These measurements were valuable for sites that were too shallow for valid Secchi transparency observations, as attenuation coefficients calculated from the profile data are a consistent index for seasonal comparison of lake transparency. This information begins to address a data gap noted in the 1998-2001 Lake Monitoring Report (Breen, et.al, 2002).

The profile information from deeper lakes can also be of value for comparison with dissolved oxygen and temperature data to relate to productivity/food web studies. Several profiles were taken in deeper lakes during the summer of 2007 to support a University of Maine research project on zooplankton community structure (Whitmore, 2008).

Since most of the shallow lakes only have data from one complete season, it is too early to comment on any potential trends. All the data collected from 2006 through 2008 are consistent with those collected in earlier “snapshot” monitoring efforts. Light penetration profile data and graphs are found in Appendix F.

### **Benthic macroinvertebrates**

The reference collection increased to a total of 227 species in 2008. All new species collected in future sampling will be added to the collection. Details of model results from 2005 to 2007 and graphs of continuous stream temperatures for each sampling year are included in Appendix H.

### *Precipitation and Stream Flow*

In 2005, the 3.17 inches of August rainfall was above the 1982 to 2004 August average of 2.71 inches, and the distance from the water surface level to the top of the rock bags generally increased during the sample period. Flow rates were the equivalent or slightly faster at bag take-out,

compared to bag put-in. The exception was Lurvey Spring, which had a decreased depth and flow rate. In 2006 and 2007, with 2.59" and 2.66" of rainfall respectively, stream depths were shallower, and flow was slower when the bags were retrieved than when they were placed, as expected with late-summer low flow conditions. Man O' War Brook was completely dried up by its retrieval date in September 2007, so no sample was collected.

#### *Model/Class Analysis*

Stream classifications determined by model analysis were based on the relative abundance of certain key taxa such as EPT (*Ephemeroptera*, *Plecoptera*, *Tricoptera*), overall generic richness, and other weighted calculations such as the ratio of selected indices to mean total abundance. The model results determine whether a stream attains its assigned statutory water quality designation (class A, B, or C, with A being the highest quality), drops to a lower classification level, or is in non-attainment of state water quality standards. All streams in ANP were designated as Class A by the Maine State Legislature's Water Classification Program (38 MRSA 4-A). The program provides for the use of best professional judgment (BPJ) in interpreting the model results in certain situations where it can be shown that there is a preponderance of evidence that an adjustment to the outcome of the statistical model is warranted.

During a period of severe drought in 2001 and a subsequent slow recovery, analysis of monitoring results showed that Duck Brook had gone from a class A stream (sample years 1997 to 2000), to the equivalent of a class C in 2001, and class B in 2002. By 2004, it appeared that possible effects from the drought had ceased and Duck Brook had "recovered" to class A. (Seeger, Gawley, 2006). Sampling of Duck Brook continued from 2005 through 2007, yielding class A status in 2005 using the model, and based on BPJ in 2006, as the minimum number (total mean abundance) for the decision model was not met. In 2007, Duck Brook received a non-attainment status based on BPJ due to low flow. Re-sampling was recommended. The mean Duck Brook stream temperature during the 2007 sampling period (17.88° C) was almost two degrees colder than the previous two years, which were 19.53° C in 2005 and 19.84° C in 2006.

Hunters Brook, last sampled in 2005, is an example of a stream that appears to have successfully recovered from the drought effects of 2001. Monitoring results from 1999-2001 assigned Hunters Brook two "I" (insufficient number) determinations since the sample did not satisfy the minimum data requirements of total mean abundance of at least 50 individuals; generic richness for 3 replicate samplers of at least 15), and one class C determination, respectively. Conditions improved in 2003, and the brook returned to a class A status, retaining this rating in 2004 and 2005. Hunters Brook stream temperatures for the 2005 sample period ranged from 20.04° C to 13.36° C, with a mean of 16.47° C.

Otter Creek was originally monitored under the site name "Canon Brook", a reference to the creek's major contributing headwater stream. The Otter Creek name was adopted in 2006 to remain consistent with the NETN and USGS name for this sampling site. Monitoring efforts at this site from 1997 through 2001 yielded mostly poor results. 1997 and 1998 both received C determinations, 1999 received an A, and both 2000 and 2001 received I determinations. The C and I ratings were reached because the minimum requirement for mean total abundance was not met. In 2006, it was decided that Otter Creek would be sampled again, but the sample site was moved approximately 150 yards upstream of the traditional pool sites in order to utilize water that was shallower and quicker moving. This decision was discussed with the DEP, and the 2006 sample yielded a B model class. This rating was based on the model, but may have been influenced by the large number of *Rheotanytarsus*, a pollution-tolerant species.

Stanley Brook consistently scored a class A result from 1997 to 2003. In 2004 an additional site (named as “Stanley- North”) was sampled about 500 feet upstream of the historic site (now called “Stanley- South”), and about 70 feet downstream of the confluence of Stanley and its tributary. The new site was sampled to investigate the variance of results along the stream channel. Due to storm events and resulting high and fast flows, the rock bags at the historic site (Stanley- South) were completely covered by the sand and gravel substrate, thus samples were not collected. At the upstream site, the bags were filled with smaller amounts of sand and gravel, and samples were able to be collected. Despite the sediment contamination and slightly new location, Stanley Brook received a class A score in 2004, consistent with results from the previous seven years. The 2005-2007 samples were all taken at the original (downstream) location, and these samples all received class A designations. Stanley Brook temperatures were fairly consistent from year to year; although 2005’s lowest temperature was warmer than the other two years by two degrees.

Model results for Lurvey Spring Brook have improved from a class C to B designation since 1998. Samples from 2003 received a C classification, but the 2004 model results returned the stream to class A status, which it retained in 2005 and 2006. Lurvey Spring Brook, fed predominantly with cooler groundwater, was the coldest of all the macroinvertebrate streams, averaging between 12 and 13° C. Lurvey Spring Brook was not sampled in 2007.

Macroinvertebrate samples have been taken at Marshall Brook since 2000, and analysis results returned a class A rating for the first three years sampled, including the period of the 2001 drought. In 2003, the stream dropped to class C determination, though in 2004 and 2005 the designation returned to class A. In 2006, Marshall Brook received a class B rating, and analysis notes suggested that larger numbers of *Rheotanytarsus* in the sample could have contributed to the slightly lower rating. Mean, maximum, and minimum stream temperatures were nearly identical in 2005 and 2006.

Three new stream sample locations were added in 2007, including the Lake Wood outlet stream, another site on Duck Brook (at the outlet to Eagle Lake), and Man O’ War Brook. These sites were chosen for macroinvertebrate monitoring in order to supplement the physical and chemical data already being collected at these NETN monitoring sites. All three new sites yielded poor results due to low flow.

The Lake Wood outlet site was located approximately 360 meters downstream of Lake Wood. It yielded a class C determination due to low numbers of collected organisms, and re-sampling was suggested. The Duck Brook/ Eagle Lake outlet model results returned a N/A determination. Due to low flow, re-sampling was suggested. The new Duck Brook site was considerably warmer than the historic site. The lowest temperature at the Eagle Lake outlet reached only 18.41° C, and the maximum temperature was 25.78° C. Man O’ War Brook completely dried up by the take-out date, so no sample was analyzed.

### **Invasive aquatic plants**

ANP staff, Mount Desert Water District staff, and community volunteers have surveyed 10 different ponds for aquatic invasive plants since 2004 (see Table 7 for surveyed waterbodies). Seven ponds were surveyed in 2004; six in 2005, seven in 2006, eight in 2007, and 10 ponds were surveyed in 2008. Most of these surveys were screened at a level one intensity.

Throughout the five years of monitoring, level two surveys have been completed five times, and level three surveys were done twice. The NETN protocol recommends conducting level two

surveys on high risk lakes on a rotating basis, exemplified by the 2008 survey of the south end of Long Pond. Mount Desert Water District staff also opted to conduct level two surveys of Lower Hadlock and Jordan Ponds in 2004 and 2007 respectively, and a level three survey of Lower Hadlock in 2007. In 2008, Hodgdon Pond was monitored by ANP/NETN staff using level two methods, and The Tarn at level three, in order to provide a thorough initial invasive plant screening as well as a general inventory of native aquatic plants.

The primary targets of the invasive plant surveys were the 11 plants currently listed by the MCIAP as imminent threats to Maine waters. These are:

- European Frogbit (*Hydrocharis morsus-ranae*)
- Water Chestnut (*Trapa natans*)
- Yellow Floating Heart (*Nymphoides peltata*)
- Eurasian Water Milfoil (*Myriophyllum spicatum*)
- Variable Water Milfoil (*Myriophyllum heterophyllum*)
- Parrot Feather (*Myriophyllum aquaticum*)
- Fanwort (*Cabomba caroliniana*)
- Hydrilla (*Hydrilla verticillata*)
- Brazilian Elodea (*Egeria densa*)
- European Naiad (*Najas minor*)
- Curly-Leaved Pondweed (*Potamogeton crispus*)

Results indicated that invasive aquatic plants do not currently exist in any of ANP's surveyed ponds.

## CONCLUSIONS

### Lakes and streams

The incorporation of NETN lake and stream monitoring protocols during the 2006 season bolstered the ability to detect changes in the quality and quantity of ANP surface waters, while retaining data comparability with the park's ongoing acidification effects monitoring, stream macroinvertebrate monitoring, invasive aquatic plant surveys, and historic water quality records dating back to the early 1980s. Implementation of an annual stream monitoring program addressed a need for a standardized regimen for the collection of water chemistry and streamflow data that was expressed in the Acadia National Park Water Resources Management Plan. The subsequent testing, evaluation, and revision of these protocols over the three monitoring seasons covered in this report successfully demonstrated that these methods could be effective in capturing valid data from a variety of water bodies, during wide-ranging weather, climate, and flow conditions.

It is clear that changes in water quantity, and their effects on water quality, must be evaluated in concert with the apparently increased variation in annual and seasonal environmental/climatic patterns experienced in recent years. The ranges of seasonal and annual precipitation and temperature conditions appear to have become more extreme in the past decade, and an effort should be made to consider the consequences to lakes and streams if these conditions persist.

Two high-precipitation years (2006 and 2008), and one year with precipitation levels slightly above average produced the expected decline in lake water transparency during the reporting period, but most lakes appear to be experiencing a longer trend of decreasing transparency when we plot a data range beginning in the mid-1990s. This apparent trend was discovered during an in-progress statistical analysis of the past 10 years of lake water quality data. The perceptible decline has yet to have been correlated with any other single chemical or environmental parameter, although the trend analysis project is currently not complete (A.C. Ellsworth, pers. comm., 2009).

Lake levels and stream flows varied in accordance with seasonal precipitation trends. Although total annual precipitation in 2007 was slightly above the 1982 through 2008 average of 54.3 inches, the summer months (especially July and August) were relatively dry, creating challenges for stream discharge measurements and macroinvertebrate monitoring. Several alternative techniques and instrumentation choices for obtaining flow values were discussed in the 2007 post-season review. The opposite issue arose the following year when in the aftermath of two hurricanes, high-flow conditions washed away two sets of macroinvertebrate collectors, and complicated discharge monitoring by approaching the recommended limits of the Price Pygmy™ meter.

Dissolved oxygen levels were within the expected ranges for the trophic type of each lake. Deep lakes (25 to 50 meters) remained well oxygenated at all depths despite strong thermal stratification. Medium (12 to 24 meters) depth and shallow (< 12 meter) lakes exhibited some oxygen depletion in lower strata, but concentrations were generally above 6 mg/L in at least 50% of the water column of these lakes. All monitored streams were well oxygenated, with only Heath Brook and Aunt Betty Pond Inlet approaching minimal average concentrations of 6 mg/L (6.4 and 6.6 mg/L respectively, in 2008).

Results of summer (May-June/August) nutrient sampling showed that phosphorus, nitrogen and chlorophyll *a* concentrations from 2006 to 2008 were relatively low, and generally within the historical range of variability for ANP waters. Notable exceptions were the high P and N values in Seawall Pond in 2007. There is a minimal historic data record for this pond, so it is difficult to determine whether these values are representative of “normal” water chemistry, but the frequent use of the pond by waterfowl suggests this may be the case. Spring/Fall acidification sampling of lakes indicated that pH and acid neutralizing capacity (ANC) remained relatively stable both seasonally and annually, and reflect the changes in precipitation chemistry resulting from the emission reductions required by the Clean Air Act.

Although current lake transparency and temperature/dissolved oxygen descriptive statistics were compared to those dating back to the mid 1990s, this report did not attempt to determine long-term trends for specific water chemistry parameters. Several of the analytes have changed in recent years from those used in earlier monitoring efforts, and not all sites have a sufficient data history to enable trend detection. This is especially the case with stream sites, most of which have not been monitored regularly by ANP staff before the inception of the NETN program. A rigorous statistical analysis of 10 years of lake monitoring data (1996 through 2006), including an assessment of earlier lake monitoring data sets, is currently being conducted by the NPS Regional Hydrologist, with a final report expected in early 2010. This report will help to determine if the NETN monitoring strategy will provide the data necessary to determine long-term trends in key water monitoring parameters.

In summary, three years of monitoring under the NETN protocol have provided critical information on the chemical and physical status of ANP lakes and streams. Refinements of the monitoring

protocol, such as changes in the analytical laboratory and enhanced QA/QC procedures, have improved the data quality with each subsequent year, allowing a better understanding of the seasonal and temporal variability of individual constituents within each water body. As more data are collected, the ability to detect changes outside this natural range of variability will increase, which in turn will more clearly indicate the status of the vital signs of water chemistry, nutrient enrichment, water quantity, and the detection of invasive plant species.

### **Benthic macroinvertebrates**

The benthic macroinvertebrate monitoring program at Acadia National Park continues to fulfill the objectives initially set out in 1997. Since the program was established, eleven years of baseline abundance and diversity data have been obtained for two park streams, eight to nine years for two other park streams, six to seven years for three streams, and one year of data on another three streams. There is likely a sufficient amount of data to consider analysis for long-term trends. This could be accomplished through a collaborative project with MDEP biologists, or as a project for a university graduate student.

Recommendations for future monitoring include continuing to incorporate NETN monitoring sites into the macroinvertebrate monitoring schedule, and exploring different stretches of upper Duck Brook (Eagle Lake Outlet) and Man O' War Brook for more suitable rock bag placement. Also, it may be beneficial to sample upstream and downstream of several prominent storm water drainages into Stanley Brook to determine possible environmental effects of these inflows on stream ecology.

### **Invasive aquatic plants**

Invasive aquatic plant monitoring has become a core component of the ANP water program. Since non-native, invasive plants have recently been found in over 20 Maine lakes (MCIAP, 2009), it has become crucial to closely monitor the status of park waters. The early detection of an infestation can make eradication or control more feasible, and it can lead to efforts that reduce the spread of the plant to neighboring waterbodies. Designating the early detection of these plants as a NETN vital sign and the ongoing partnership with state and local monitoring and eradication efforts are highly effective prevention strategies, and are recommended to continue at current or enhanced levels.

### **Further recommendation**

The data gathered by ANP/NETN aquatic monitoring efforts should continue to be integrated with information obtained from other aquatic research conducted at ANP, in order to better understand the current condition of the freshwater resources, as well as their responses to environmental variability and anthropogenic threats. Encouragement, attraction, and facilitation of external research are important ANP Water Resource Program/NETN functions.

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## **APPENDIX A**

Water chemistry data: 2006-2008



## Lake Acidification Chemistry Data 2006

| Lake             | Date       | CCpH | EQpH | SpCond (uS/L) | ANC (ueq/L) | T color (PCU) | DOC (mg/L) | TN(mg/L) | Ca (ueq/L) | Mg (ueq/L) | K (ueq/L) | Na (ueq/L) | Cl (ueq/L) | NO3 (ueq/L)      | SO4 (ueq/L) | NH4 (mg/L)        | Al (ug/L) |
|------------------|------------|------|------|---------------|-------------|---------------|------------|----------|------------|------------|-----------|------------|------------|------------------|-------------|-------------------|-----------|
| Bubble Pond      | 4/12/2006  | 6.42 | 6.75 | 29.4          | 46.38       | 5             | 2.3        | 0.15     | 82.76      | 37.10      | 5.54      | 128.93     | 127.64     | 1.3              | 56.77       | 0.004             | 49.1      |
| Bubble Pond      | 10/17/2006 | 6.45 | 7.02 | 28.8          | 65.6        | 3             | 2.41       | 0.12     | 72.85      | 33.74      | 5.88      | 130.94     | 111        | <MRL 1           | 64.42       | <MDL 0.02         | 16        |
| Eagle Lake       | 4/18/2006  | 6.33 | 6.71 | 32.9          | 41.45       | 4             | 2.1        | 0.13     | 75.12      | 37.00      | 5.60      | 159.87     | 155.8      | 0.75             | 58.8        | <MDL              | 17.3      |
| Eagle Lake       | 10/11/2006 | 6.42 | 6.82 | 33.3          | 49.3        | 3             | 2.32       | 0.10     | 67.37      | 34.56      | 5.88      | 160.08     | 155        | <MRL 1           | 61.97       | <MDL 0.02         | <MRL 10   |
| Echo Lake        | 4/19/2006  | 6.65 | 6.92 | 64.5          | 72.33       | 10            | 3.5        | 0.15     | 126.18     | 60.62      | 9.28      | 344.11     | 370.3      | 0.59             | 73.2        | <MDL              | 28.8      |
| Echo Lake        | 10/24/2006 | 6.63 | 7.06 | 66.2          | 90          | 7             | 3.65       | 0.13     | 125.25     | 60.07      | 9.72      | 308.85     | 374        | 0.38             | 72.94       | <MDL 0.02         | <MRL 10   |
| Jordan Pond      | 4/12/2006  | 6.45 | 6.85 | 32.9          | 56.85       | 5             | 2          | 0.13     | 92.29      | 41.95      | 6.24      | 144.85     | 136.75     | 2                | 68.11       | 0.005             | 23.5      |
| Jordan Pond      | 10/16/2006 | 6.63 | 7.08 | 32.6          | 64.5        | 4             | 2.12       | 0.12     | 82.34      | 37.85      | 6.65      | 141.81     | 131        | <MRL 1           | 68.62       | 0.02 (E,<MRL 0.1) | 17        |
| Long Pond (MDI)  | 4/18/2006  | 6.38 | 6.75 | 45.9          | 49          | 13            | 3.5        | 0.22     | 89.22      | 57.74      | 7.94      | 230.19     | 230.6      | 2.36             | 76.6        | 0.005             | 33        |
| Long Pond (MDI)  | 10/24/2006 | 6.45 | 6.91 | 46.6          | 58.9        | 10            | 3.55       | 0.16     | 83.83      | 56.78      | 7.93      | 202.71     | 232        | 1.64             | 77.8        | <MDL 0.02         | 23        |
| Sargent Mtn Pond | 4/12/2006  | 4.80 | 4.86 | 28.4          | -14.4       | 13            | 3.4        | 0.27     | 17.88      | 25.98      | 6.43      | 115.38     | 127.45     | 4.1              | 49.89       | 0.003             | 188.6     |
| Sargent Mtn Pond | 10/11/2006 | 4.98 | 5.07 | 23.3          | -3.9        | 10            | 3.89       | 0.20     | 18.96      | 18.93      | 6.14      | 107.88     | 96         | 0.35 (E, <MRL 1) | 56.71       | <MDL 0.02         | 132       |
| Seal Cove Pond   | 4/19/2006  | 6.39 | 6.69 | 39.2          | 48.64       | 17            | 4.8        | 0.21     | 80.21      | 56.43      | 7.34      | 190.63     | 186.8      | 0.94             | 64.1        | <MDL 0.02         | 78.3      |
| Seal Cove Pond   | 10/24/2006 | 6.55 | 7.00 | 40.2          | 75.3        | 12            | 4.93       | 0.21     | 78.84      | 58.43      | 7.67      | 170.52     | 185        | 0.35 (E, <MRL 1) | 60.03       | <MDL 0.02         | 17        |
| Seal Cove Pond   | 10/24/2006 | 6.57 | 7.02 | 40.6          | 74.6        | 12            | 5.29       | 0.21     | 72.36      | 53.49      | 6.91      | 156.60     | 185        | 0.38 (E, <MRL 1) | 59.98       | <MDL 0.02         | 15        |
| The Bowl         | 4/12/2006  | 6.11 | 6.29 | 32.9          | 14.95       | 4             | 1.9        | 0.16     | 46.62      | 42.77      | 5.46      | 170.18     | 175.18     | 0.6              | 61.45       | 0.003             | 25.3      |
| The Bowl         | 10/11/2006 | 6.29 | 6.64 | 31.7          | 32.5        | 6             | 3.39       | 0.21     | 42.42      | 37.03      | 5.63      | 172.70     | 161        | <MRL 1           | 56.4        | <MDL 0.02         | 13        |
| Upper Hadlock    | 4/18/2006  | 6.15 | 6.54 | 50.6          | 28.59       | 8             | 2.6        | 0.13     | 96.37      | 40.88      | 5.48      | 271.61     | 302.5      | 1.1              | 63.2        | <MDL 0.02         | 50.9      |
| Upper Hadlock    | 10/11/2006 | 6.41 | 6.80 | 38.6          | 72          | 10            | 4.12       | 0.20     | 74.35      | 32.09      | 6.40      | 184.44     | 173        | <MRL 1           | 60.26       | <MDL 0.02         | 21        |
| Witch Hole Pond  | 4/13/2006  | 6.09 | 6.59 | 23.7          | 32.99       | 17            | 2.6        | 0.22     | 44.28      | 31.28      | 5.08      | 123.57     | 113.45     | <MRL 0.1         | 34.9        | <MDL 0.02         | 24.3      |
| Witch Hole Pond  | 10/16/2006 | 6.19 | 6.99 | 24.4          | 66.1        | 25            | 5.95       | 0.35     | 51.90      | 31.27      | 6.40      | 128.76     | 109        | <MRL 1           | 24.83       | 0.03 (E,<MRL 0.1) | 23        |

## Lake Acidification Chemistry Data 2007

| Lake             | Date       | CCpH | EQpH | SpCond (uS/L) | ANC (ueq/L) | T color (PCU) | DOC (mg/L) | TN(mg/L) | Ca (ueq/L) | Mg (ueq/L) | K (ueq/L) | Na (ueq/L) | Cl (ueq/L) | NO3 (ueq/L) | SO4 (ueq/L) | NH4 (mg/L) | Al (ug/L) |
|------------------|------------|------|------|---------------|-------------|---------------|------------|----------|------------|------------|-----------|------------|------------|-------------|-------------|------------|-----------|
| Bubble Pond      | 5/1/2007   | 6.16 | 6.97 | 32.7          | 58          | 6             | 2.28       | 0.13     | 77.84      | 37.03      | 7.16      | 130.07     | 144        | 3.4         | 59          | <MRL 0.1   | 55        |
| Bubble Pond      | 10/24/2007 | 6.63 | 7.12 | 33.8          | 71.1        | 3.4           | 2.22       | <MRL 0.1 | 92.32      | 38.68      | 6.65      | 131.81     | 140        | <MRL 0.1    | 63          | <MRL 0.1   | 22        |
| Eagle Lake       | 4/26/2007  | 6.17 | 6.80 | 33.6          | 47.4        | 4             | 1.93       | <MRL 0.1 | 64.87      | 35.38      | 6.14      | 144.42     | 164        | 1.4         | 56          | <MRL 0.1   | 17        |
| Eagle Lake       | 10/24/2007 | 6.44 | 6.92 | 35.1          | 50.8        | 2.7           | 2.12       | <MRL 0.1 | 74.85      | 35.38      | 6.40      | 148.77     | 169        | <MRL 0.1    | 58          | <MRL 0.1   | <MRL 10   |
| Echo Lake        | 4/26/2007  | 6.39 | 7.04 | 64            | 75.2        | 10            | 2.95       | 0.12     | 108.78     | 54.31      | 10.23     | 302.76     | 351        | 1.3         | 69          | <MRL 0.1   | 41        |
| Echo Lake        | 10/22/2007 | 6.52 | 7.18 | 66.4          | 84.9        | 4.4           | 2.64       | 0.10     | 121.26     | 57.60      | 10.23     | 307.98     | 370        | <MRL 0.1    | 72          | <MRL 0.1   | <MRL 10   |
| Jordan Pond      | 5/1/2007   | 6.34 | 7.01 | 32.9          | 59.5        | 4             | 2.2        | <MRL 0.1 | 80.34      | 38.68      | 7.42      | 133.55     | 139        | 1.9         | 66          | <MRL 0.1   | 25        |
| Jordan Pond      | 10/24/2007 | 6.49 | 7.05 | 33.5          | 64.7        | 2.7           | 1.89       | <MRL 0.1 | 86.83      | 39.50      | 6.14      | 130.07     | 139        | <MRL 0.1    | 67          | <MRL 0.1   | 12        |
| Long Pond (MDI)  | 4/26/2007  | 6.22 | 6.87 | 44.9          | 52.1        | 12            | 2.87       | 0.14     | 74.85      | 51.84      | 8.44      | 196.19     | 222        | 3.3         | 73          | <MRL 0.1   | 43        |
| Long Pond (MDI)  | 10/22/2007 | 6.35 | 6.97 | 47.3          | 57.9        | 6.6           | 2.75       | 0.11     | 83.33      | 53.49      | 8.19      | 210.11     | 232        | <MRL 0.1    | 75          | <MRL 0.1   | 16        |
| Sargent Mtn Pond | 5/2/2007   | 4.91 | 5.00 | 24            | -6.5        | 14            | 3.57       | 0.17     | 16.47      | 20.57      | 6.91      | 99.18      | 111        | 1.4         | 46          | <MRL 0.1   | 220       |
| Sargent Mtn Pond | 10/23/2007 | 4.86 | 4.89 | 28.3          | -11.4       | 12            | 3.61       | 0.15     | 15.97      | 23.04      | 5.63      | 106.58     | 111        | <MRL 0.1    | 69          | <MRL 0.1   | 188       |
| Seal Cove Pond   | 4/25/2007  | 6.09 | 6.75 | 38.2          | 48.3        | 18            | 4.24       | 0.14     | 63.37      | 50.20      | 8.44      | 165.30     | 190        | 1.4         | 57          | <MRL 0.1   | 108       |
| Seal Cove Pond   | 10/22/2007 | 6.41 | 7.03 | 42.3          | 67.3        | 6.6           | 3.7        | 0.17     | 77.35      | 55.96      | 8.95      | 177.92     | 201        | <MRL 0.1    | 61          | <MRL 0.1   | <MRL 10   |
| The Bowl         | 5/1/2007   | 5.78 | 6.25 | 39.2          | 13.7        | 4             | 1.82       | 0.12     | 41.92      | 46.08      | 7.16      | 191.84     | 228        | 1.4         | 60          | <MRL 0.1   | 38        |
| The Bowl         | 10/29/2007 | 5.96 | 6.49 | 42.5          | 21.7        | 4.9           | 3.2        | 0.14     | 51.90      | 48.55      | 7.93      | 206.19     | 240        | <MRL 0.1    | 62          | <MRL 0.1   | 12        |
| Upper Hadlock    | 4/30/2007  | 5.83 | 6.56 | 53.4          | 30.8        | 10            | 2.87       | 0.11     | 77.84      | 35.38      | 9.46      | 297.98     | 320        | 1.9         | 61          | <MRL 0.1   | 92        |
| Witch Hole Pond  | 5/2/2007   | 5.95 | 6.65 | 26.9          | 31          | 14            | 3.34       | 0.16     | 38.42      | 31.27      | 6.65      | 124.85     | 147        | 0.21        | 36          | <MRL 0.1   | 27        |
| Witch Hole Pond  | 10/18/2007 | 6.19 | 6.96 | 30            | 58.2        | 18            | 6.42       | 0.29     | 130.24     | 40.32      | 8.44      | 136.16     | 213        | 1.6         | 40          | <MRL 0.1   | 20        |

## Lake Acidification Chemistry Data 2008

| Lake             | Date       | CCpH | EQpH | SpCond (uS/L) | ANC (ueq/L) | T color (PCU) | DOC (mg/L) | TN(mg/L) | Ca (ueq/L) | Mg (ueq/L) | K (ueq/L) | Na (ueq/L) | Cl (ueq/L) | NO3 (ueq/L) | SO4 (ueq/L) | NH4 (mg/L) | Al (ug/L) |
|------------------|------------|------|------|---------------|-------------|---------------|------------|----------|------------|------------|-----------|------------|------------|-------------|-------------|------------|-----------|
| Bubble Pond      | 4/24/2008  | 6.25 | 6.91 | 31.1          | 67.6        | 4             | 2.29       | <MRL 0.1 | 83.83      | 32.90      | 7.93      | 121.80     | 124        | 1.7         | 58          | <MRL 0.1   | 41.5      |
| Bubble Pond      | 10/23/2008 | 6.62 | 7.02 | 28.9          | 70.6        | 11            | 3.95       | 0.20     | 77.84      | 32.90      | 7.16      | 141.81     | 104        | <MRL 1      | 56          | <MRL 0.1   | 45        |
| Eagle Lake       | 4/23/2008  | 6.24 | 6.73 | 34.4          | 48.3        | 3             | 2.24       | 0.10     | 67.37      | 32.08      | 8.69      | 156.60     | 174        | 0.95        | 57          | <MRL 0.1   | 19.2      |
| Eagle Lake       | 10/21/2008 | 6.58 | 6.90 | 34.3          | 51.2        | 3             | 2.04       | 0.10     | 72.85      | 34.55      | 6.14      | 183.14     | 161        | <MRL 1      | 55          | <MRL 0.1   | <MRL 10   |
| Echo Lake        | 4/28/2008  | 6.41 | 6.85 | 64.8          | 74.4        | 10            | 3.05       | 0.13     | 138.72     | 64.99      | 14.06     | 401.07     | 384        | 0.64        | 72          | <MRL 0.1   | 30.3      |
| Echo Lake        | 10/20/2008 | 6.58 | 7.04 | 64.3          | 75.8        | 10            | 3.63       | 0.16     | 114.27     | 54.29      | 9.97      | 397.59     | 365        | <MRL 1      | 70          | <MRL 0.1   | 14        |
| Jordan Pond      | 4/24/2008  | 6.38 | 6.87 | 32.2          | 59.1        | 3             | 2.34       | 0.12     | 47.90      | 23.03      | 5.11      | 45.68      | 134        | 2.1         | 64          | <MRL 0.1   | 14.4      |
| Jordan Pond      | 10/21/2008 | 6.71 | 7.02 | 31.6          | 63.5        | 5             | 1.99       | <MRL 0.1 | 82.83      | 37.02      | 6.14      | 149.21     | 124        | <MRL 1      | 62          | <MRL 0.1   | 19        |
| Long Pond (MDI)  | 4/28/2008  | 6.41 | 6.77 | 44.1          | 51.8        | 10            | 3.34       | 0.14     | 94.81      | 60.05      | 10.48     | 255.78     | 232        | 1.4         | 71          | <MRL 0.1   | 35.2      |
| Long Pond (MDI)  | 10/27/2008 | 6.50 | 6.89 | 44            | 53.8        | 12            | 3.42       | 0.13     | <MRL 0.05  | <MRL 0.05  | <MRL 0.05 | <MRL 0.05  | 223        | <MRL 1      | 72          | <MRL 0.1   | <MRL 10   |
| Sargent Mtn Pond | 4/30/2008  | 4.87 | 5.00 | 24            | -7.3        | 5             | 3.55       | 0.14     | 22.46      | 23.03      | 8.44      | 127.02     | 104        | 1.6         | 47          | <MRL 0.1   | 214       |
| Sargent Mtn Pond | 10/20/2008 | 4.97 | 5.02 | 22.1          | -5.6        | 26            | 5          | 0.23     | 14.97      | 16.45      | 5.11      | 110.93     | 82         | <MRL 1      | 48          | <MRL 0.1   | 258       |
| Seal Cove Pond   | 4/29/2008  | 6.01 | 6.76 | 47.3          | 48.3        | 26            | 5.2        | 0.23     | 86.33      | 62.52      | 11.76     | 272.31     | 253        | 0.73        | 61          | <MRL 0.1   | 90.8      |
| Seal Cove Pond   | 10/20/2008 | 6.39 | 6.87 | 40.7          | 58.4        | 20            | 5.41       | 0.23     | 73.85      | 51.82      | 7.93      | 223.16     | 194        | <MRL 1      | 58          | <MRL 0.1   | 59        |
| The Bowl         | 4/30/2008  | 5.84 | 6.50 | 35.5          | 22.4        | 15            | 2.19       | 0.12     | 59.38      | 49.36      | 7.93      | 210.98     | 189        | 1           | 63          | <MRL 0.1   | 30        |
| The Bowl         | 10/28/2008 | 6.26 | 6.64 | 30.9          | 29.4        | 5             | 3.53       | 0.16     | 78.84      | 54.29      | 8.18      | 236.21     | 150        | <MRL 1      | 62          | <MRL 0.1   | 34        |
| Upper Hadlock    | 4/23/2008  | 5.86 | 6.58 | 59.3          | 31.4        | 9             | 2.73       | 0.11     | 80.84      | 31.26      | 7.67      | 327.12     | 356        | 1.8         | 63          | <MRL 0.1   | 97.3      |
| Upper Hadlock    | 10/21/2008 | 6.17 | 6.65 | 34.9          | 44.6        | 29            | 5.99       | 0.19     | 68.86      | 27.97      | 5.88      | 209.24     | 159        | <MRL 1      | 57          | <MRL 0.1   | 141       |
| Witch Hole Pond  | 4/29/2008  | 6.10 | 6.67 | 24.4          | 39.7        | 18            | 3.75       | 0.40     | 50.40      | 34.55      | 8.44      | 152.25     | 116        | 0.35        | 35          | <MRL 0.1   | 27.1      |
| Witch Hole Pond  | 10/23/2008 | 6.18 | 6.84 | 24.3          | 56.7        | 37            | 7.03       | 0.34     | 46.91      | 30.44      | 5.63      | 18.71      | 99         | <MRL 1      | 25          | <MRL 0.1   | 39        |

## Lake Nutrient Data 2006- 2008

| Lake            | Date      | Depth (m) | Type | Lab pH | ANC (ueq/L) | A Color (PCU) | CHLA (ug/L) | TP (ug/L) | TDP (ug/L) | Ortho P (ug/L) | TN (mg/L) | TDN (mg/L) | NO2+NO3 (mg/L)        | NO2 (mg/L)            | NH3 (mg/L)           |
|-----------------|-----------|-----------|------|--------|-------------|---------------|-------------|-----------|------------|----------------|-----------|------------|-----------------------|-----------------------|----------------------|
| Aunt Bettys     | 6/19/2006 | 1         | C    |        |             | 40            | 1.8         | <MRL 2    |            | <MRL 6         | <MRL 0.06 |            | <MRL 0.06             | <MRL 0.002            | 0.008 (E, <MRL 0.01) |
| Aunt Bettys     | 8/9/2006  | 0.2       | G    |        |             | 63            | 1.2         | 8         |            | 4 (E, <MRL 6)  | 0.48      |            | <MRL 0.016            | 0.001 (E, <MRL 0.002) | <MDL 0.005           |
| Bear Brook Pond | 6/19/2006 | 2         | C    |        |             | 25            | 3           | <MRL 2    |            | <MRL 6         | <MRL 0.06 |            | <MRL 0.060            | <MRL 0.002            | 0.008 (E, <MRL 0.01) |
| Bear Brook Pond | 8/9/2006  | 0.2       | G    |        |             | 50            | 2.5         | 11        |            | 4 (E, <MRL 6)  | 0.37      |            | <MRL 0.016            | 0.001 (E, <MRL 0.002) | <MDL 0.005           |
| Bubble Pond     | 6/21/2006 | 4         | C    |        |             | 5             | 1.6         | <MRL 2    |            | 3 (E, <MRL 6)  | 0.16      |            | <MRL 0.060            | <MRL 0.002            | 0.007 (E, <MRL 0.01) |
| Bubble Pond     | 8/10/2006 | 8         | C    |        |             | 8             | 1.3         | 4         |            | 4 (E, <MRL 6)  | 0.13      |            | <MRL 0.016            | <MRL 0.002            | <MDL 0.005           |
| Eagle Lake      | 6/15/2006 | 6         | C    |        |             | 5             | 0.8         | <MRL 2    |            | 4 (E, <MRL 6)  | <MRL 0.06 |            | <MRL 0.060            | <MRL 0.002            | 0.017                |
| Eagle Lake      | 8/10/2006 | 5         | C    |        |             | 5             | 0.8         | 5         |            | 3 (E, <MRL 6)  | 0.15      |            | <MRL 0.016            | <MRL 0.002            | <MDL 0.005           |
| Echo Lake       | 6/20/2006 | 6         | C    |        |             | 8             | 1.6         | <MRL 2    |            | <MRL 6         | 0.19      |            | <MRL 0.060            | <MRL 0.002            | 0.007 (E, <MRL 0.01) |
| Echo Lake       | 8/22/2006 | 9         | C    |        |             | 13            | 4.1         | 4         |            | <MRL 6         | 0.17      |            | <MRL 0.016            | <MRL 0.002            | 0.012                |
| Jordan Pond     | 6/22/2006 | 5         | C    |        |             | 5             | 0.6         | <MRL 2    |            | 3 (E, <MRL 6)  | 0.18      |            | <MRL 0.060            | <MRL 0.002            | 0.008 (E, <MRL 0.01) |
| Jordan Pond     | 8/23/2006 | 8         | C    |        |             | 8             | 1.2         | <MRL 4    |            | 3 (E, <MRL 6)  | 0.12      |            | <MRL 0.016            | <MRL 0.002            | 0.007 (E, <MRL 0.01) |
| Long Pond (IAH) | 4/6/2006  | 0.2       | G    | 6.18   | 68.25       | 7             |             |           |            |                |           |            |                       |                       |                      |
| Long Pond (MDI) | 6/16/2006 | 6         | C    |        |             | 13            | 1.6         | <MRL 2    |            | <MRL 6         | <MRL 0.06 |            | <MRL 0.060            | <MRL 0.002            | 0.019                |
| Long Pond (MDI) | 8/25/2006 | 10        | C    |        |             | 15            | 1.7         | <MRL 4    |            | <MRL 6         | 0.16      |            | 0.008 (E, <MRL 0.016) | <MRL 0.002            | 0.008 (E, <MRL 0.01) |
| Lower Breakneck | 6/22/2006 | 0.2       | G    |        |             | 18            | 1.7         | <MRL 2    |            | <MRL 6         | 0.22      |            | <MRL 0.060            | <MRL 0.002            | 0.006 (E, <MRL 0.01) |
| Lower Breakneck | 8/17/2006 | 1         | C    |        |             | 20            | 2           | 10        |            | 4 (E, <MRL 6)  | 0.29      |            | <MRL 0.016            | <MRL 0.002            | <MRL 0.01            |
| Seal Cove Pond  | 6/16/2006 | 2         | C    |        |             | 15            | 2           | <MRL 2    |            | <MRL 6         | <MRL 0.06 |            | <MRL 0.060            | <MRL 0.002            | 0.01 (E, <MRL 0.01)  |
| Seal Cove Pond  | 8/24/2006 | 7         | C    |        |             | 20            | 3.9         | 4         |            | <MRL 6         | 0.21      |            | <MRL 0.016            | <MRL 0.002            | 0.006 (E, <MRL 0.01) |

## Appendix A

| Lake            | Date      | Depth (m) | Type | Lab pH | ANC (ueq/L) | A Color (PCU) | CHLA (ug/L) | TP (ug/L)       | TDP (ug/L) | Ortho P (ug/L) | TN (mg/L) | TDN (mg/L) | NO2+NO3 (mg/L) | NO2 (mg/L) | NH3 (mg/L)           |
|-----------------|-----------|-----------|------|--------|-------------|---------------|-------------|-----------------|------------|----------------|-----------|------------|----------------|------------|----------------------|
| Upper Hadlock   | 6/15/2006 | 3         | C    |        |             | 25            | 0.8         | <MRL 2          |            | 4 (E, <MRL 6)  | <MRL 0.06 |            | <MRL 0.060     | <MRL 0.002 | 0.007 (E, <MRL 0.01) |
| Upper Hadlock   | 8/23/2006 | 4         | C    |        |             | 20            | 2.2         | 4 (E, <MRL 4)   |            | 3 (E, <MRL 6)  | 0.22      |            | <MRL 0.016     | <MRL 0.002 | 0.007 (E, <MRL 0.01) |
| Witch Hole Pond | 6/21/2006 | 0.2       | G    |        |             | 25            | 2.3         | 10 (E, <MRL 20) |            | <MRL 6         | 0.31      |            | <MRL 0.060     | <MRL 0.002 | 0.008 (E, <MRL 0.01) |
| Witch Hole Pond | 8/21/2006 | 4         | C    |        |             | 40            | 5.7         | 12              |            | <MRL 6         | 0.37      |            | <MRL 0.016     | <MRL 0.002 | 0.022                |
| Bubble Pond     | 6/21/2007 | 6         | C    |        | 66.10       | 12            | 1           | 4               | 2.3        | <MRL 1         | 0.101     | <MRL 0.1   |                |            |                      |
| Bubble Pond     | 8/30/2007 | 10        | C    | 7.02   | 74.30       | 10            | 1.5         | 3.1             | 1.6        | <MRL 1         | 0.106     | <MRL 0.1   | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |
| Bubble Pond     | 9/27/2007 | 0.2       | G    | 7.07   |             |               |             |                 |            |                |           |            |                |            |                      |
| Eagle Lake      | 6/14/2007 | 7         | C    |        | 48.20       | 12            | 1.7         | 2.1             | <MRL 1     | 1.3            | 0.1       | <MRL 0.1   | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |
| Eagle Lake      | 8/22/2007 | 10        | C    |        | 51.50       | 8             | 1.1         | 1.2             | 1.3        | <MRL 1         | <MRL 0.1  | <MRL 0.1   | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |
| Echo Lake       | 6/1/2007  | 0.2       | G    | 6.96   |             |               |             |                 |            |                |           |            |                |            |                      |
| Echo Lake       | 6/18/2007 | 7         | C    |        | 75.90       | 18            | 1.4         | 6.3             | 2.3        | <MRL 1         | 0.123     | 0.121      | <MRL 0.016     | <MRL 0.002 | 0.01 (E, <MRL 0.02)  |
| Echo Lake       | 8/20/2007 | 9         | C    |        | 83.30       | 17            | 2.4         | 4               | 1.2        | <MRL 1         | 0.169     | <MRL 0.1   | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |
| Hodgdon Pond    | 5/31/2007 | 0.2       | G    | 6.26   |             |               |             |                 |            |                |           |            |                |            |                      |
| Hodgdon Pond    | 6/27/2007 | 3         | C    |        | 47.20       | 52            | 2.5         | 7.9             | 2          | <MRL 1         | 0.242     | 0.207      | <MRL 0.016     | <MRL 0.002 | 0.014 (E, <MRL 0.02) |
| Hodgdon Pond    | 8/30/2007 | 4         | C    | 6.65   | 49.60       | 32            | 1.9         | 6.4             | 1.8        | <MRL 1         | 0.175     | 0.173      | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |
| Jordan Pond     | 5/31/2007 | 0.2       | G    | 6.76   |             |               |             |                 |            |                |           |            |                |            |                      |
| Jordan Pond     | 6/21/2007 | 7         | C    |        | 63.50       | 9             | 0.9         | 2.2             | 2          | <MRL 1         | <MRL 0.1  | <MRL 0.1   |                |            |                      |
| Jordan Pond     | 8/22/2007 | 10        | C    |        | 66.40       | 8             | 1.2         | 1.5             | 2          | <MRL 1         | <MRL 0.1  | <MRL 0.1   | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |
| Long Pond (MDI) | 6/1/2007  | 0.2       | G    | 6.80   |             |               |             |                 |            |                |           |            |                |            |                      |
| Long Pond (MDI) | 6/20/2007 | 7         | C    |        | 54.40       | 20            | 3.3         | 2.8             | 2.5        | <MRL 1         | 0.148     | 0.167      | 0.02           | <MRL 0.002 | <MRL 0.02            |
| Long Pond (MDI) | 8/30/2007 | 9         | C    |        | 61.40       | 15            | 2.3         | 3.4             | 2.1        | <MRL 1         | 0.113     | 0.101      | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |
| Lower Hadlock   | 6/25/2007 | 4         | C    |        | 40.30       | 16            | 0.8         | 4               | 2.2        | <MRL 1         | <MRL 0.1  | <MRL 0.1   | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |
| Lower Hadlock   | 8/21/2007 | 6         | C    |        | 42.00       | 14            | 1.5         | 4.2             | 1.5        | <MRL 1         | 0.134     | <MRL 0.1   | <MRL 0.016     | <MRL 0.002 | <MRL 0.02            |

Appendix A

| Lake            | Date      | Depth (m) | Type | Lab pH | ANC (ueq/L) | A Color (PCU) | CHLA (ug/L) | TP (ug/L) | TDP (ug/L) | Ortho P (ug/L) | TN (mg/L) | TDN (mg/L) | NO2+NO3 (mg/L)        | NO2 (mg/L) | NH3 (mg/L)           |
|-----------------|-----------|-----------|------|--------|-------------|---------------|-------------|-----------|------------|----------------|-----------|------------|-----------------------|------------|----------------------|
| Seal Cove Pond  | 5/31/2007 | 0.2       | G    | 6.80   |             |               |             |           |            |                |           |            |                       |            |                      |
| Seal Cove Pond  | 6/18/2007 | 4         | C    |        | 55.10       | 32            | 2.4         | 5.9       | 1.4        | <MRL 1         | 0.172     | 0.108      | <MRL 0.016            | <MRL 0.002 | <MRL 0.02            |
| Seal Cove Pond  | 8/23/2007 | 8         | C    |        | 66.10       | 18            | 2.3         | 3.5       | 2.9        | <MRL 1         | 0.171     | 0.109      | <MRL 0.016            | <MRL 0.002 | <MRL 0.02            |
| Seawall Pond    | 6/1/2007  | 0.2       | G    | 4.50   |             |               |             |           |            |                |           |            |                       |            |                      |
| Seawall Pond    | 6/27/2007 | 0.5       | G    |        | -29.10      | 292           | 9.4         | 18.4      | 10.5       | 1.9            | 0.703     | 0.631      | <MRL 0.016            | 0.003      | 0.04                 |
| Seawall Pond    | 8/20/2007 | 0.3       | G    |        | 41.70       | 485           | 19.3        | 51        | 46         | 4.8            | 2.29      | 1.99       | 0.014 (E, <MRL 0.016) | 0.007      | 0.908                |
| Upper Hadlock   | 6/13/2007 | 4         | C    |        | 42.20       | 19            | 1.2         | 5.1       | 1.4        | 1.2            | 0.15      | 0.128      | <MRL 0.016            | <MRL 0.002 | <MRL 0.02            |
| Upper Hadlock   | 8/30/2007 | 7         | C    | 6.94   | 57.60       | 15            | 2.4         | 4.2       | 3.8        | <MRL 1         | 0.153     | <MRL 0.1   | <MRL 0.016            | <MRL 0.002 | <MRL 0.02            |
| Witch Hole Pond | 6/14/2007 | 3         | C    |        | 41.80       | 43            | 7.3         | 13.6      | 1.8        | 2.1            | 0.255     | 0.181      | <MRL 0.016            | <MRL 0.002 | 0.014 (E, <MRL 0.02) |
| Witch Hole Pond | 8/29/2007 | 3         | C    | 6.97   | 52.00       | 31            | 1.9         | 9.7       | 2.1        | <MRL 1         | 0.308     | 0.152      | <MRL 0.016            | <MRL 0.002 | <MRL 0.02            |
| Witch Hole Pond | 9/27/2007 | 0.2       | G    | 6.73   |             |               |             |           |            |                |           |            |                       |            |                      |
| Bubble Pond     | 6/17/2008 | 10        | C    | 6.83   | 72.00       | 8             | 1.1         | 4.3       | 2.7        | <MRL 1         | 0.107     | <MRL 0.1   | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Bubble Pond     | 8/25/2008 | 10        | C    | 6.75   | 76.00       | 12.1          | 1.8         | 4.2       | 2.4        | 1.2            | 0.12      | 0.106      | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Eagle Lake      | 6/19/2008 | 8         | C    | 6.58   | 48.70       | 8             | 0.9         | 3.2       | 2.1        | <MRL 1         | <MRL 0.1  |            | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Eagle Lake      | 8/13/2008 | 10        | C    | 6.63   | 50.60       | 9             | 1.5         | 3.2       | 2.7        | <MRL 1         | <MRL 0.1  | <MRL 0.1   | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Echo Lake       | 6/19/2008 | 7         | C    | 6.88   | 78.00       | 15            | 2.1         | 6.9       | 1.4        | <MRL 1         | 0.111     | 0.125      | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Echo Lake       | 8/19/2008 | 7         | C    | 6.85   | 79.60       | 19            | 2.1         | 7.4       | 1.5        | <MRL 1         | 0.134     | 0.131      | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Jordan Pond     | 6/25/2008 | 8         | C    | 6.72   | 61.50       | 7             | 0.6         | 3.9       | 3.2        | 1.9            | 0.115     | 0.123      | 0.02                  | <MRL 0.005 | <MRL 0.08            |
| Jordan Pond     | 8/21/2008 | 10        | C    | 6.78   | 63.90       | 9             | 1.5         | 3.8       | 1.3        | 1.4            | <MRL 0.1  | <MRL 0.1   | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Lake Wood       | 6/26/2008 | 4         | C    | 6.55   | 48.40       | 21            | 1.6         | 5.7       | 3.7        | <MRL 1         | 0.186     | 0.132      | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Lake Wood       | 8/14/2008 | 4         | C    | 6.60   | 57.20       | 23            | 2.4         | 7.5       | 3          | 1              | 0.181     | 0.165      | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |
| Long Pond (IAH) | 10/3/2008 | 0.2       | G    | 6.03   | 30.37       | 12            |             |           |            |                |           |            |                       |            |                      |
| Long Pond (MDI) | 6/30/2008 | 9         | C    | 6.63   | 54.30       | 15            | 2.1         | 5.2       | 1.8        | 1.1            | 0.117     | 0.129      | <MRL 0.005            | <MRL 0.005 | <MRL 0.08            |

## Appendix A

| Lake            | Date      | Depth (m) | Type | Lab pH | ANC (ueq/L) | A Color (PCU) | CHLA (ug/L) | TP (ug/L) | TDP (ug/L) | Ortho P (ug/L) | TN (mg/L) | TDN (mg/L) | NO2+NO3 (mg/L) | NO2 (mg/L) | NH3 (mg/L) |
|-----------------|-----------|-----------|------|--------|-------------|---------------|-------------|-----------|------------|----------------|-----------|------------|----------------|------------|------------|
| Long Pond (MDI) | 8/18/2008 | 10        | C    | 6.58   | 53.70       | 17            | 2.6         | 3.4       | 2.3        | 1.1            | 0.136     | 0.139      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Round Pond      | 6/30/2008 | 5         | C    | 6.30   | 30.40       | 28            | 5.2         | 5.7       | 4.6        | 1.1            | 0.211     | 0.174      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Round Pond      | 8/25/2008 | 4         | C    | 6.27   | 37.00       | 36.4          | 4.9         | 9.4       | 2.6        | <MRL 1         | 0.291     | 0.226      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Seal Cove Pond  | 6/25/2008 | 6         | C    | 6.60   | 55.70       | 25            | 2.7         | 5.5       | 2.9        | <MRL 1         | 0.18      | 0.129      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Seal Cove Pond  | 8/26/2008 | 8         | C    | 6.64   | 65.60       | 19.9          | 2.9         | 3.6       | 3.9        | 5.9            | 0.187     | 0.171      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Upper Breakneck | 6/23/2008 | 2         | C    | 6.82   | 98.70       | 31            | 1.5         | 11        | 6.9        | <MRL 1         | 0.3       | 0.248      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Upper Breakneck | 8/20/2008 | 2         | C    | 6.60   | 128.00      | 55            | 3.1         | 6.9       | 3.1        | 1.5            | 0.415     | 0.328      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Upper Hadlock   | 6/19/2008 | 5         | C    | 6.43   | 46.40       | 22            | 2.5         | 7.6       | 1.8        | <MRL 1         | 0.161     | 0.123      | 0.0065         | <MRL 0.005 | <MRL 0.08  |
| Upper Hadlock   | 8/13/2008 | 6         | C    | 6.25   | 49.00       | 42            | 5.8         | 7         | 7          | 4.2            | 0.219     | 0.176      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Witch Hole Pond | 6/23/2008 | 2         | C    | 6.45   | 48.70       | 39            | 2.1         | 13        | 5.7        | 1.5            | 0.279     | 0.227      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |
| Witch Hole Pond | 8/20/2008 | 4         | C    | 6.45   | 59.80       | 48            | 3           | 8.6       | 4.1        | 1.9            | 0.389     | 0.336      | <MRL 0.005     | <MRL 0.005 | <MRL 0.08  |

## Stream Nutrient Chemistry 2006-2008

| Stream                | Date      | Lab pH | ANC (ueq/L) | A Color (PCU) | TP (ug/L)       | TDP (ug/L) | Ortho P (ug/L) | TN (mg/L)           | TDN (mg/L) | NO2+NO3 (mg/L)        | NO2 (mg/L)            | NH3 (mg/L)           |
|-----------------------|-----------|--------|-------------|---------------|-----------------|------------|----------------|---------------------|------------|-----------------------|-----------------------|----------------------|
| Aunt Betty Pond Inlet | 6/26/2006 |        |             | 40            | 10 (E, <MRL 20) |            | <MRL 6         | 0.43                |            | <MRL 0.06             | <MRL 0.002            | 0.006 (E, <MRL 0.01) |
| Aunt Betty Pond Inlet | 8/30/2006 |        |             | 60            | 14              |            | <MRL 6         | 0.47                |            | <MRL 0.016            | <MRL 0.002            | 0.015                |
| Breakneck Brook       | 6/26/2006 |        |             | 20            | <MRL 20         |            | <MRL 6         | 0.21                |            | <MRL 0.06             | <MRL 0.002            | 0.005 (E, <MRL 0.01) |
| Breakneck Brook       | 8/31/2006 |        |             | 18            | 3 (E, <MRL 4)   |            | 4 (E, <MRL 6)  | 0.24                |            | 0.08                  | <MRL 0.002            | <MRL 0.01            |
| Cadillac Stream       | 6/28/2006 |        |             | 3             | <MRL 20         |            | <MRL 6         | <MRL 0.06           |            | <MRL 0.06             | <MRL 0.002            | <MRL 0.01            |
| Cadillac Stream       | 9/1/2006  |        |             | 5             | <MRL 4          |            | 4 (E, <MRL 6)  | 0.05 (E, <MRL 0.06) |            | <MRL 0.016            | <MRL 0.002            | 0.006 (E, <MRL 0.01) |
| Hadlock Brook         | 6/28/2006 |        |             | 10            | <MRL 20         |            | 4 (E, <MRL 6)  | 0.04 (E, <MRL 0.06) |            | <MRL 0.06             | <MRL 0.002            | <MRL 0.01            |
| Hadlock Brook         | 9/5/2006  |        |             | 18            | 3 (E, <MRL 4)   |            | 3 (E, <MRL 6)  | 0.19                |            | 0.038                 | <MRL 0.002            | 0.008 (E, <MRL 0.01) |
| Heath Brook           | 6/27/2006 |        |             | 100           | <MRL 20         |            | <MRL 6         | 0.37                |            | <MRL 0.06             | <MRL 0.002            | 0.006 (E, <MRL 0.01) |
| Heath Brook           | 8/31/2006 |        |             | 200           | 13              |            | 4 (E, <MRL 6)  | 0.53                |            | <MRL 0.016            | 0.002                 | 0.016                |
| Hunters Brook         | 6/26/2006 |        |             | 20            | <MRL 20         |            | <MRL 6         | 0.03 (E, <MRL 0.06) |            | <MRL 0.06             | <MRL 0.002            | 0.006 (E, <MRL 0.01) |
| Hunters Brook         | 8/30/2006 |        |             | 13            | 4               |            | 4 (E, <MRL 6)  | 0.06                |            | 0.02                  | <MRL 0.002            | 0.007 (E, <MRL 0.01) |
| Jordan Stream         | 6/26/2006 |        |             | 5             | <MRL 20         |            | <MRL 6         | 0.06                |            | <MRL 0.06             | <MRL 0.002            | 0.005 (E, <MRL 0.01) |
| Jordan Stream         | 8/30/2006 |        |             | 8             | 3 (E, <MRL 4)   |            | <MRL 6         | 0.09                |            | <MRL 0.016            | <MRL 0.002            | 0.01                 |
| Kebo Brook            | 6/26/2006 |        |             | 5             | <MRL 20         |            | <MRL 6         | <MRL 0.06           |            | <MRL 0.06             | <MRL 0.002            | <MRL 0.01            |
| Kebo Brook            | 8/30/2006 |        |             | 3             | 3 (E, <MRL 4)   |            | 3 (E, <MRL 6)  | <MRL 0.06           |            | 0.015 (E, <MRL 0.016) | <MRL 0.002            | 0.008 (E, <MRL 0.01) |
| Lurvey Spring Brook   | 6/27/2006 |        |             | 40            | <MRL 20         |            | <MRL 6         | 0.12                |            | <MRL 0.06             | <MRL 0.002            | <MRL 0.01            |
| Lurvey Spring Brook   | 8/31/2006 |        |             | 25            | 3 (E, <MRL 4)   |            | 5 (E, <MRL 6)  | 0.1                 |            | 0.021                 | <MRL 0.002            | 0.005 (E, <MRL 0.01) |
| Marshall Brook        | 6/27/2006 |        |             | 88            | <MRL 20         |            | 3 (E, <MRL 6)  | 0.37                |            | <MRL 0.06             | <MRL 0.002            | 0.007 (E, <MRL 0.01) |
| Marshall Brook        | 8/31/2006 |        |             | 80            | 10              |            | <MRL 6         | 0.39                |            | 0.114                 | 0.001 (E, <MRL 0.002) | 0.007 (E, <MRL 0.01) |

## Appendix A

| Stream             | Date      | Lab pH | ANC (ueq/L) | A Color (PCU) | TP (ug/L)     | TDP (ug/L) | Ortho P (ug/L) | TN (mg/L)           | TDN (mg/L) | NO2+NO3 (mg/L)        | NO2 (mg/L)            | NH3 (mg/L)           |
|--------------------|-----------|--------|-------------|---------------|---------------|------------|----------------|---------------------|------------|-----------------------|-----------------------|----------------------|
| Otter Creek        | 6/28/2006 |        |             | 8             | <MRL 20       |            | <MRL 6         | 0.04 (E, <MRL 0.06) |            | <MRL 0.06             | <MRL 0.002            | <MRL 0.01            |
| Otter Creek        | 8/29/2006 |        |             | 15            | 4 (E, <MRL 4) |            | 4 (E, <MRL 6)  | 0.08                |            | 0.017                 | <MRL 0.002            | 0.006 (E, <MRL 0.01) |
| Sargent Brook      | 6/27/2006 |        |             | 10            | <MRL 20       |            | <MRL 6         | 0.03 (E, <MRL 0.06) |            | <MRL 0.06             | <MRL 0.002            | <MRL 0.01            |
| Sargent Brook      | 8/30/2006 |        |             | 13            | 3 (E, <MRL 4) |            | 4 (E, <MRL 6)  | 0.07                |            | <MRL 0.016            | <MRL 0.002            | 0.008 (E, <MRL 0.01) |
| Browns Brook       | 5/8/2007  | 6.38   | 44.00       | 4             | 2.9           | 3.1        | <MRL 1         | <MRL 0.1            | <MRL 0.1   | 0.013 (E, <MRL 0.016) | <MRL 0.002            | <MRL 0.02            |
| Browns Brook       | 8/14/2007 | 6.71   | 102.00      | 3             | 3.1           | 2.9        | <MRL 1         | <MRL 0.1            | <MRL 0.1   | <MRL 0.016            | 0.002 (E, <MRL 0.002) | <MRL 0.02            |
| Cadillac Stream    | 5/9/2007  | 5.96   | 26.00       | 4             | 1.8           | 1.4        | <MRL 1         | <MRL 0.1            | <MRL 0.1   | <MRL 0.016            | <MRL 0.002            | <MRL 0.02            |
| Cadillac Stream    | 8/15/2007 | 6.09   | 123.00      | 7             | 7.9           | 2.7        | 3.1            | <MRL 0.1            | <MRL 0.1   | <MRL 0.016            | <MRL 0.002            | <MRL 0.02            |
| Duck Brook         | 5/8/2007  | 6.53   | 45.10       | 9             | 3.5           | 1.5        | <MRL 1         | <MRL 0.1            | 0.105      | 0.013 (E, <MRL 0.016) | <MRL 0.002            | <MRL 0.02            |
| Duck Brook         | 8/9/2007  | 6.74   | 60.10       | 6             | 1.8           | 1.7        | <MRL 1         | <MRL 0.1            | <MRL 0.1   | <MRL 0.016            | <MRL 0.002            | <MRL 0.02            |
| Duck Pond Brook    | 5/7/2007  | 4.96   | -0.10       | 26            | 3.8           | 1.4        | <MRL 1         | <MRL 0.1            | <MRL 0.1   |                       |                       |                      |
| Bubble Pond Outlet | 5/8/2007  | 6.50   | 51.60       | 12            | 4.4           | 2          | <MRL 1         | 0.105               | <MRL 0.1   | 0.025                 | 0.001 (E, <MRL 0.002) | <MRL 0.02            |
| Bubble Pond Outlet | 8/16/2007 | 6.80   | 53.90       | 20            | 6.7           | 7.9        | 1              | 0.144               | 0.114      | <MRL 0.016            | <MRL 0.002            | <MRL 0.02            |
| Hadlock Brook      | 5/9/2007  | 5.98   | 17.30       | 7             | 1.5           | 1.2        | <MRL 1         | 0.149               | 0.155      | 0.091                 | <MRL 0.002            | <MRL 0.02            |
| Hadlock Brook      | 8/14/2007 | 6.37   | 69.30       | 8             | 4.3           | 3.5        | <MRL 1         | <MRL 0.1            | <MRL 0.1   | 0.018                 | <MRL 0.002            | <MRL 0.02            |
| Lake Wood Outlet   | 5/22/2007 | 6.23   | 36.40       | 13            | 4.4           | 8.7        | <MRL 1         | <MRL 0.1            | <MRL 0.1   | <MRL 0.016            | <MRL 0.002            | <MRL 0.02            |
| Lake Wood Outlet   | 8/8/2007  | 6.27   | 61.80       | 13            | 4.6           | 4.3        | 1.2            | 0.156               | 0.163      | 0.022                 | <MRL 0.002            | <MRL 0.02            |
| Lurvey Brook       | 5/7/2007  | 4.54   | -14.50      | 63            | 4.7           | 4          | <MRL 1         | 0.137               | 0.141      | <MRL 0.016            | 0.001 (E, <MRL 0.002) | <MRL 0.02            |
| Lurvey Brook       | 8/15/2007 | 5.36   | 19.50       | 113           | 38            | 10         | 1              | 0.166               | 0.204      |                       |                       |                      |
| Man o'War Brook    | 5/7/2007  | 6.41   | 68.00       | 18            | 3.7           | 4          | <MRL 1         | 0.129               | 0.133      | 0.051                 | 0.001 (E, <MRL 0.002) | <MRL 0.02            |
| Man o'War Brook    | 8/13/2007 | 6.88   | 200.00      | 28            | 15            | 6          | 1              | 0.23                | 0.156      | 0.064                 | 0.001 (E, <MRL 0.002) | <MRL 0.02            |
| Otter Creek        | 5/9/2007  | 6.52   | 63.70       | 8             | 1.7           | 1.4        | <MRL 1         | <MRL 0.1            | <MRL 0.1   | <MRL 0.016            | <MRL 0.002            | <MRL 0.02            |

| Stream                | Date      | Lab pH | ANC (ueq/L) | A Color (PCU) | TP (ug/L) | TDP (ug/L) | Ortho P (ug/L) | TN (mg/L) | TDN (mg/L) | NO2+NO3 (mg/L) | NO2 (mg/L)               | NH3 (mg/L)              |
|-----------------------|-----------|--------|-------------|---------------|-----------|------------|----------------|-----------|------------|----------------|--------------------------|-------------------------|
| Otter Creek           | 8/8/2007  | 6.80   | 172.00      | 37            | 7.7       | 3.4        | <MRL 1         | 0.163     | 0.235      | 0.041          | 0.001 (E,<br><MRL 0.002) | 0.015 (E,<br><MRL 0.02) |
| Stanley Brook         | 5/8/2007  | 6.92   | 126.00      | 24            | 4.3       | 3.1        | <MRL 1         | 0.27      | 0.272      | 0.202          | 0.001 (E,<br><MRL 0.002) | <MRL 0.02               |
| Stanley Brook         | 8/9/2007  | 7.27   | 224.00      | 43            | 6.2       | 4.9        | 1.3            | 0.262     | 0.258      | 0.125          | 0.002 (E,<br><MRL 0.002) | <MRL 0.02               |
| Aunt Betty Pond Inlet | 5/13/2008 | 6.35   | 81.60       | 41            | 6         | 5.4        | 1.4            | 0.167     | <MRL 0.1   | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Aunt Betty Pond Inlet | 8/4/2008  | 6.06   | 101.00      | 70            | 9.6       | 6.6        | <MRL 1         | 0.318     | 0.321      | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Breakneck Brook       | 5/12/2008 | 6.87   | 117.00      | 16            | 3.3       | <MRL 1     | 1.7            | <MRL 0.1  | 0.111      | 0.025          | <MRL 0.005               | <MRL 0.08               |
| Breakneck Brook       | 8/5/2008  | 6.64   | 96.50       | 39            | 8.2       | 5.2        | <MRL 1         | 0.205     | 0.221      | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Cadillac Stream       | 5/15/2008 | 6.14   | 41.30       | 1             | <MRL 1    | <MRL 1     | 1.1            | <MRL 0.1  | <MRL 0.1   | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Cadillac Stream       | 8/11/2008 | 6.19   | 67.10       | 3             | 2.5       | 1          | <MRL 1         | <MRL 0.1  | <MRL 0.1   | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Hadlock Brook         | 5/7/2008  | 6.11   | 22.80       | 6             | <MRL 1    | <MRL 1     | 1.7            | <MRL 0.1  | <MRL 0.1   | 0.023          | <MRL 0.005               | <MRL 0.08               |
| Hadlock Brook         | 8/4/2008  | 5.63   | 15.30       | 21            | 2.9       | 1.1        | <MRL 1         | 0.126     | 0.151      | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Heath Brook           | 5/21/2008 | 5.52   | 30.30       | 105           | 7         | 4.8        | <MRL 1         | 0.282     | 0.261      | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Heath Brook           | 8/7/2008  | 4.78   | 22.40       | 261           | 12        | 8.3        | 1.7            | 0.586     | 0.55       | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Hunters Brook         | 5/19/2008 | 6.97   | 112.00      | 7             | 1         | 2.2        | <MRL 1         | <MRL 0.1  | <MRL 0.1   | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Hunters Brook         | 8/11/2008 | 6.79   | 105.00      | 17            | 4.9       | 2.7        | 1.3            | <MRL 0.1  | 0.114      | 0.0089         | <MRL 0.005               | <MRL 0.08               |
| Jordan Stream         | 5/12/2008 | 6.62   | 57.70       | 7             | <MRL 1    | 1.5        | <MRL 1         | <MRL 0.1  | <MRL 0.1   | 0.026          | <MRL 0.005               | <MRL 0.08               |
| Jordan Stream         | 8/6/2008  | 6.85   | 62.90       | 8             | 2.1       | 2.2        | <MRL 1         | <MRL 0.1  | 0.113      | 0.0057         | <MRL 0.005               | <MRL 0.08               |
| Kebo Brook            | 5/13/2008 | 6.77   | 79.10       | 1             | <MRL 1    | <MRL 1     | 1.1            | <MRL 0.1  | <MRL 0.1   | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Kebo Brook            | 8/6/2008  | 6.73   | 83.30       | 3             | <MRL 1    | 6.7        | 4.2            | <MRL 0.1  | <MRL 0.1   | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Lurvey Spring Brook   | 5/22/2008 | 6.53   | 120.00      | 22            | 3.5       | 2.2        | <MRL 1         | <MRL 0.1  | <MRL 0.1   | 0.011          | <MRL 0.005               | <MRL 0.08               |
| Lurvey Spring Brook   | 8/7/2008  | 5.90   | 49.60       | 47            | 4.7       | 6.7        | 1.5            | 0.163     | 0.182      | 0.0068         | <MRL 0.005               | <MRL 0.08               |
| Marshall Brook        | 5/21/2008 | 7.22   | 284.00      | 61            | 6.3       | 4.8        | 1              | 0.257     | 0.244      | 0.089          | <MRL 0.005               | <MRL 0.08               |
| Marshall Brook        | 8/7/2008  | 6.64   | 174.00      | 180           | 11        | 12         | 1.8            | 0.444     | 0.425      | 0.027          | <MRL 0.005               | <MRL 0.08               |
| Otter Creek           | 5/7/2008  | 6.55   | 51.80       | 7             | 1.9       | 1.9        | 1.5            | <MRL 0.1  | <MRL 0.1   | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Otter Creek           | 8/5/2008  | 6.38   | 46.80       | 18            | 5.3       | 1.4        | <MRL 1         | <MRL 0.1  | 0.104      | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Sargent Brook         | 5/20/2008 | 5.80   | 17.50       | 6             | 1.5       | 1.6        | <MRL 1         | <MRL 0.1  | <MRL 0.1   | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |
| Sargent Brook         | 8/4/2008  | 5.20   | 6.50        | 17            | 2.8       | 2.5        | <MRL 1         | 0.14      | 0.152      | <MRL 0.005     | <MRL 0.005               | <MRL 0.08               |

## Blank Sample Accuracy Analysis

|                                         | ANC   | Acolor | TotalP | TotalN | PO4  | TDP    | TDN  | Chla | NH3  | NO2    | NO2+NO3 |
|-----------------------------------------|-------|--------|--------|--------|------|--------|------|------|------|--------|---------|
| Unit:                                   | µeq/L | PCU    | mg/L   | mg/L   | µg/L | mg/L   | mg/L | µg/L | mg/L | mg/L   | mg/L    |
| Method Detection Limit (MDL):           | n/a   | 1      | 0.0005 | 0.05   | 0.5  | 0.0005 | 0.05 |      | 0.04 | 0.0025 | 0.0025  |
| Concentration threshold:                | 100   | 10     | 0.3    | 0.3    | 15   | 0.3    | 0.3  | n/a  | 0.4  | 0.4    | 0.4     |
| Low Conc. Accuracy Objective (Diff):    | 4     | 1      | 0.02   | 0.02   | 1    | 0.02   | 0.02 | n/a  | 0.02 | 0.02   | 0.02    |
| High Conc. Accuracy Objective (% Diff): | 10    | 10     | 7      | 7      | 7    | 7      | 7    | 2    | 5    | 5      | 5       |

| Station Name | Sample Date | ANC   | ANC Diff. | A color | A color Diff. | Total P     | TP Diff. | Total N    | TN Diff. | PO4      | PO4 Diff. | TDP       | TDP Diff. | TDN        | TDN Diff. | Chl A | ChlA Diff. | NH3         | NH3 Diff. | NO2          | NO2 Diff. | NO2 + NO3    | NO2 + NO3 Diff. |
|--------------|-------------|-------|-----------|---------|---------------|-------------|----------|------------|----------|----------|-----------|-----------|-----------|------------|-----------|-------|------------|-------------|-----------|--------------|-----------|--------------|-----------------|
|              | Unit:       | µeq/L | µeq/L     | PCU     | PCU           | mg/L        | mg/L     | mg/L       | mg/L     | µg/L     | µg/L      | mg/L      | mg/L      | mg/L       | mg/L      | µg/L  | µg/L       | mg/L        | mg/L      | mg/L         | mg/L      | mg/L         | mg/L            |
|              | MRL:        | 100   |           | 1       |               | 0.004, 0.02 |          | 0.06       |          | 6        |           |           |           |            |           |       |            | 0.01        |           | 0.002        |           | 0.06, 0.016  |                 |
| Lake Blank 1 | 7/5/2006    | <100  |           | <1      |               | <0.02       |          | <0.06      |          | <6       |           |           |           |            |           |       |            | E0.006      | 0.006     | <0.002       |           | <0.060       |                 |
| Stream Blank | 7/5/2006    | <100  |           | <1      |               | <0.02       |          | <0.06      |          | <6       |           |           |           |            |           |       |            | E0.006      | 0.006     | <0.002       |           | <0.060       |                 |
| Lake Blank 1 | 8/18/2006   | <100  |           | <1      |               | E0.002      | 0.002    | <0.06      |          | E3       | 3         |           |           |            |           |       |            | <0.010      |           | <0.002       |           | <0.016       |                 |
| Lake Blank 2 | 8/21/2006   | <100  |           | <1      |               | E0.003      | 0.003    | <0.06      |          | E3       | 3         |           |           |            |           |       |            | <0.010      |           | <0.002       |           | <0.016       |                 |
| Stream Blank | 8/31/2006   | <100  |           | 5       | 5             | <0.004      |          | <0.06      |          | <6       |           |           |           |            |           |       |            | E0.007      | 0.007     | <0.002       |           | <0.016       |                 |
|              |             |       |           |         |               |             |          |            |          |          |           |           |           |            |           |       |            |             |           |              |           |              |                 |
| Stream Blank | 5/22/2007   | -0.3  | 0.3       | 0       | 0             | <0.001      |          | <0.1       |          | <1       |           | <0.001    |           | <0.1       |           |       |            |             |           |              |           |              |                 |
| Lake Blank   | 6/27/2007   | 1.6   | 1.6       | 1       | 1             | 0.001       | 0.001    | <0.1       |          | 1.4      | 1.4       | 0.003     | 0.003     | <0.1       |           | 0.1   | 0.1        | E0.012      | 0.012     | <0.002       |           | <0.016       |                 |
| Stream Blank | 8/14/2007   | 1.0   | 1         | 0       | 0             | 0.001       | 0.001    | <0.1       |          | <1       |           | 0.002     | 0.002     | <0.1       |           |       |            | <0.02       |           | <0.002       |           | <0.016       |                 |
|              |             |       |           |         |               |             |          |            |          |          |           |           |           |            |           |       |            |             |           |              |           |              |                 |
| Stream Blank | 5/15/2008   | 0.1   | 0.1       | 0       | 0             | <RL 0.001   |          | <RL 0.1    |          | 1.1      | 1.1       | <RL 0.001 |           | <RL 0.1    |           |       |            | <RL 0.08    |           | <RL of 0.005 |           | <RL of 0.005 |                 |
| Lake Blank   | 6/18/2008   | 0.2   | 0.2       | 1       | 1             | <RL 0.001   |          | <RL of 0.1 |          | <RL of 1 |           | <RL 0.001 |           | <RL of 0.1 |           | 0     |            | <RL of 0.08 |           | <RL of 0.005 |           | <RL of 0.005 |                 |
| Stream Blank | 8/7/2008    | -1.9  | 1.9       | 0       | 0             | <RL 0.001   |          | <RL of 0.1 |          | <RL of 1 |           | 0.001     | 0.001     | <RL of 0.1 |           |       |            | <RL of 0.08 |           | <RL of 0.005 |           | <RL of 0.005 |                 |
| Lake Blank   | 8/14/2008   | 0.3   | 0.3       | 5       | 5             | <RL 0.001   |          | <RL of 0.1 |          | <RL of 1 |           | 0.002     | 0.002     | <RL of 0.1 |           | 0     |            | <RL of 0.08 |           | <RL of 0.005 |           | <RL of 0.005 |                 |

Appendix A

## Replicate Sample Precision Analysis

| Replicate Objectives |                                                    | ANC   | Acolor | TotalP | TotalN | PO4  | TDP    | TDN  | Chla | NH3  | NO2    | NO2 + NO3 |
|----------------------|----------------------------------------------------|-------|--------|--------|--------|------|--------|------|------|------|--------|-----------|
|                      | Unit:                                              | µeq/L | PCU    | mg/L   | mg/L   | µg/L | mg/L   | mg/L | µg/L | mg/L | mg/L   | mg/L      |
|                      | Method Detection Limit (MDL):                      | n/a   | 1      | 0.0005 | 0.05   | 0.5  | 0.0005 | 0.05 |      | 0.04 | 0.0025 | 0.0025    |
|                      | Concentration threshold:                           | 100   | 10     | 0.3    | 0.3    | 15   | 0.3    | 0.3  | n/a  | 0.4  | 0.4    | 0.4       |
|                      | Low Conc. Precision Objective (StDev):             | 5     | 2      | 0.05   | 0.05   | 2    | 0.05   | 0.05 | n/a  | 0.03 | 0.03   | 0.03      |
|                      | High Conc. Precision Objective (% Relative StDev): | 5     | 10     | 10     | 10     | 10   | 10     | 10   | 20   | 5    | 5      | 5         |

| Station Name                       | Sample Date                  | ANC    | Apparent color | TP          | TN     | PO4  |  |  |  | NH3    | NO2    | NO2 + NO3   |
|------------------------------------|------------------------------|--------|----------------|-------------|--------|------|--|--|--|--------|--------|-------------|
|                                    | Unit:                        | µeq/L  | Pt-Co unit     | mg/L        | mg/L   | µg/L |  |  |  | mg/L   | mg/L   | mg/L        |
|                                    | MRL:                         | 100    | 1              | 0.004, 0.02 | 0.06   | 6    |  |  |  | 0.01   | 0.002  | 0.06, 0.016 |
| Witch Hole Pond                    | 06/21/2006                   | <100   | 25             | E0.01       | 0.29   | <6   |  |  |  | 0.007  | <0.002 | <0.060      |
| Witch Hole Pond (Replicate Sample) | 06/21/2006                   | <100   | 25             | E0.01       | 0.31   | <6   |  |  |  | 0.008  | <0.002 | <0.060      |
|                                    | Mean:                        |        |                |             | 0.3000 |      |  |  |  | 0.0075 |        |             |
|                                    | Standard Deviation:          |        |                |             | 0.0141 |      |  |  |  | 0.0007 |        |             |
|                                    | Relative Standard Deviation: |        |                |             | 4.71   |      |  |  |  | 9.43   |        |             |
|                                    |                              |        |                |             |        |      |  |  |  |        |        |             |
| Witch Hole Pond Replicate Sample   | 8/21/2006                    | 120    | 35             | 0.009       | 0.37   | <6   |  |  |  | 0.021  | <0.002 | <0.016      |
| Witch Hole Pond                    | 08/21/2006                   | 120    | 40             | 0.012       | 0.37   | <6   |  |  |  | 0.022  | <0.002 | <0.016      |
|                                    | Mean:                        |        | 37.50          | 0.0105      | 0.3700 |      |  |  |  | 0.0215 |        |             |
|                                    | Standard Deviation:          |        | 3.54           | 0.0021      | 0.0000 |      |  |  |  | 0.0007 |        |             |
|                                    | Relative Standard Deviation: |        | 9.43           | 20.20       | 0.00   |      |  |  |  | 3.29   |        |             |
|                                    |                              |        |                |             |        |      |  |  |  |        |        |             |
| Hunter's Brook                     | 06/26/2006                   | 140    | 20             | <0.02       | E0.03  | <6   |  |  |  | E0.006 | <0.002 | <0.060      |
| Hunter's Brook Replicate Sample    | 06/26/2006                   | 140    | 18             | <0.02       | E0.03  | E3   |  |  |  | <0.010 | <0.002 | <0.060      |
|                                    | Mean:                        | 140.00 | 19.00          |             |        |      |  |  |  |        |        |             |
|                                    | Standard Deviation:          | 0.00   | 1.41           |             |        |      |  |  |  |        |        |             |
|                                    | Relative Standard Deviation: | 0.00   | 7.44           |             |        |      |  |  |  |        |        |             |
|                                    |                              |        |                |             |        |      |  |  |  |        |        |             |
| Aunt Betty Inlet                   | 08/30/2006                   | 180    | 60             | 0.014       | 0.47   | <6   |  |  |  | 0.015  | <0.002 | <0.016      |
| Aunt Betty Inlet Replicate Sample  | 08/30/2006                   | 160    | 60             | 0.012       | 0.48   | E4   |  |  |  | 0.016  | <0.002 | <0.016      |
|                                    | Mean:                        | 170.00 | 60.00          | 0.01        | 0.48   |      |  |  |  | 0.02   |        |             |
|                                    | Standard Deviation:          | 14.14  | 0.00           | 0.001       | 0.01   |      |  |  |  | 0.001  |        |             |
|                                    | Relative Standard Deviation: | 8.32   | 0.00           | 10.88       | 1.49   |      |  |  |  | 4.56   |        |             |

## Appendix A

| Station Name                       | Sample Date                  | ANC    | Apparent color | TP      | TN      | PO4      | TDP    | TDN        | Chla | NH3         | NO2          | NO2 + NO3    |
|------------------------------------|------------------------------|--------|----------------|---------|---------|----------|--------|------------|------|-------------|--------------|--------------|
|                                    | Unit:                        | µeq/L  | Pt-Co unit     | mg/L    | mg/L    | µg/L     | mg/L   | mg/L       | µg/L | mg/L        | mg/L         | mg/L         |
| Lake Wood Outlet (SECRL)           | 5/22/2007                    | 36.4   | 13             | 0.0044  | <0.1    | <1       | <0.001 | <0.1       |      | <0.02       | <0.002       | <0.016       |
| Lake Wood Replicate (SECRL & NWQL) | 5/22/2007                    | 37.3   | 5              | 0.006   | 0.11    | <6       | 0.003  | 0.09       |      | <0.02       | <0.002       | <0.016       |
|                                    | Mean:                        | 36.85  | 9.00           | 0.01    |         |          |        |            |      |             |              |              |
|                                    | Standard Deviation:          | 0.64   | 5.66           | 0.0011  |         |          |        |            |      |             |              |              |
|                                    | Relative Standard Deviation: | 1.73   | 62.85          | 21.76   |         |          |        |            |      |             |              |              |
|                                    |                              |        |                |         |         |          |        |            |      |             |              |              |
| L. Hadlock (SECRL)                 | 6/25/2007                    | 40.3   | 16             | 0.0     | <0.1    | <1       | 0.0022 | <0.1       | 0.8  | <0.02       | <0.002       | <0.016       |
| L. Hadlock (SECRL & NWQL) rep      | 6/25/2007                    | 40.2   | 10             | 0.0     | 0.17    | <6       | <0.006 | 0.11       | 0.8  | <0.02       | <0.002       | <0.016       |
|                                    | Mean:                        | 40.25  | 13.00          | 0.005   |         |          |        |            |      |             |              |              |
|                                    | Standard Deviation:          | 0.07   | 4.24           | 0.001   |         |          |        |            |      |             |              |              |
|                                    | Relative Standard Deviation: | 0.18   | 32.64          | 15.71   |         |          |        |            |      |             |              |              |
|                                    |                              |        |                |         |         |          |        |            |      |             |              |              |
| Man O'War Brook(ACMOWB)            | 8/13/2007                    | 200    | 28             | 0.015   | 0.230   | 1        | 0.006  | 0.156      |      | <0.02       | 0.001        | 0.064        |
| Man O'War Brook(ACMOWB) Frep       | 8/13/2007                    | 200    | 20             | 0.008   | 0.25    | <6       | 0.006  | 0.21       |      | <0.02       | <0.002       | 0.063        |
|                                    | Mean:                        | 200.00 | 24.00          | 0.012   | 0.24    |          |        | 0.18       |      |             |              |              |
|                                    | Standard Deviation:          | 0.00   | 5.66           | 0.005   | 0.01    |          |        | 0.04       |      |             |              |              |
|                                    | Relative Standard Deviation: | 0.00   | 23.57          | 43.04   | 5.89    |          |        | 20.87      |      |             |              |              |
|                                    |                              |        |                |         |         |          |        |            |      |             |              |              |
| Echo (ACECHO)                      | 8/20/2007                    | 83.3   | 17             | 4       | 0.169   | <1       | 0.0012 | <0.1       | 2.4  | <0.02       | <0.002       | <0.016       |
| Echo Field Rep (ACECHO)            | 8/20/2007                    | 83.7   | 10             | <4      | 0.24    | <6       | <0.006 | 0.21       |      | <0.02       | <0.002       | <0.016       |
|                                    | Mean:                        | 83.50  | 13.50          | 4.00    | 0.20    |          |        |            |      |             |              |              |
|                                    | Standard Deviation:          | 0.28   | 4.95           | n/a     | 0.05    |          |        |            |      |             |              |              |
|                                    | Relative Standard Deviation: | 0.34   | 36.66          | n/a     | 24.55   |          |        |            |      |             |              |              |
|                                    |                              |        |                |         |         |          |        |            |      |             |              |              |
| Hunters Brook (ACHNTR)             | 5/19/2008                    | 112    | 7              | 0.001   | <RL 0.1 | <RL 1    | 0.0022 | <RL 0.1    |      | <RL 0.08    | <RL of 0.005 | <RL of 0.005 |
| Hunters (ACHNTR) F Rep             | 5/19/2008                    | 111    | 7              | 0.002   | <RL 0.1 | <RL 1    | 0.0013 | <RL 0.1    |      | <RL 0.08    | <RL of 0.005 | <RL of 0.005 |
|                                    | Mean:                        | 111.50 | 7.00           | 0.00125 |         |          | 0.0018 |            |      |             |              |              |
|                                    | Standard Deviation:          | 0.71   | 0.00           | 0.0004  |         |          | 0.0006 |            |      |             |              |              |
|                                    | Relative Standard Deviation: | 0.63   | 0.00           | 28.28   |         |          | 36.37  |            |      |             |              |              |
|                                    |                              |        |                |         |         |          |        |            |      |             |              |              |
| U Hadlock                          | 6/19/2008                    | 46.4   | 22             | 0.008   | 0.161   | <RL of 1 | 0.0018 | 0.123      | 2.5  | <RL of 0.08 | <RL of 0.005 | 0.0065       |
| U Hadlock                          | 6/19/2008                    | 45.9   | 22             | 0.005   | 0.14    | 1.1      | 0.0037 | <RL of 0.1 | 2.2  | <RL of 0.08 | <RL of 0.005 | <RL of 0.005 |
|                                    | Mean:                        | 46.15  | 22.00          | 0.006   | 0.15    | n/a      | 0.0028 | 0.12       | 2.35 |             |              |              |
|                                    | Standard Deviation:          | 0.35   | 0.00           | 0.002   | 0.01    | n/a      | 0.0013 | n/a        | 0.21 |             |              |              |
|                                    | Relative Standard Deviation: | 0.77   | 0.00           | 30.55   | 9.87    | n/a      | 48.85  | n/a        | 9.03 |             |              |              |

| Station Name                 | Sample Date  | ANC              | Apparent color | TP     | TN         | PO4             | TDP    | TDN   | Chla            | NH3         | NO2          | NO2 + NO3    |
|------------------------------|--------------|------------------|----------------|--------|------------|-----------------|--------|-------|-----------------|-------------|--------------|--------------|
|                              | <i>Unit:</i> | $\mu\text{eq/L}$ | Pt-Co unit     | mg/L   | mg/L       | $\mu\text{g/L}$ | mg/L   | mg/L  | $\mu\text{g/L}$ | mg/L        | mg/L         | mg/L         |
| Otter Creek                  | 8/5/2008     | 46.8             | 18             | 0.005  | <RL of 0.1 | <RL of 1        | 0.001  | 0.104 |                 | <RL of 0.08 | <RL of 0.005 | <RL of 0.005 |
| Otter Creek                  | 8/5/2008     | 47.8             | 18             | 0.003  | <RL of 0.1 | 1               | 0.005  | 0.119 |                 | <RL of 0.08 | <RL of 0.005 | <RL of 0.005 |
| Mean:                        |              | 47.30            | 18.00          | 0.004  | n/a        | 1.00            | 0.0034 | 0.11  |                 |             |              |              |
| Standard Deviation:          |              | 0.71             | 0.00           | 0.001  | n/a        | n/a             | 0.003  | 0.01  |                 |             |              |              |
| Relative Standard Deviation: |              | 1.49             | 0.00           | 34.94  | n/a        | n/a             | 83.19  | 9.51  |                 |             |              |              |
|                              |              |                  |                |        |            |                 |        |       |                 |             |              |              |
| Long Pond (ACLONG)           | 8/18/2008    | 53.7             | 17             | 0.0034 | 0.136      | 1.1             | 0.0023 | 0.139 | 2.6             | <RL of 0.08 | <RL of 0.005 | <RL of 0.005 |
| Long Pond (ACLONG) FR        | 8/18/2008    | 54               | 16             | 0.0040 | 0.136      | 2.4             | 0.0021 | 0.137 | 2.6             | <RL of 0.08 | <RL of 0.005 | <RL of 0.005 |
| Mean:                        |              | 53.85            | 16.50          | 0.0037 | 0.14       | 1.75            | 0.0022 | 0.14  | 2.60            |             |              |              |
| Standard Deviation:          |              | 0.21             | 0.71           | 0.0004 | 0.00       | 0.92            | 0.0001 | 0.00  | 0.00            |             |              |              |
| Relative Standard Deviation: |              | 0.39             | 4.29           | 11.47  | 0.00       | 52.53           | 6.43   | 1.02  | 0.00            |             |              |              |

## Secchi Transparency QA/QC (Observer Comparisons)

| Lake            | Date       | Secchi Depth (m)<br>(Obs. 1) | Secchi Depth (m)<br>(Obs. 2) | Difference | SampEventCode |
|-----------------|------------|------------------------------|------------------------------|------------|---------------|
| Bubble Pond     | 7/28/2008  | 8.75                         | 8.71                         | 0.04       | 2054          |
| Bubble Pond     | 8/25/2008  | 8.53                         | 8.35                         | 0.18       | 2065          |
| Bubble Pond     | 9/17/2008  | 5.17                         | 5.13                         | 0.04       | 2071          |
| Eagle Lake      | 6/2/2008   | 12.64                        | 12.7                         | 0.06       | 2034          |
| Eagle Lake      | 6/19/2008  | 11.16                        | 11.38                        | 0.22       | 2038          |
| Eagle Lake      | 7/23/2008  | 11.45                        | 11.95                        | 0.5        | 2050          |
| Eagle Lake      | 8/13/2008  | 10.49                        | 10.65                        | 0.16       | 2058          |
| Eagle Lake      | 9/22/2008  | 8.05                         | 7.96                         | 0.09       | 2077          |
| Eagle Lake      | 10/21/2008 | 6.94                         | 7.08                         | 0.14       | 2085          |
| Echo Lake       | 6/19/2008  | 7.99                         | 7.87                         | 0.12       | 2036          |
| Echo Lake       | 7/16/2008  | 8.64                         | 8.8                          | 0.16       | 2046          |
| Echo Lake       | 9/25/2008  | 7.23                         | 6.79                         | 0.44       | 2078          |
| Echo Lake       | 9/25/2008  | 7.23                         | 6.79                         | 0.44       | 2079          |
| Echo Lake       | 10/20/2008 | 6.56                         | 6.24                         | 0.32       | 2081          |
| Jordan Pond     | 6/25/2008  | 15.47                        | 14.92                        | 0.55       | 2041          |
| Jordan Pond     | 7/23/2008  | 14.8                         | 13.49                        | 1.31       | 2049          |
| Jordan Pond     | 8/21/2008  | 13.1                         | 13.1                         | 0          | 2064          |
| Jordan Pond     | 9/17/2008  | 7.83                         | 7.75                         | 0.08       | 2072          |
| Jordan Pond     | 10/21/2008 | 10.71                        | 10.66                        | 0.05       | 2083          |
| Lake Wood       | 7/21/2008  | 4.21                         | 4.2                          | 0.01       | 2048          |
| Lake Wood       | 8/14/2008  | 4.09                         | 4.01                         | 0.08       | 2059          |
| Lake Wood       | 10/30/2008 | 4.36                         | 4.4                          | 0.04       | 2092          |
| Long Pond (MDI) | 5/30/2008  | 7.8                          | 7.6                          | 0.2        | 2032          |
| Long Pond (MDI) | 6/30/2008  | 9.2                          | 9.3                          | 0.1        | 2044          |
| Long Pond (MDI) | 7/17/2008  | 11.25                        | 11.17                        | 0.08       | 2047          |
| Long Pond (MDI) | 9/16/2008  | 7.09                         | 7                            | 0.09       | 2069          |
| Round Pond      | 6/30/2008  | 4.7                          | 4.68                         | 0.02       | 2045          |
| Round Pond      | 7/29/2008  | 4.45                         | 4.14                         | 0.31       | 2055          |
| Round Pond      | 8/25/2008  | 4.11                         | 3.95                         | 0.16       | 2066          |
| Round Pond      | 9/16/2008  | 3.5                          | 3.6                          | 0.1        | 2070          |
| Round Pond      | 10/27/2008 | 3.34                         | 3.39                         | 0.05       | 2089          |
| Seal Cove Pond  | 5/27/2008  | 5.87                         | 5.77                         | 0.1        | 2027          |
| Seal Cove Pond  | 6/25/2008  | 6.11                         | 5.89                         | 0.22       | 2042          |
| Seal Cove Pond  | 9/16/2008  | 4.49                         | 4.41                         | 0.08       | 2068          |
| Upper Breakneck | 5/23/2008  | 3.8                          | 3.52                         | 0.28       | 2025          |
| Upper Breakneck | 7/28/2008  | 3.45                         | 3.6                          | 0.15       | 2053          |
| Upper Breakneck | 8/20/2008  | 3.49                         | 3.55                         | 0.06       | 2063          |

| Lake            | Date       | Secchi Depth (m)<br>(Obs. 1) | Secchi Depth (m)<br>(Obs. 2) | Difference | SampEventCode |
|-----------------|------------|------------------------------|------------------------------|------------|---------------|
| Upper Hadlock   | 5/22/2008  | 4.69                         | 4.7                          | 0.01       | 2024          |
| Upper Hadlock   | 6/19/2008  | 6.47                         | 6.42                         | 0.05       | 2037          |
| Upper Hadlock   | 7/24/2008  | 4.76                         | 4.79                         | 0.03       | 2051          |
| Upper Hadlock   | 8/13/2008  | 5.41                         | 5.4                          | 0.01       | 2057          |
| Upper Hadlock   | 10/21/2008 | 5.25                         | 5.36                         | 0.11       | 2084          |
| Witch Hole Pond | 5/23/2008  | 4.75                         | 4.75                         | 0          | 2026          |
| Witch Hole Pond | 6/23/2008  | 4.59                         | 4.54                         | 0.05       | 2039          |
| Witch Hole Pond | 7/24/2008  | 4.34                         | 4.53                         | 0.19       | 2052          |
| Witch Hole Pond | 9/22/2008  | 4.33                         | 4.4                          | 0.07       | 2075          |

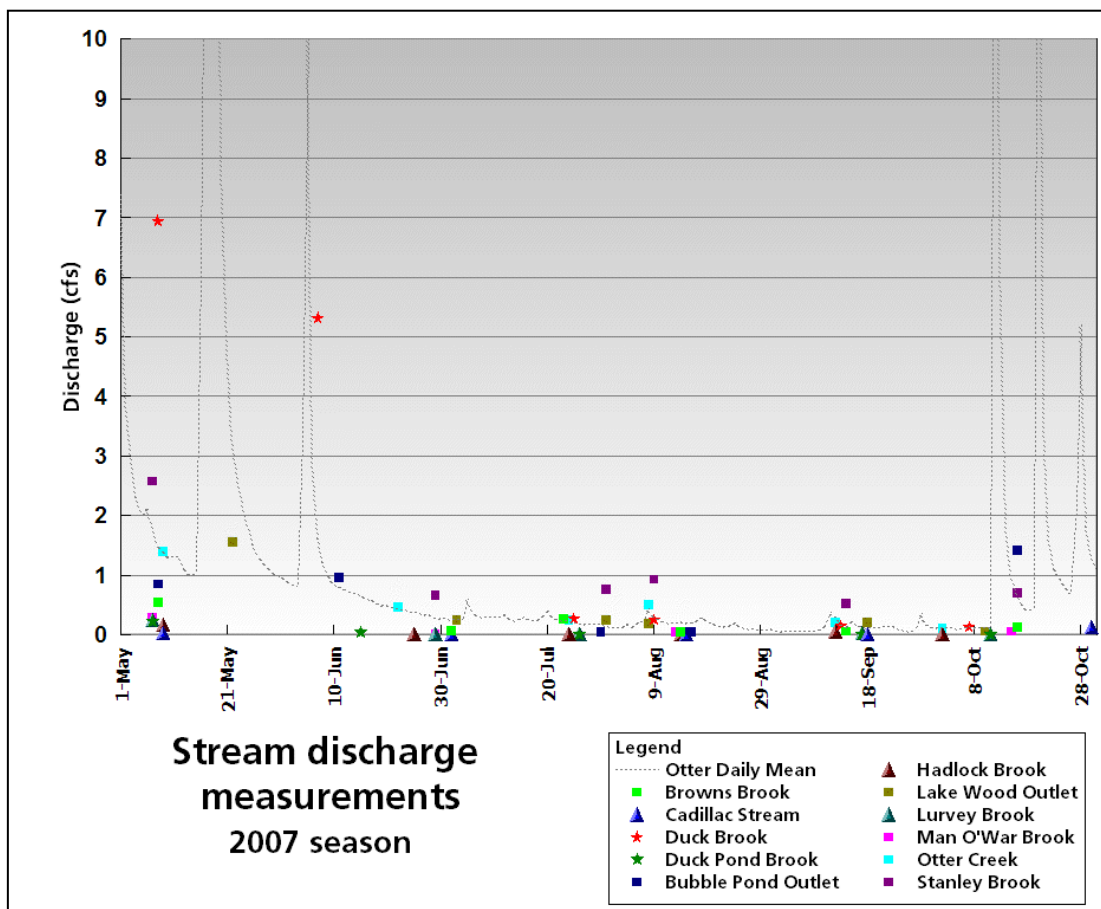
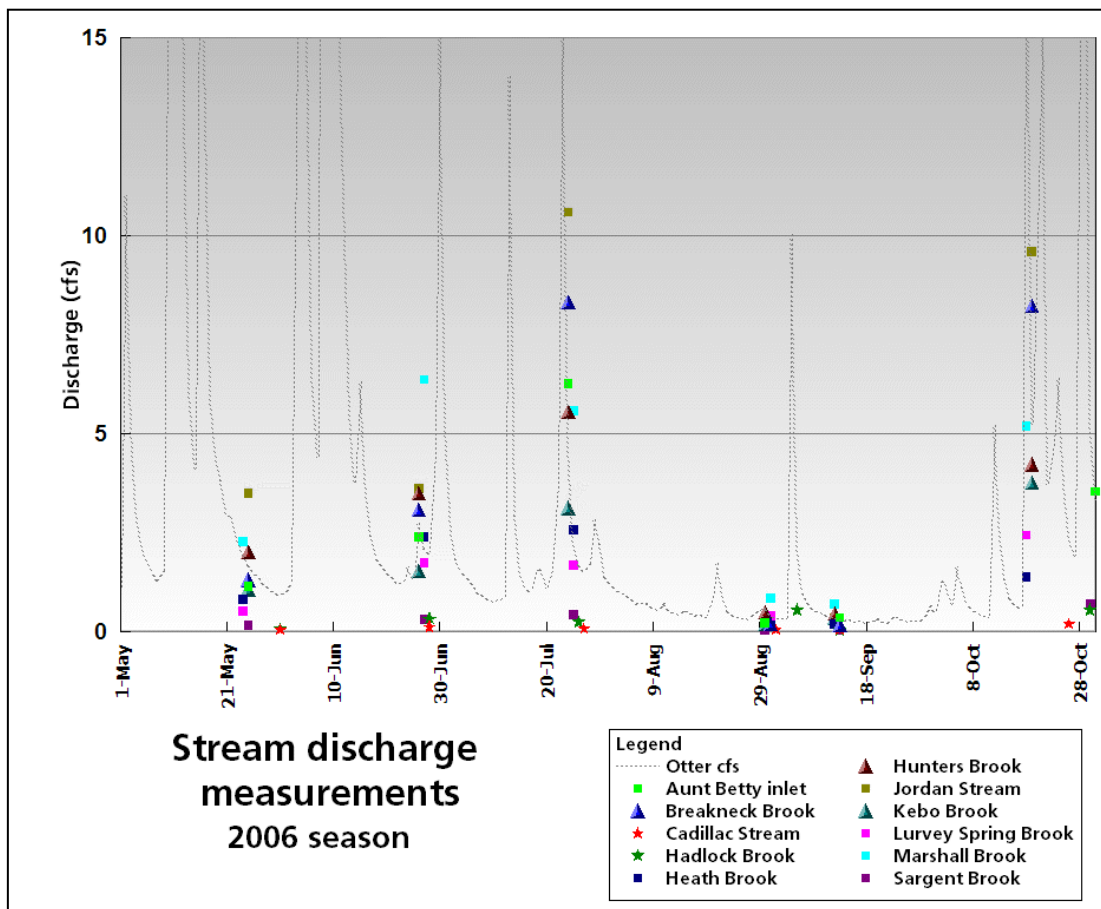
## **APPENDIX B**

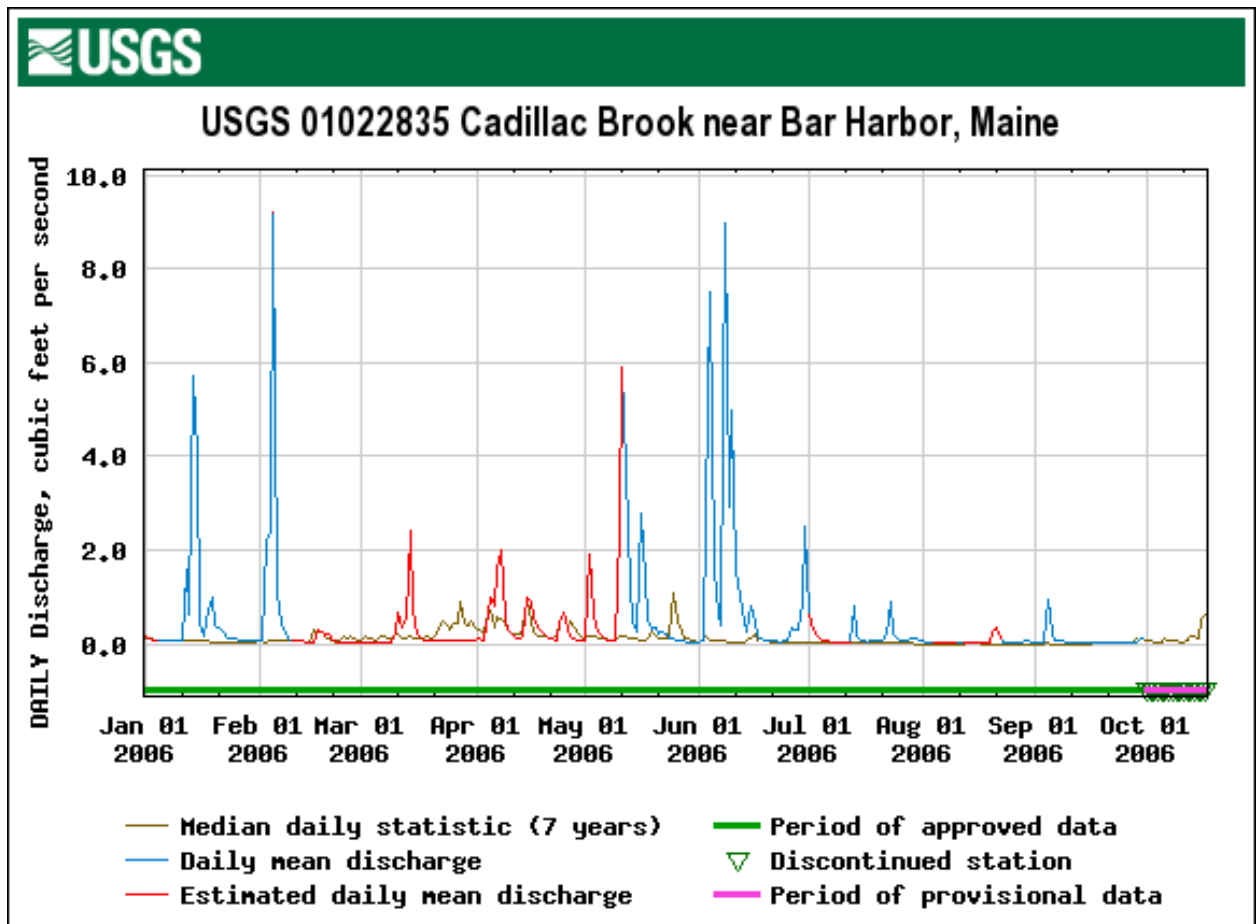
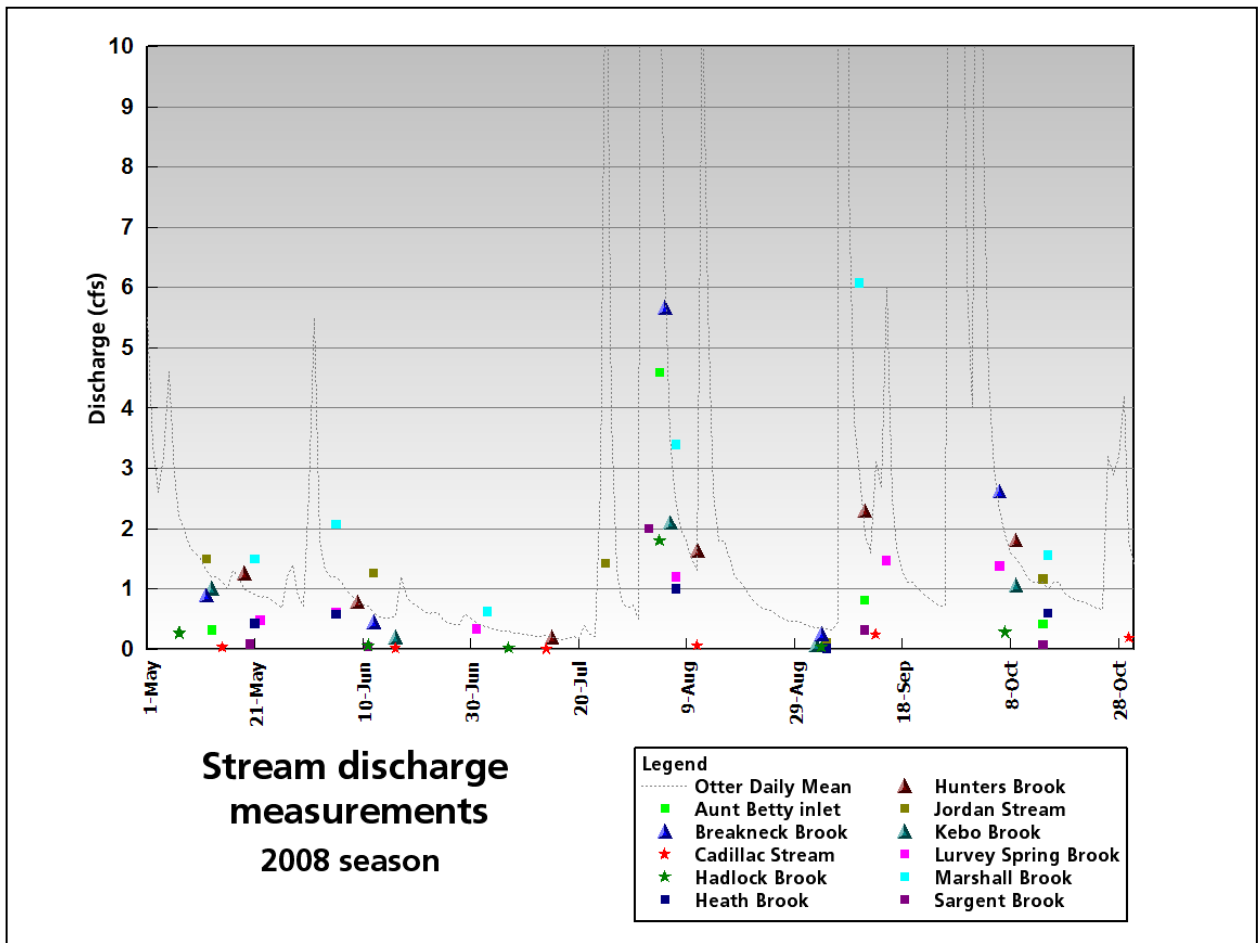
Stream Discharge and Stage Graphs 2006-2008

Weekly Lake Stage and Precipitation Graphs: 2006-2008

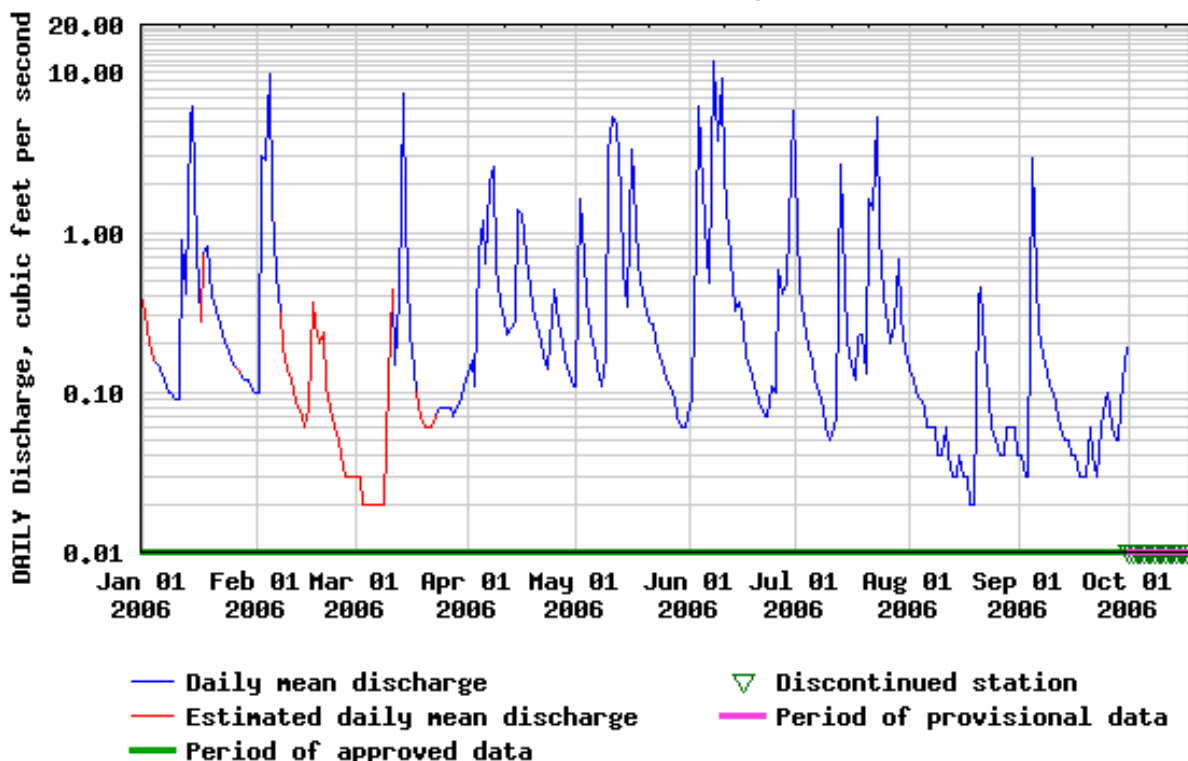
USGS Groundwater Monitoring Wells: 2006-2008



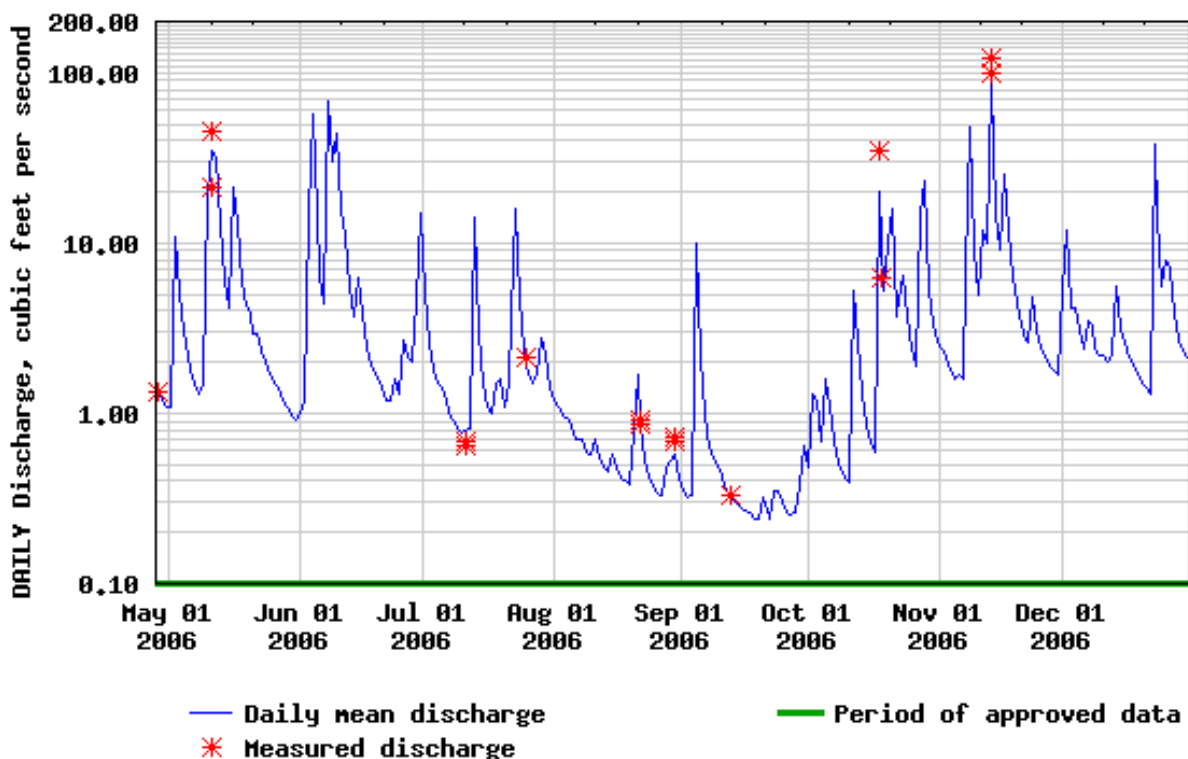




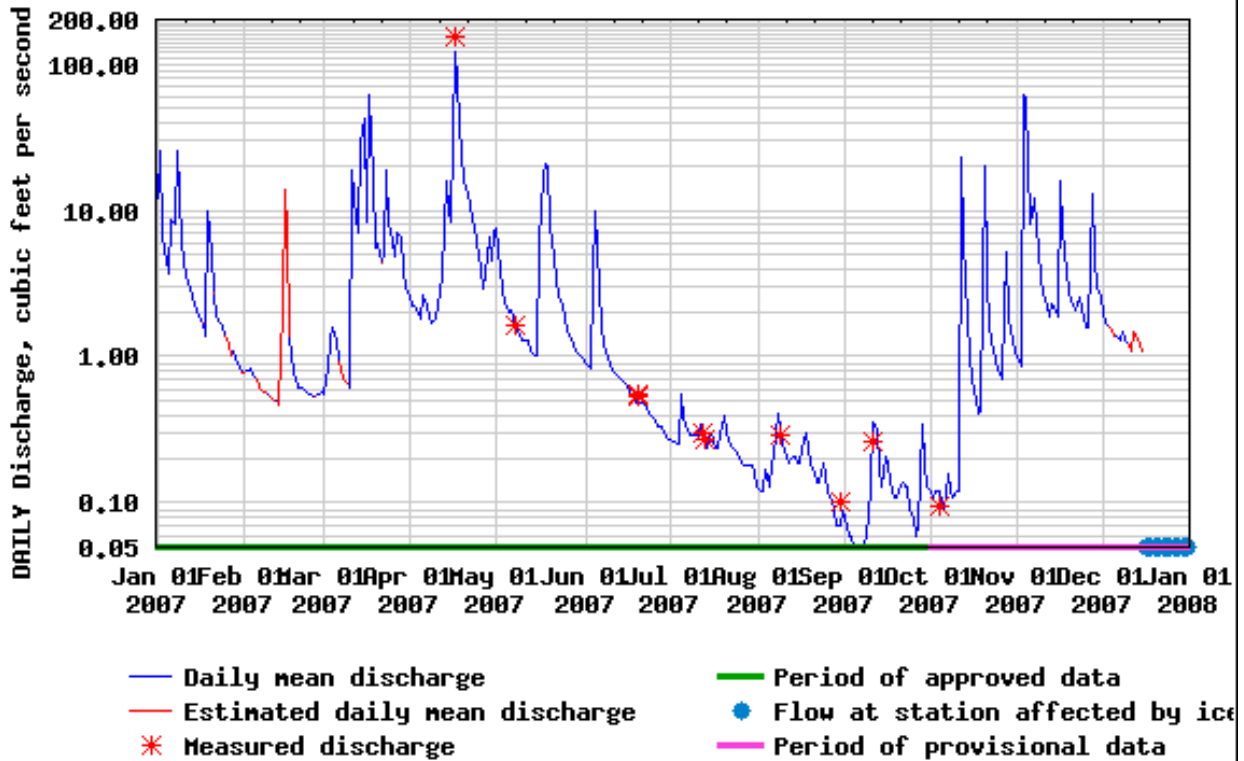
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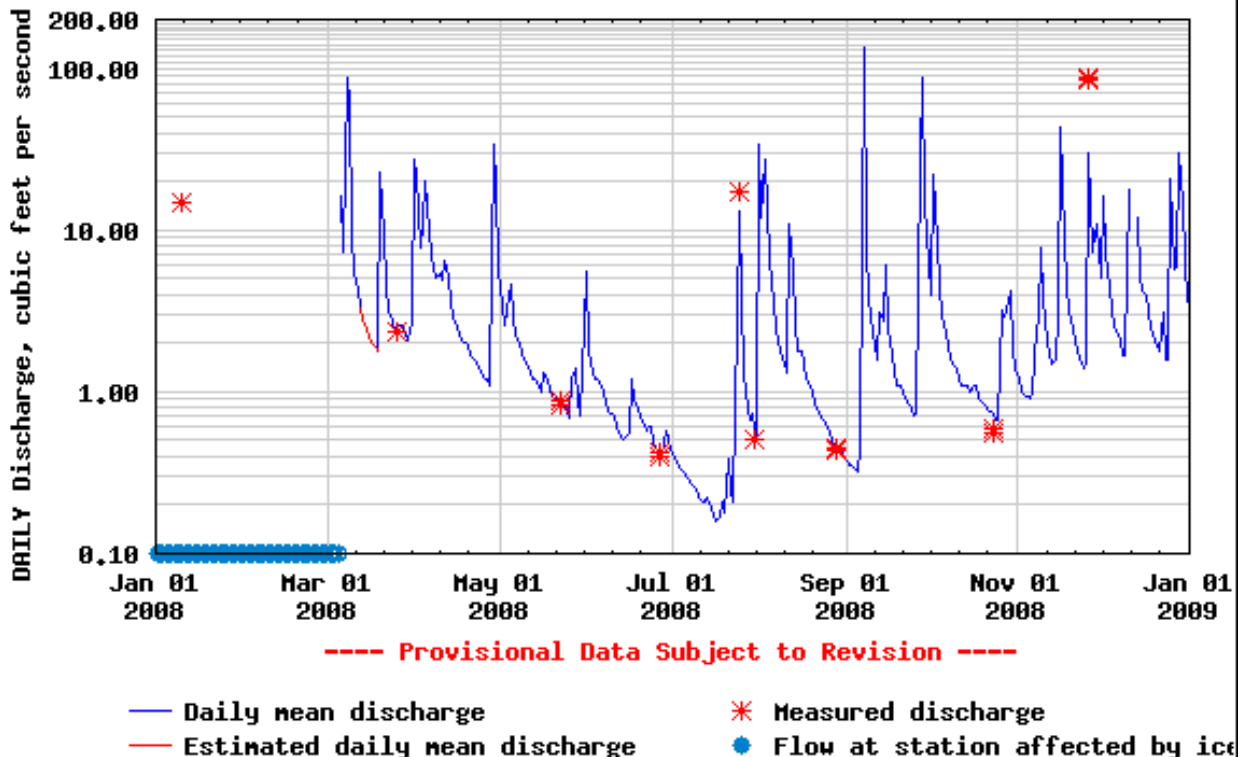
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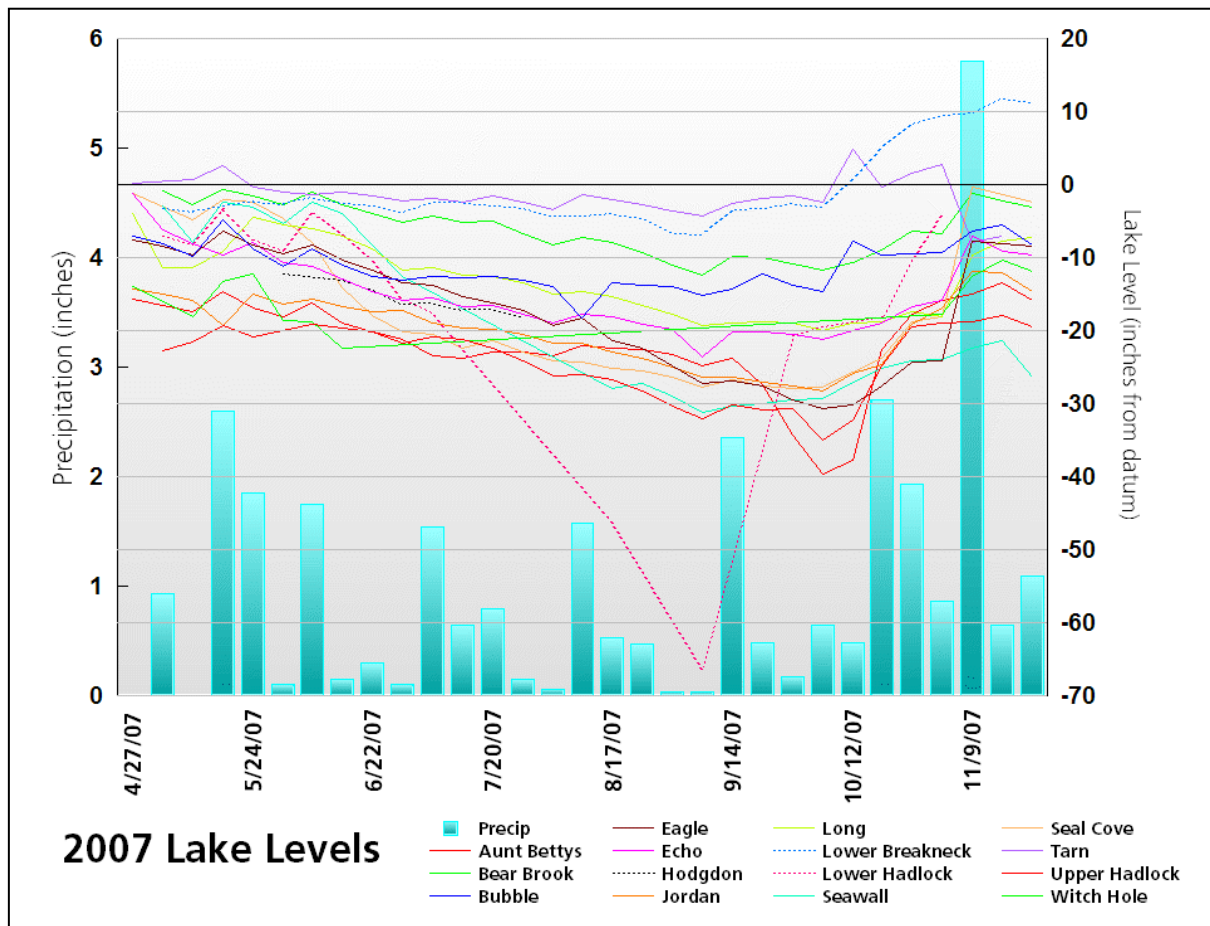
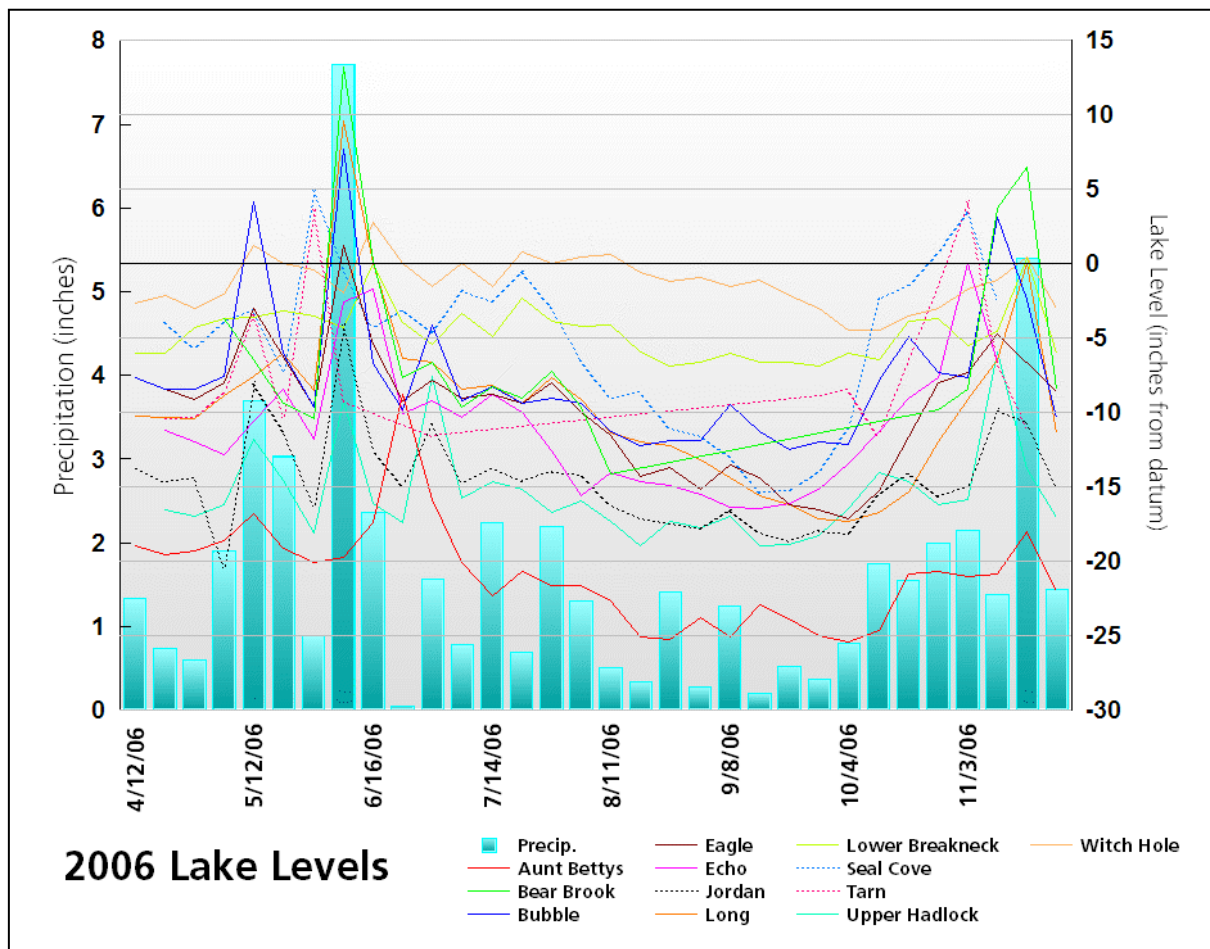


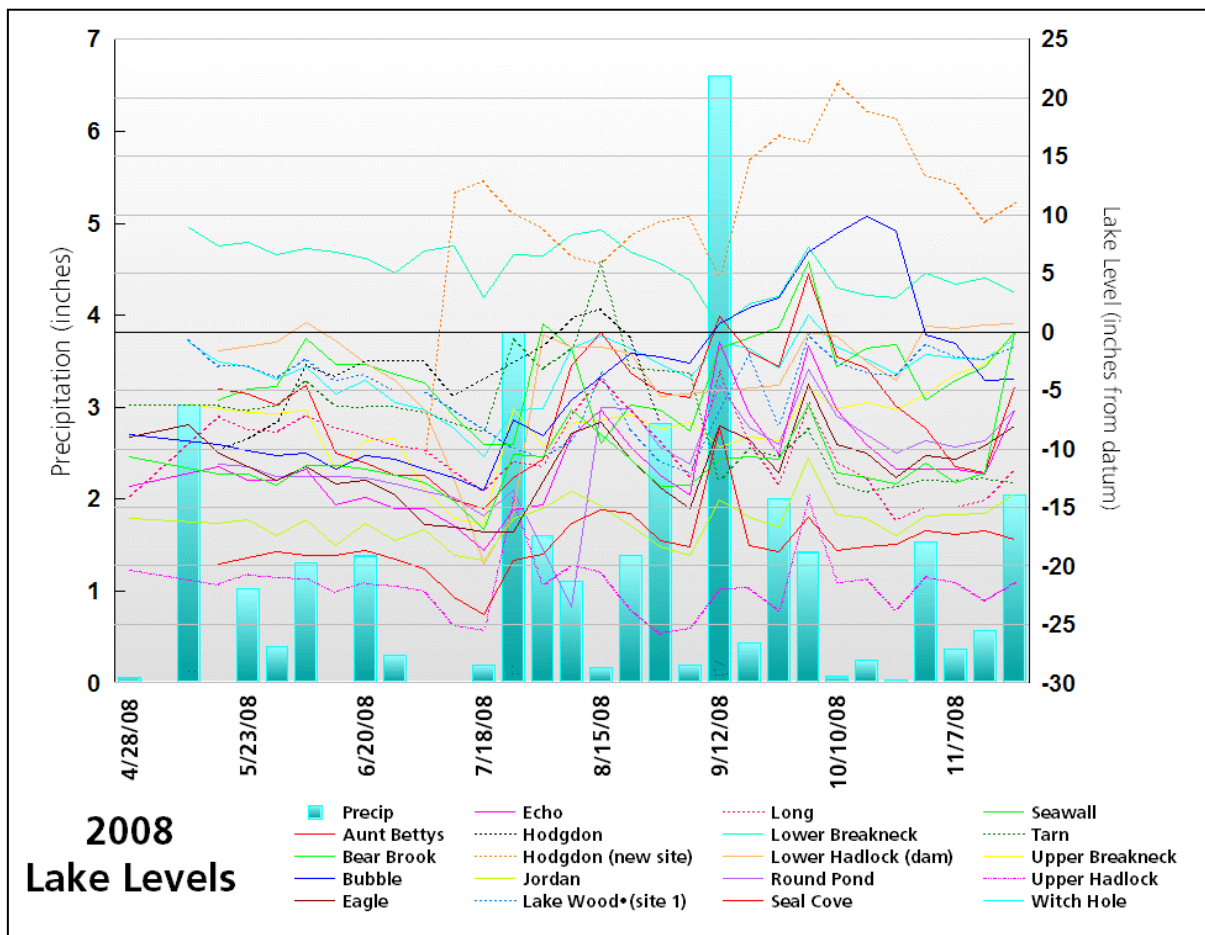
## USGS 01022840 Otter Creek near Bar Harbor, ME



## USGS 01022840 Otter Creek near Bar Harbor, ME

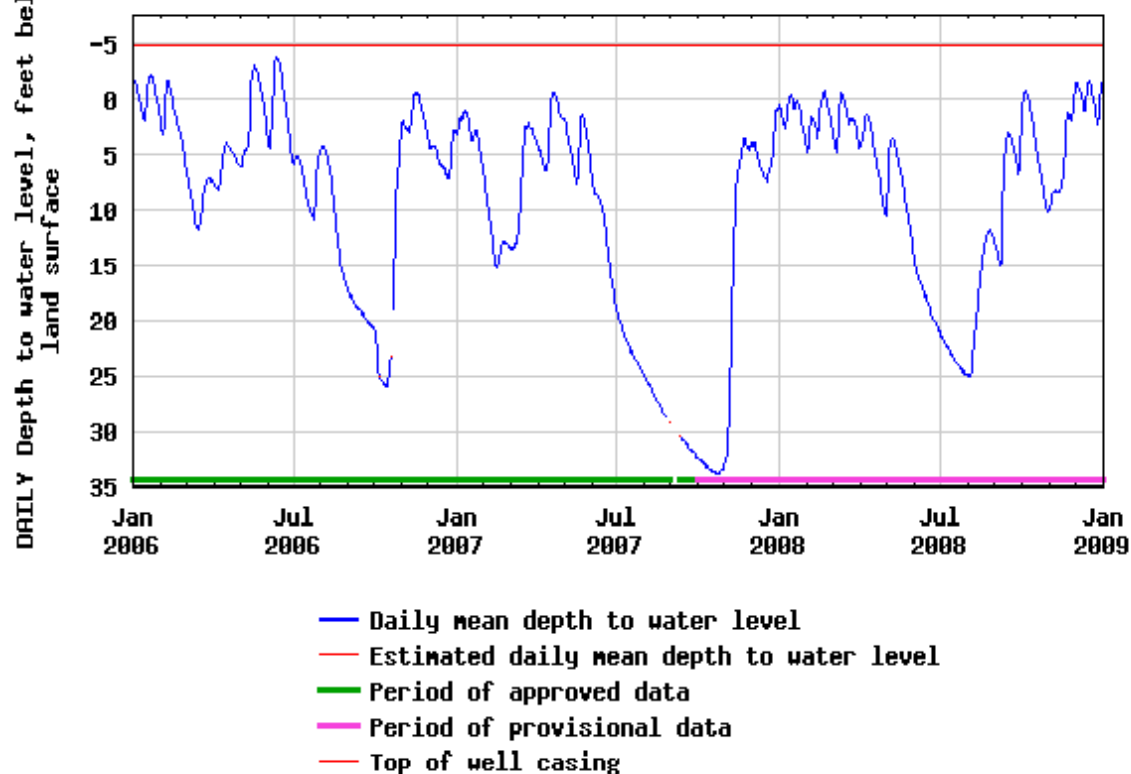




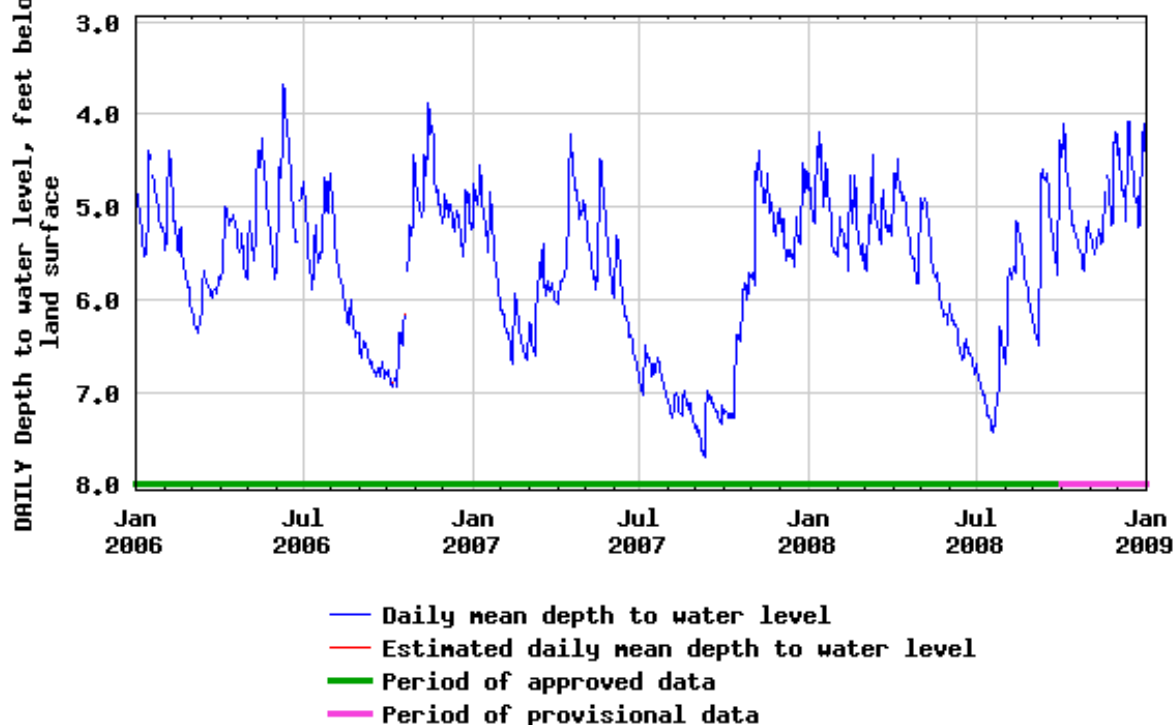




USGS 442238068154101 ME-HW171 McFarland Hill near Bar Harbor, Maine



USGS 442450068175201 ME-HW172 Crooked Road near Bar Harbor, Maine





## **APPENDIX C**

### Transparency Graphs

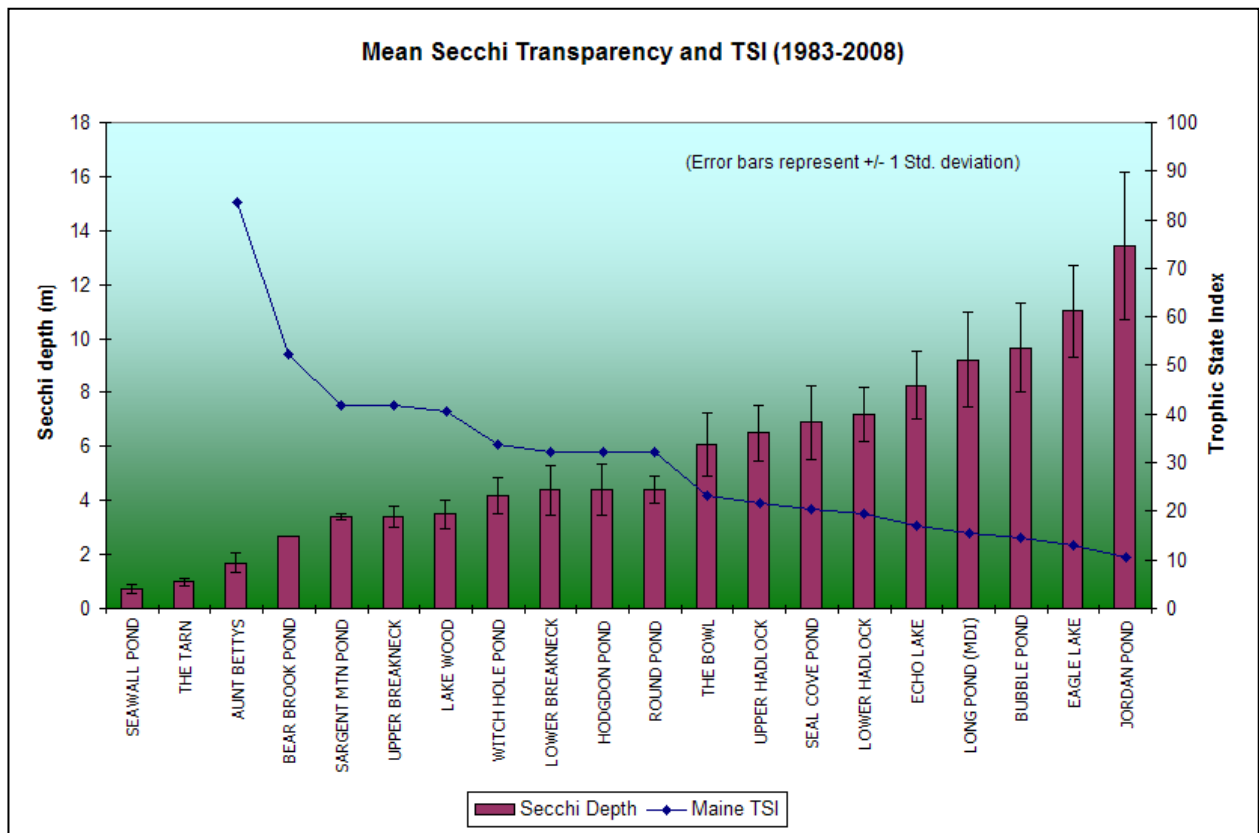
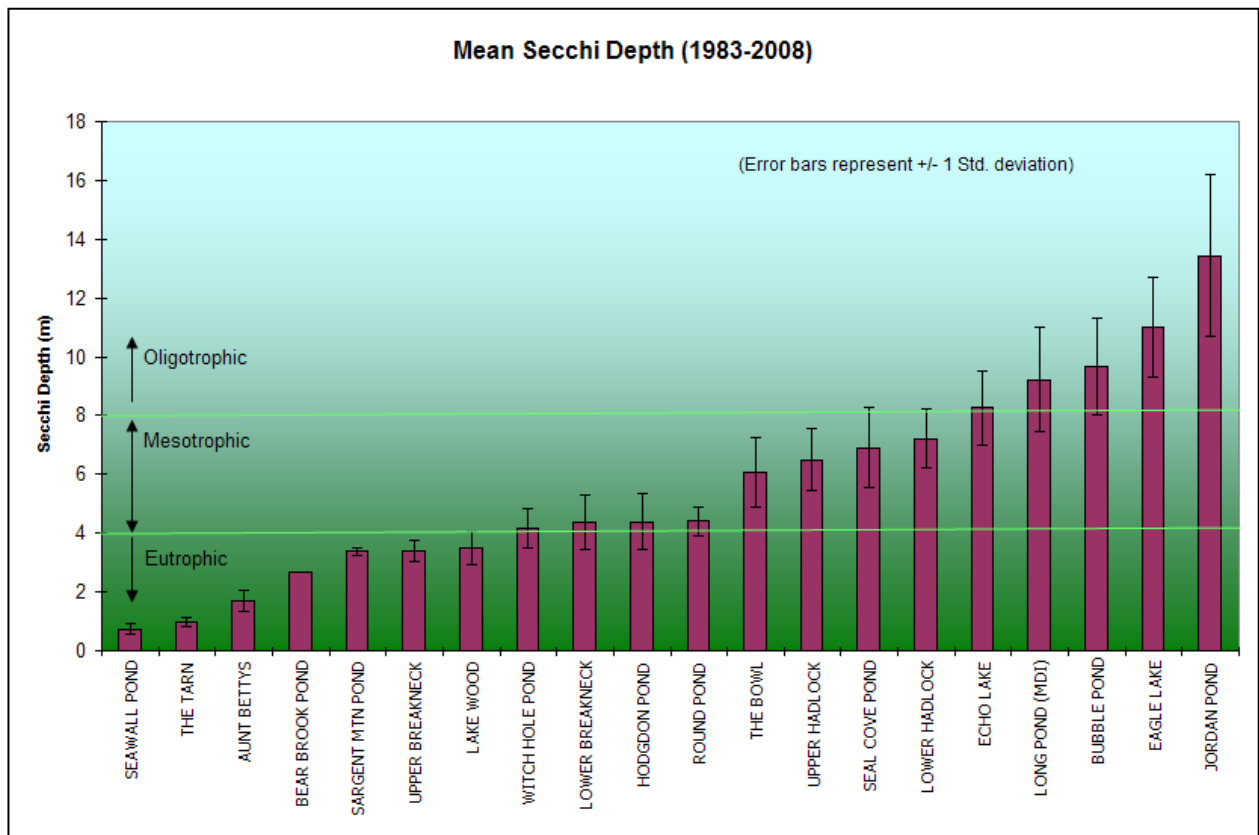
### **Explanation of the Trophic State Index (TSI)**

The Trophic State Index (TSI) was developed in 1977 by Robert Carlson as a means to be used for establishing a simple numerical scale for indicators of lake water quality that are commonly used to measure (directly or indirectly) lake productivity. Because the units of measurement and scale for Secchi disk transparency, total phosphorus and chlorophyll a differ, the TSI provides a convenient means by which the three indicators can be compared. The TSI converts raw data from each of these three indicators to standard numerical scales that range from 0 to over 100, which ranks lakes for productivity.

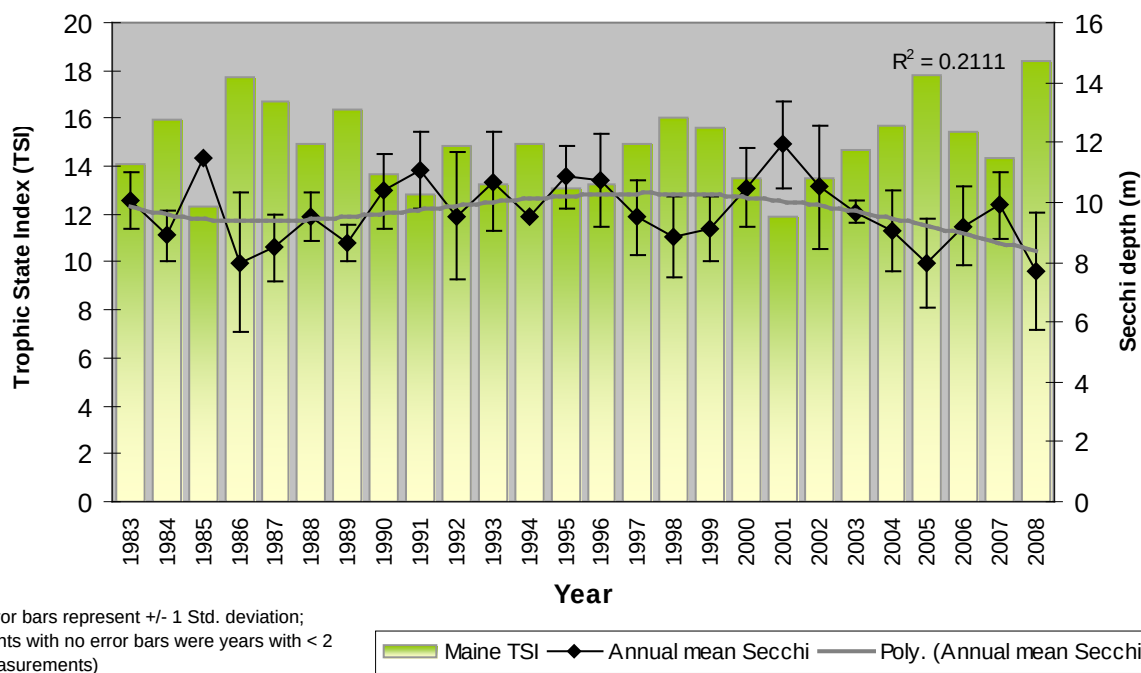
The low (zero) end of the scale supports very little algae, has excellent water quality (oligotrophic) and the high end 100+ is eutrophic and very productive. Lakes with TSI values greater than 65 may support algal blooms while values over 100 indicate extreme productivity and annual algae blooms. TSI values can be used to compare lakes with similar water color and track water quality trends within a lake.

The TSI models developed by Carlson have been modified for Maine lakes, based on historical data for each indicator.

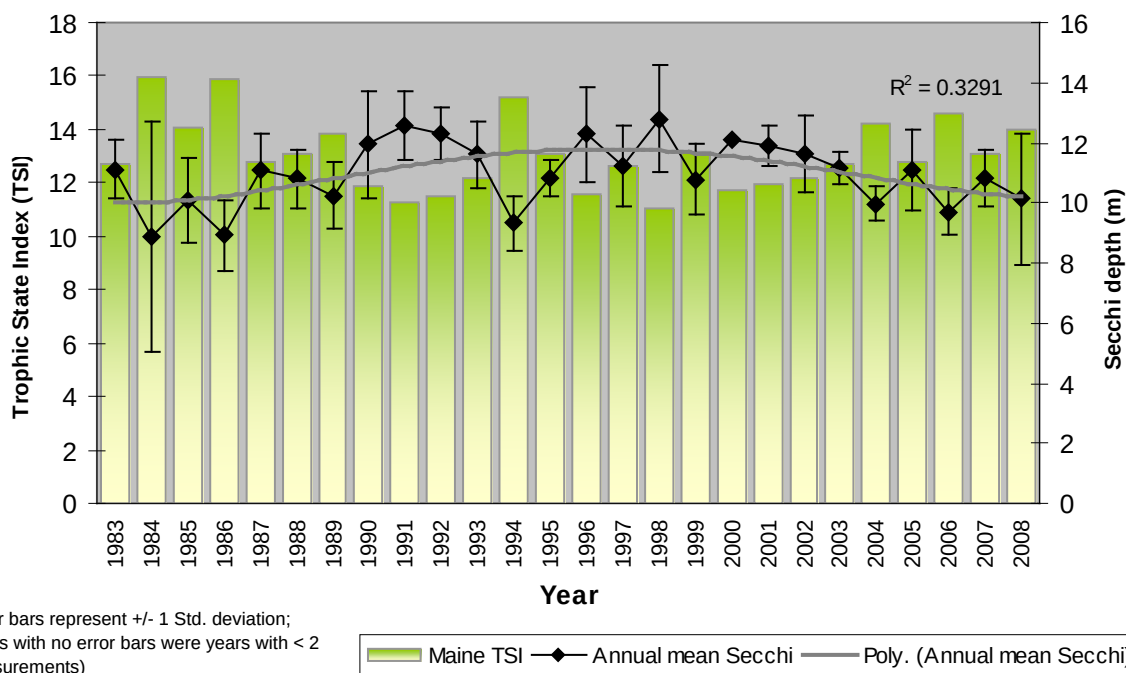
$$\text{Maine Secchi disk TSI} = 70 \log \left( \frac{105}{\text{mean Secchi disk}} + 0.7 \right)$$



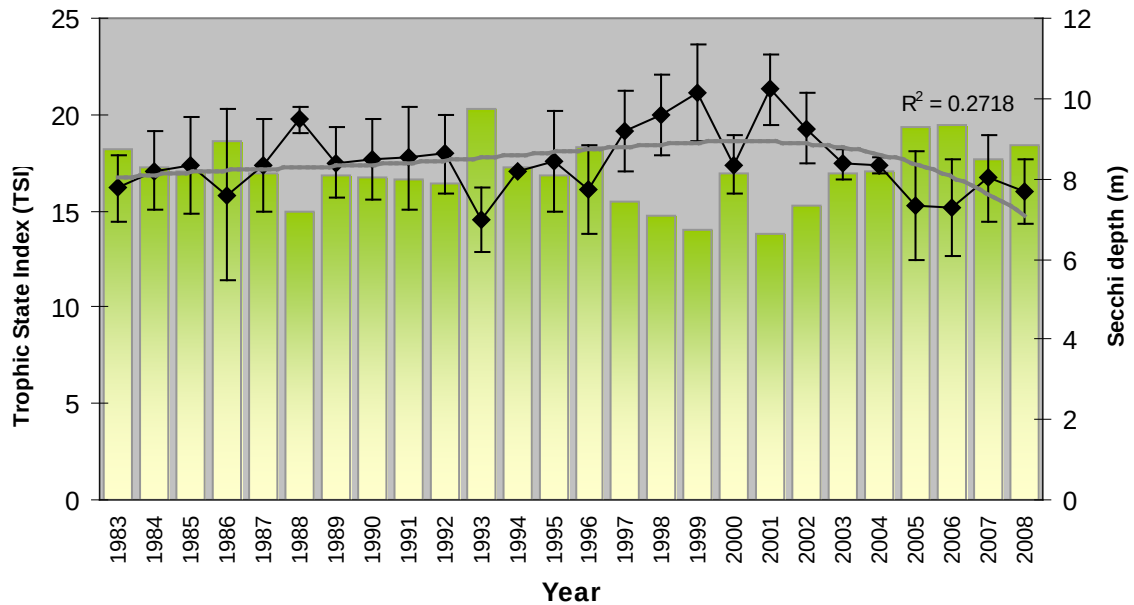
### Bubble Pond Transparency and TSI 1983- 2008



### Eagle Lake Transparency and TSI 1983- 2008



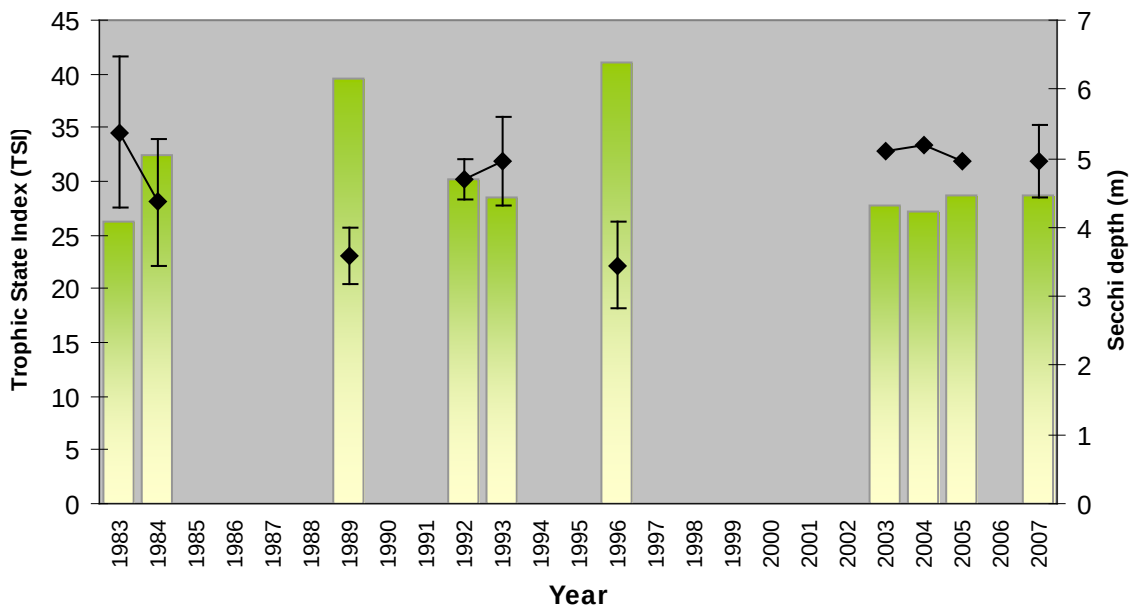
### Echo Lake Transparency and TSI 1983- 2008



(Error bars represent +/- 1 Std. deviation;  
Points with no error bars were years with < 2  
measurements)

Maine TSI — Annual mean Secchi — Poly. (Annual mean Secchi)

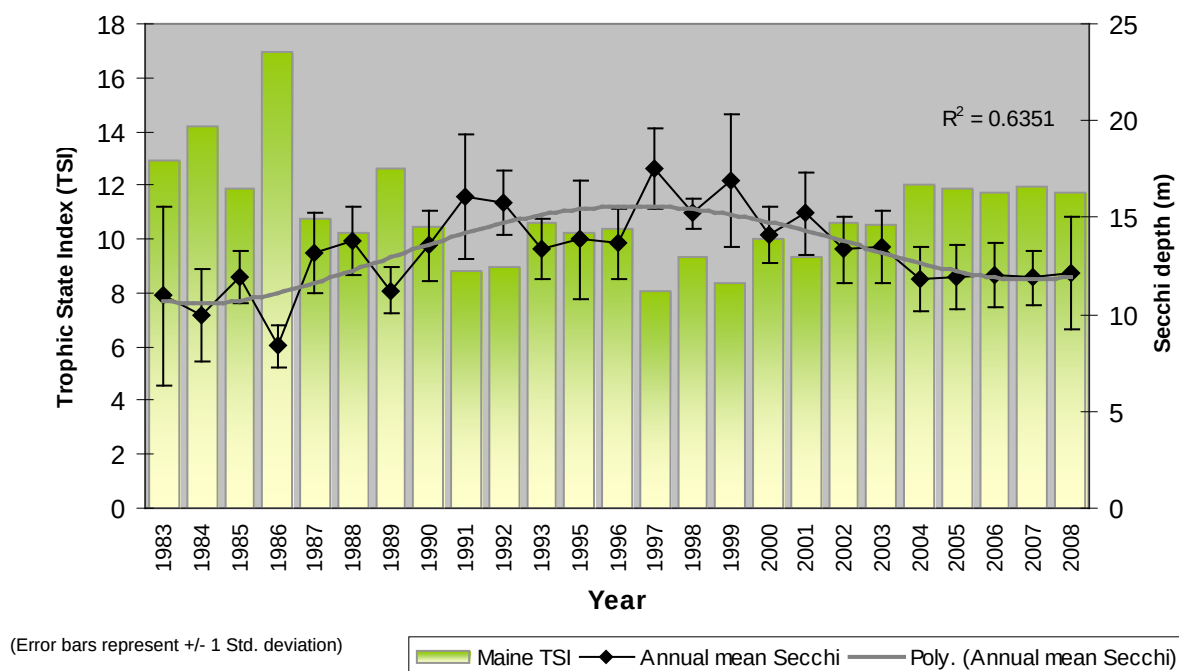
### Hodgdon Pond Transparency and TSI 1983- 2008



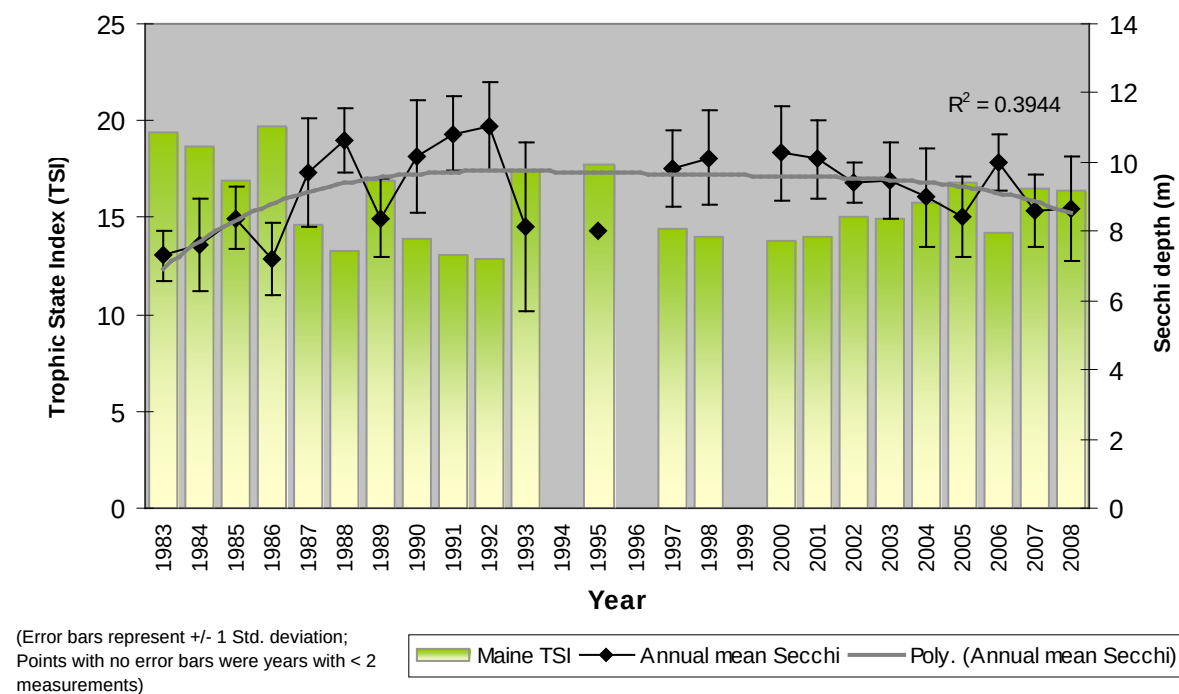
(Error bars represent +/- 1 Std. deviation;  
Points with no error bars were years with < 2  
measurements)

Maine TSI — Annual mean Secchi

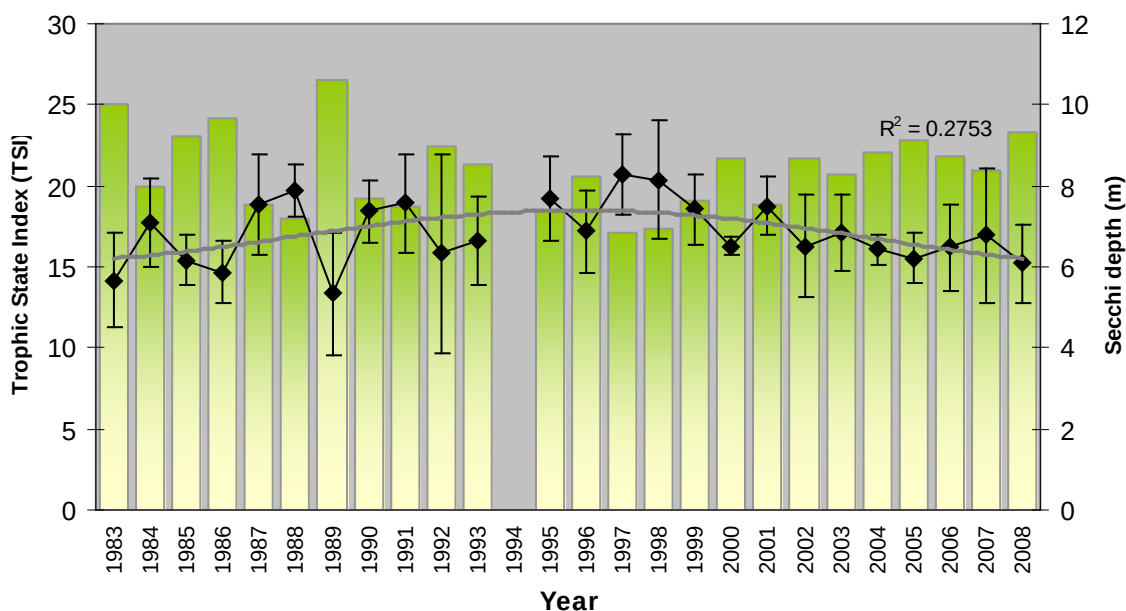
### Jordan Pond Transparency and TSI 1983- 2008



### Long Pond (MDI) Transparency and TSI 1983- 2008



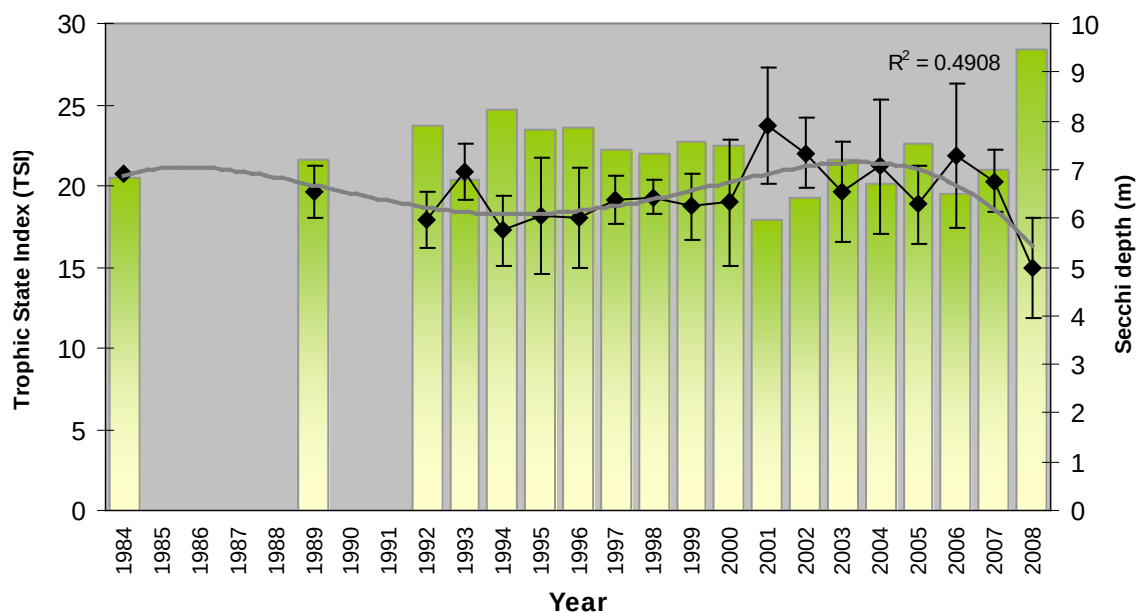
### Seal Cove Pond Transparency and TSI 1983- 2008



(Error bars represent +/- 1 Std. deviation;  
Points with no error bars were years with < 2  
measurements)

Maine TSI — Annual mean Secchi — Poly. (Annual mean Secchi)

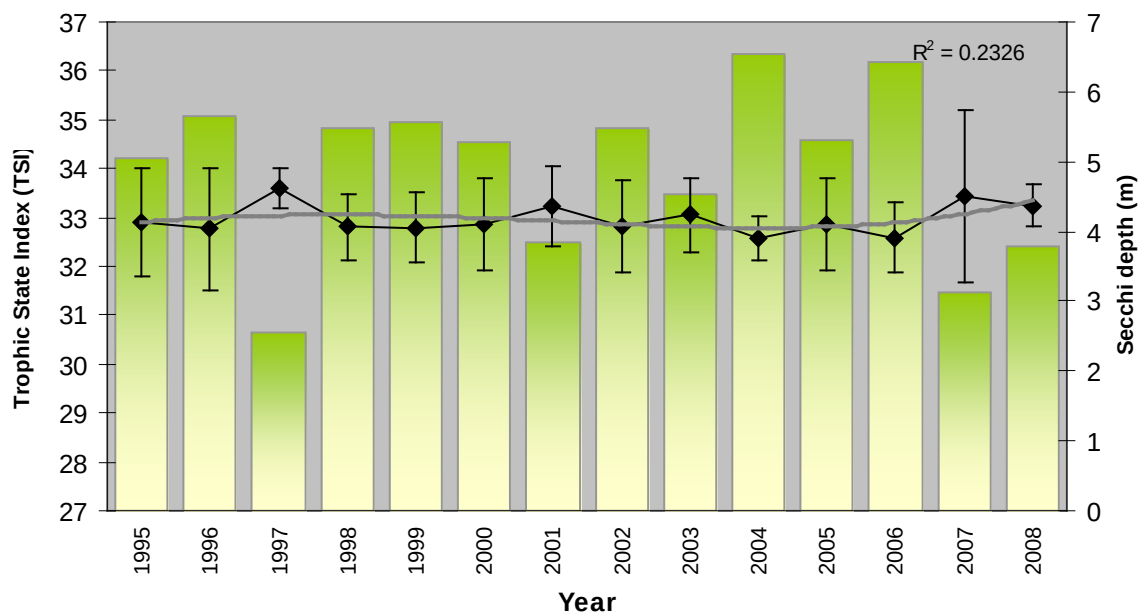
### Upper Hadlock Pond Transparency and TSI 1984- 2008



(Error bars represent +/- 1 Std. deviation;  
Points with no error bars were years with < 2  
measurements)

Maine TSI — Annual mean Secchi — Poly. (Annual mean Secchi)

### Witch Hole Pond Transparency and TSI 1995- 2008



(Error bars represent  $\pm 1$  Std. deviation;  
Points with no error bars were years with  $< 2$  measurements)

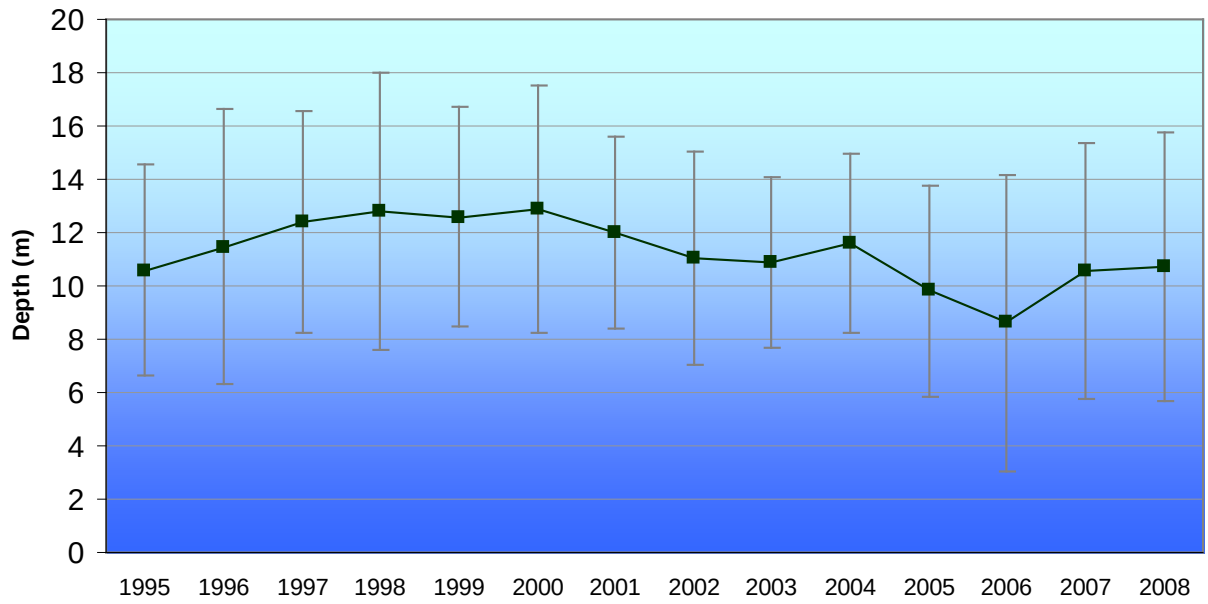
Maine TSI — Annual mean Secchi — Poly. (Annual mean Secchi)

## **APPENDIX D**

### Dissolved Oxygen and Temperature Graphs



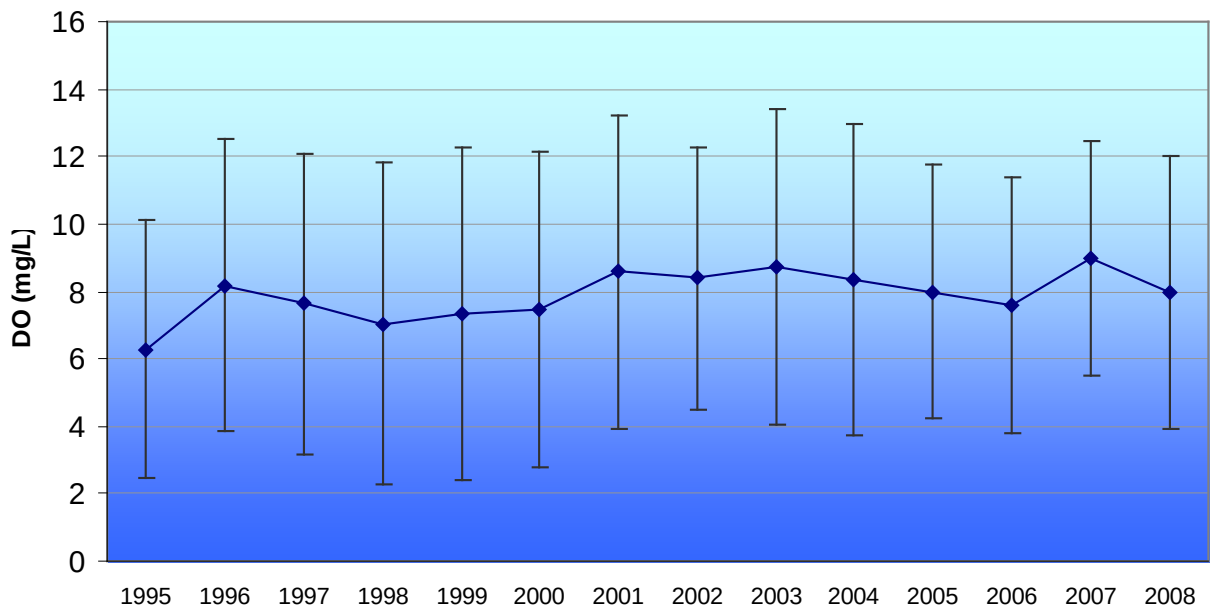
**Annual Mean Hypolimnion Depths: 1995- 2008  
(All Lakes)**



Error bars represent +/- 1 Std. dev.

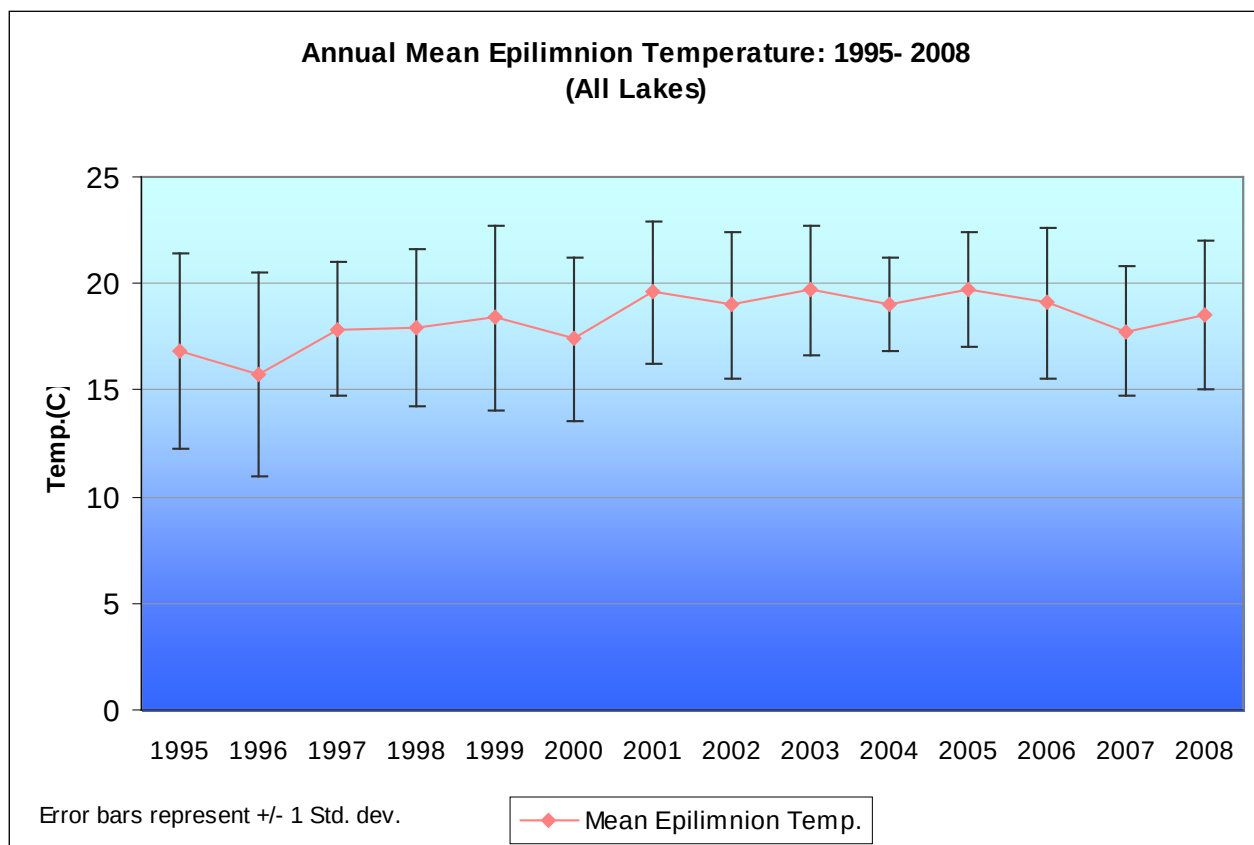
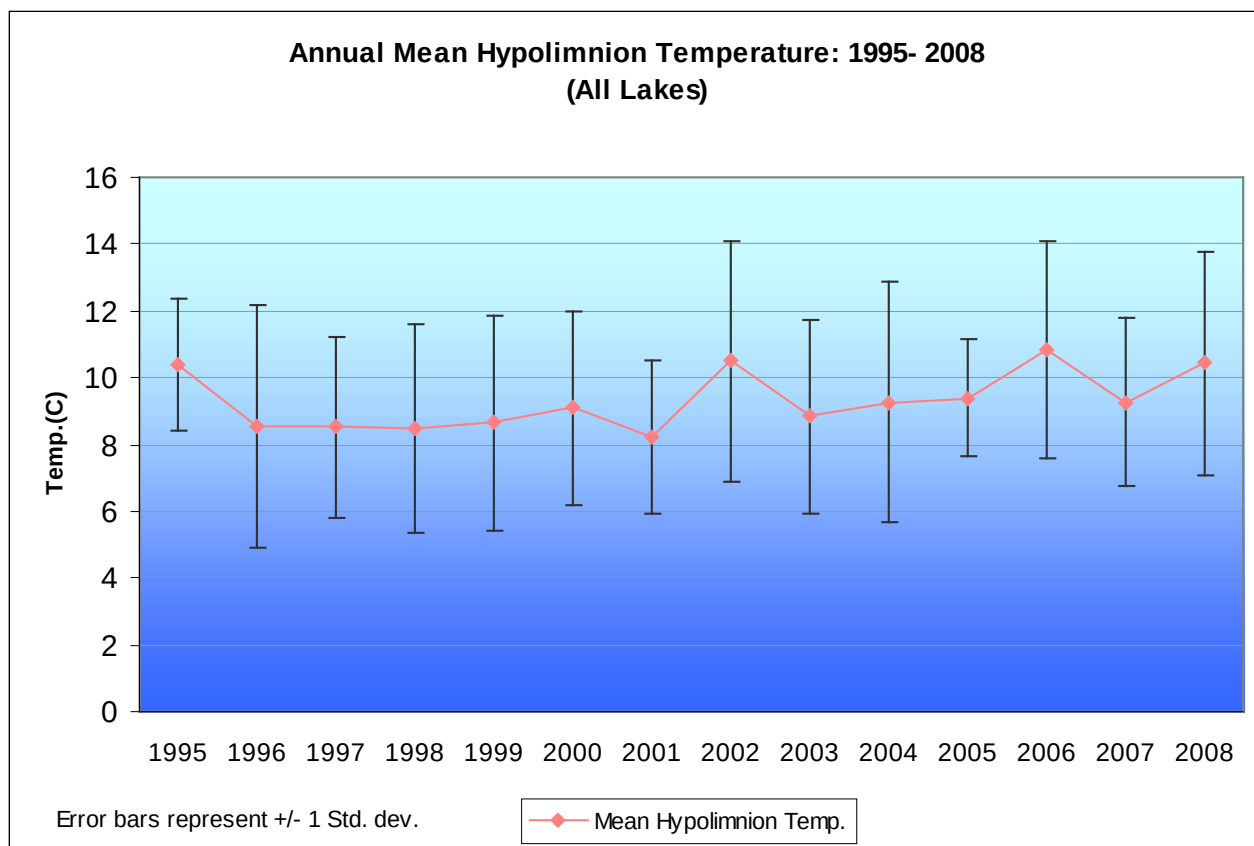
—■— Mean Hypolimnion Depth

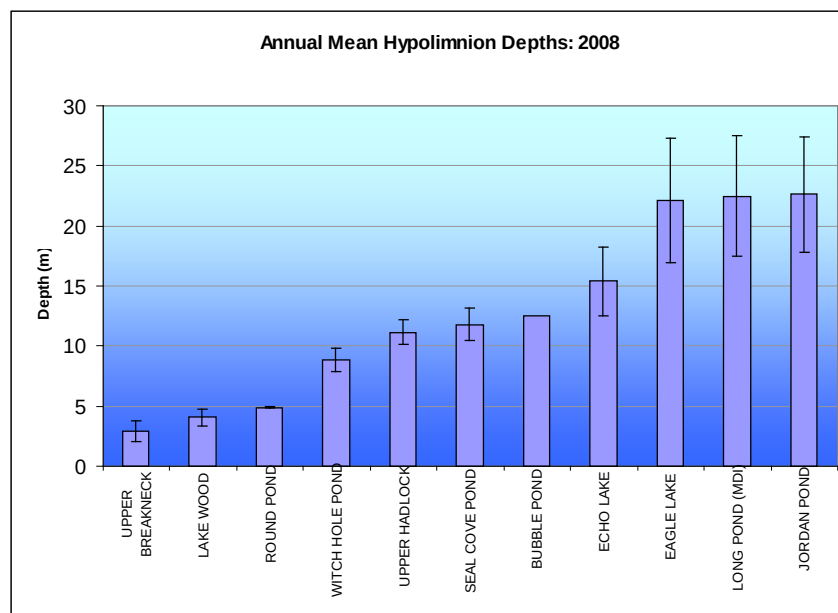
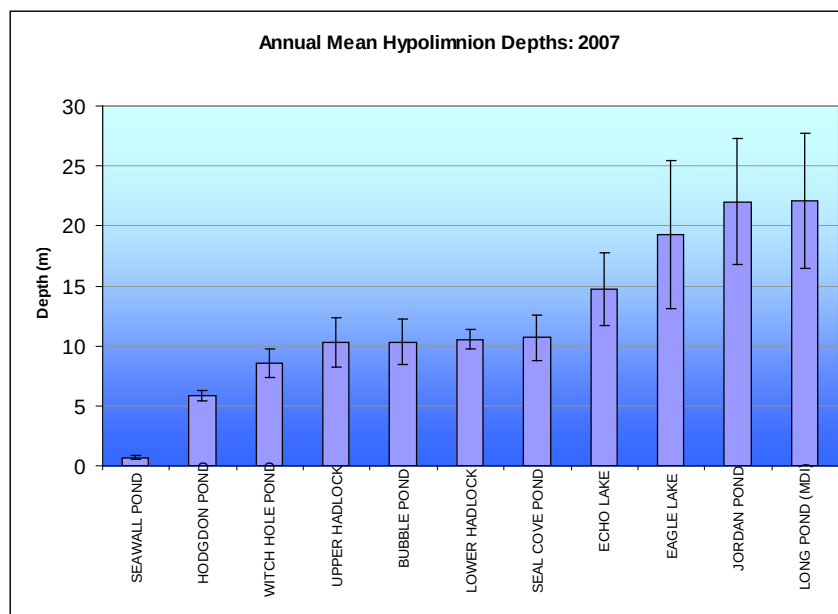
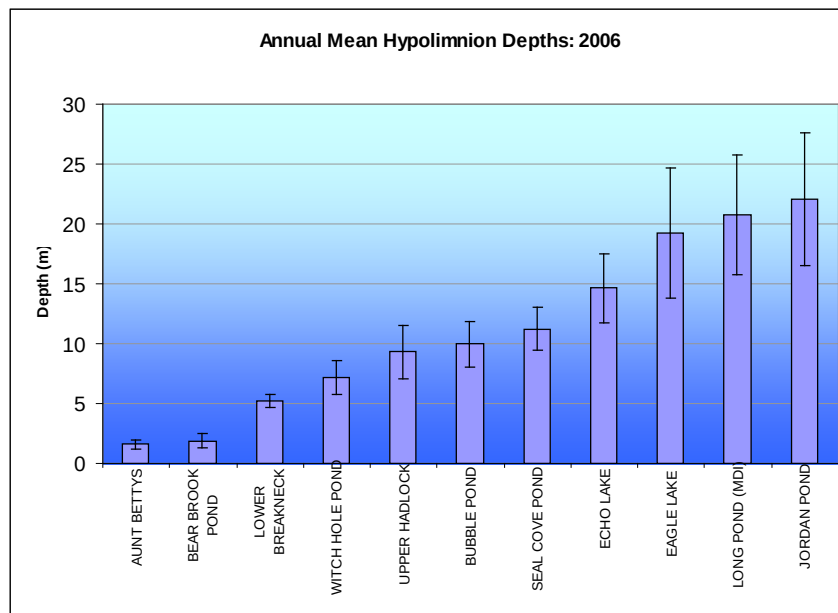
**Annual Mean Hypolimnion Dissolved Oxygen: 1995- 2008  
(All Lakes)**



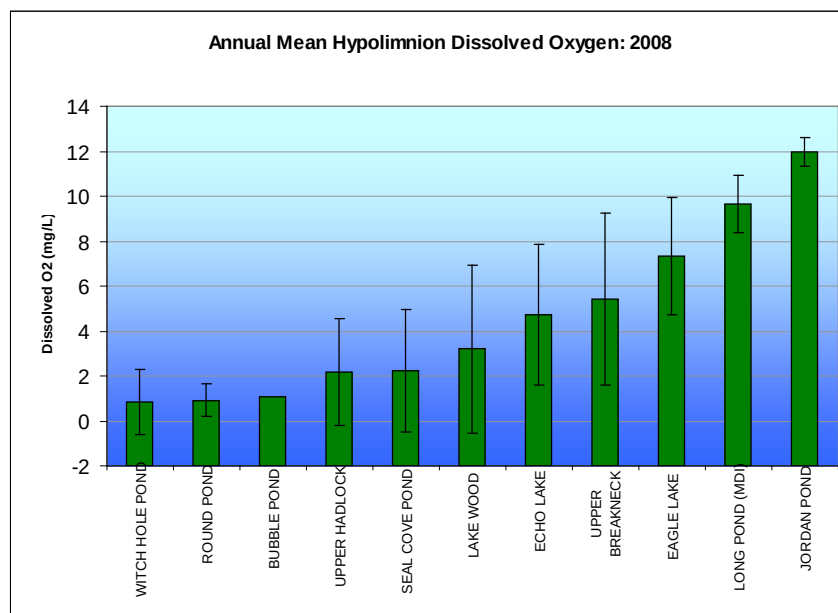
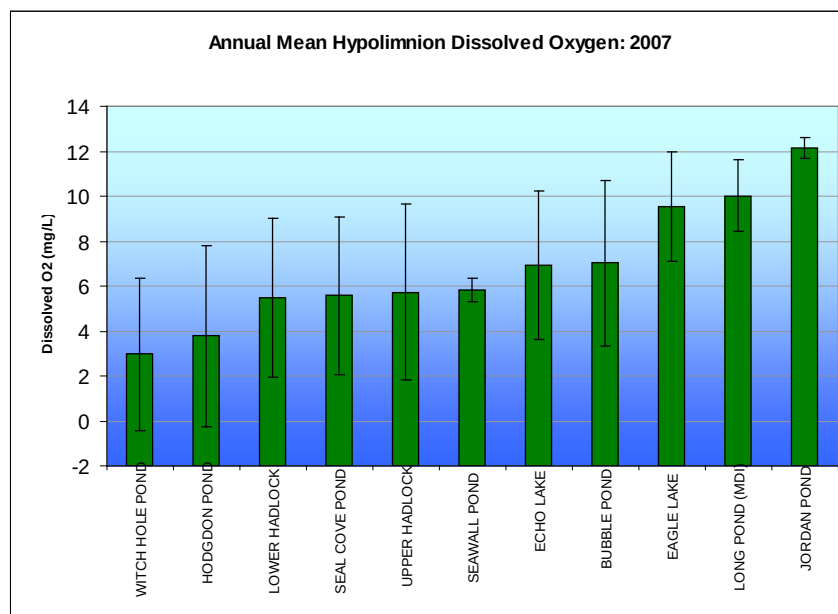
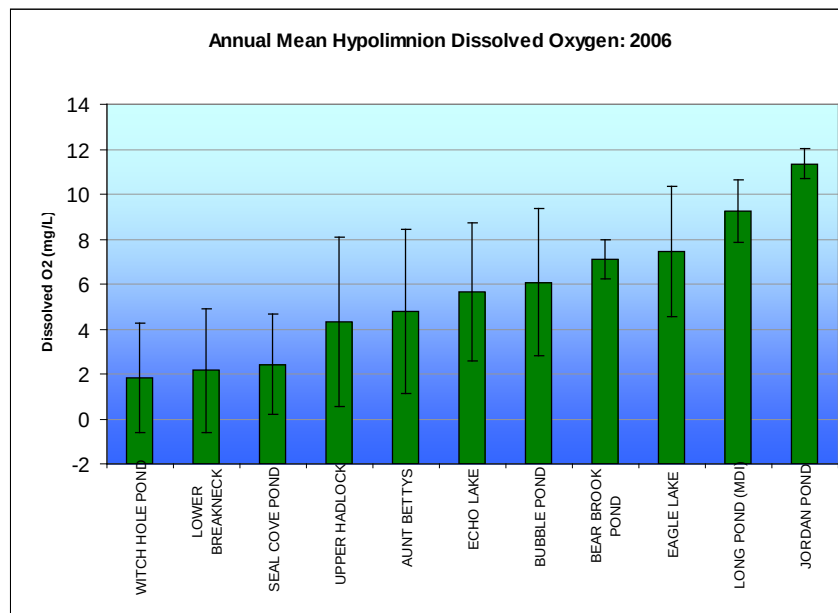
Error bars represent +/- 1 Std. dev.

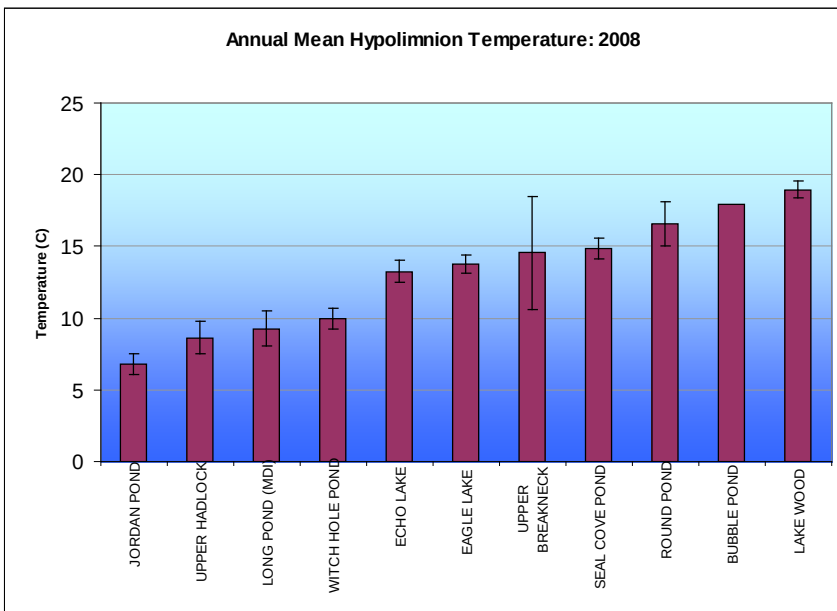
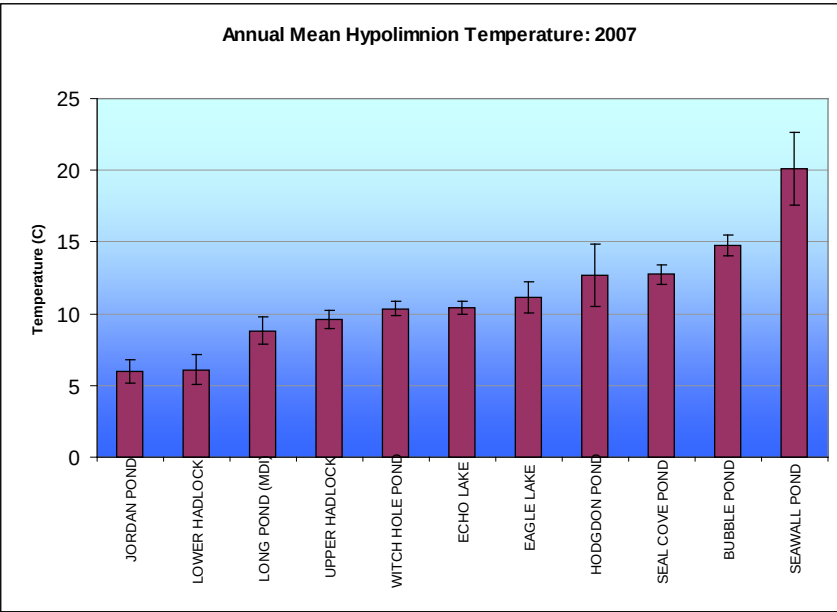
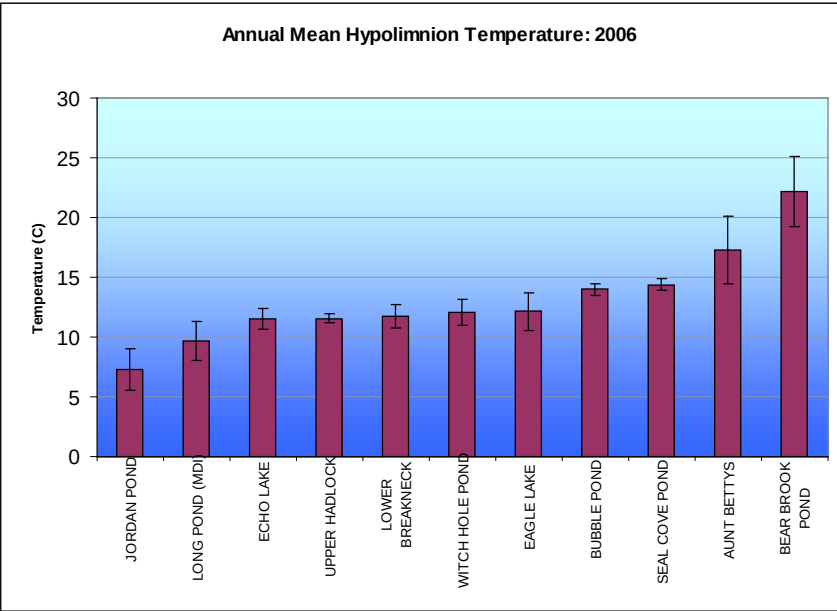
—◆— Mean Hypolimnion DO

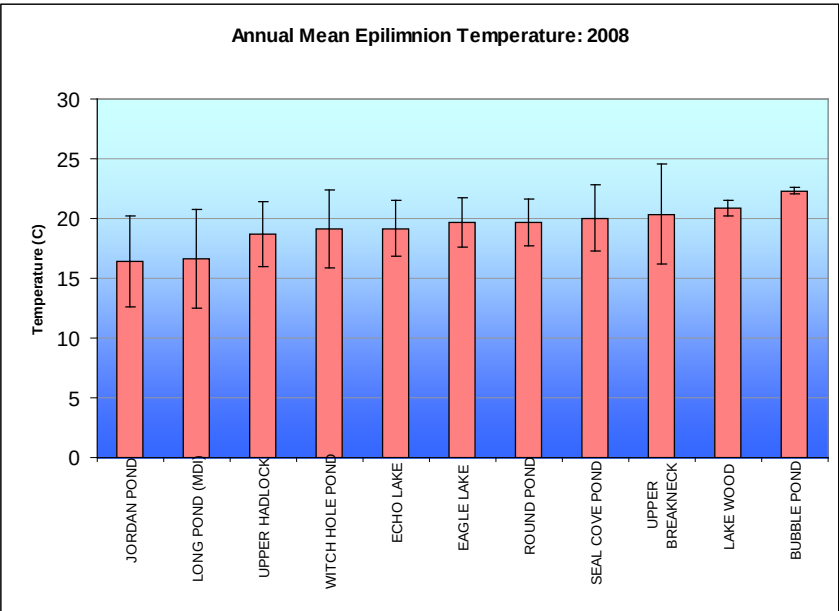
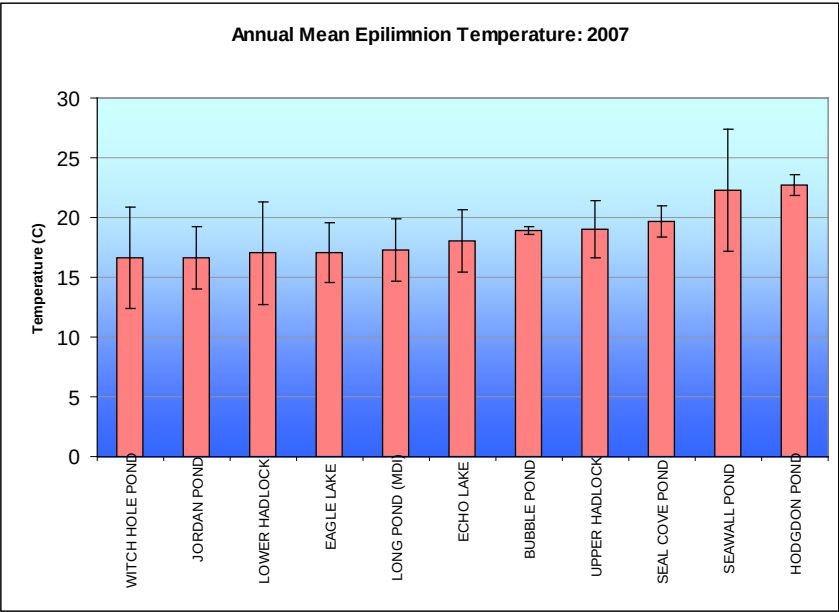
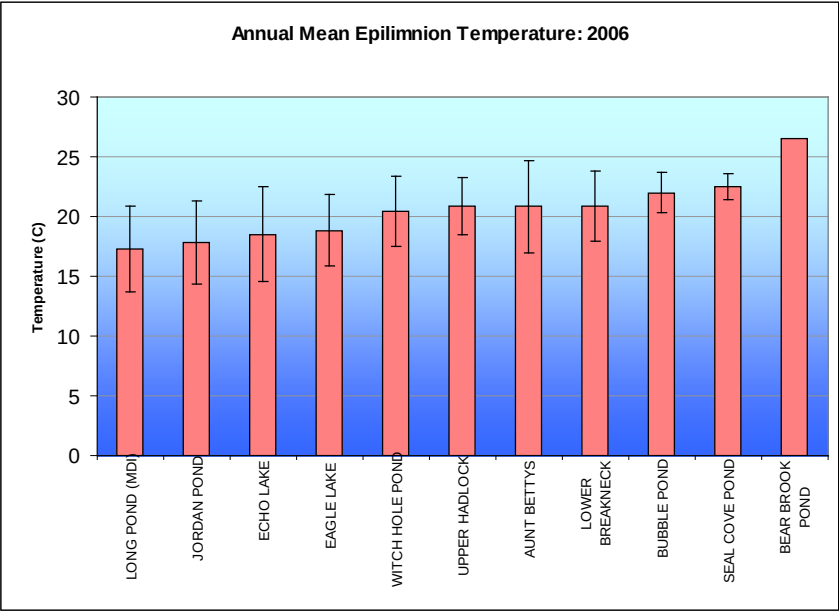




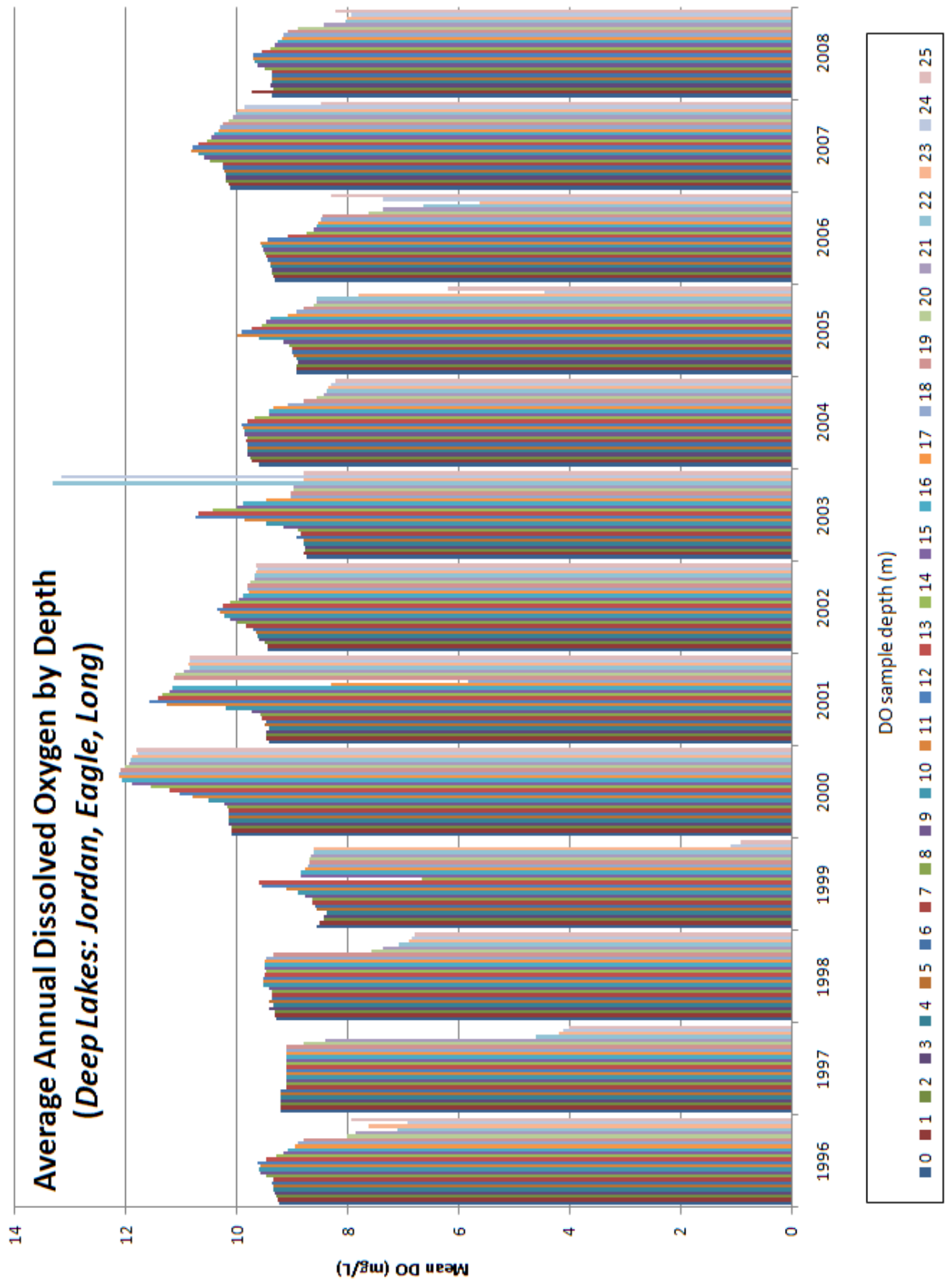
Error bars represent  $\pm 1$  Std. Dev.

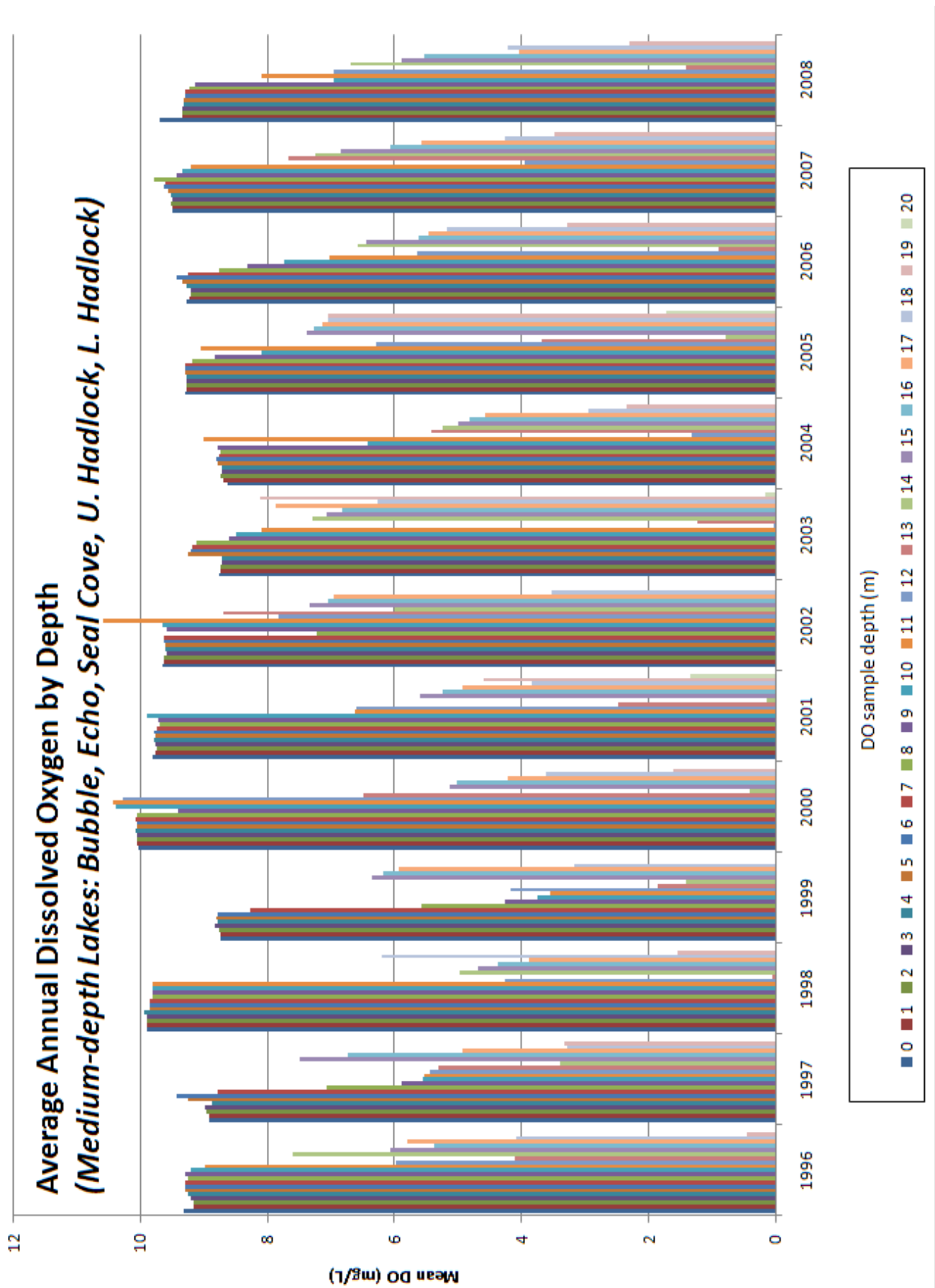


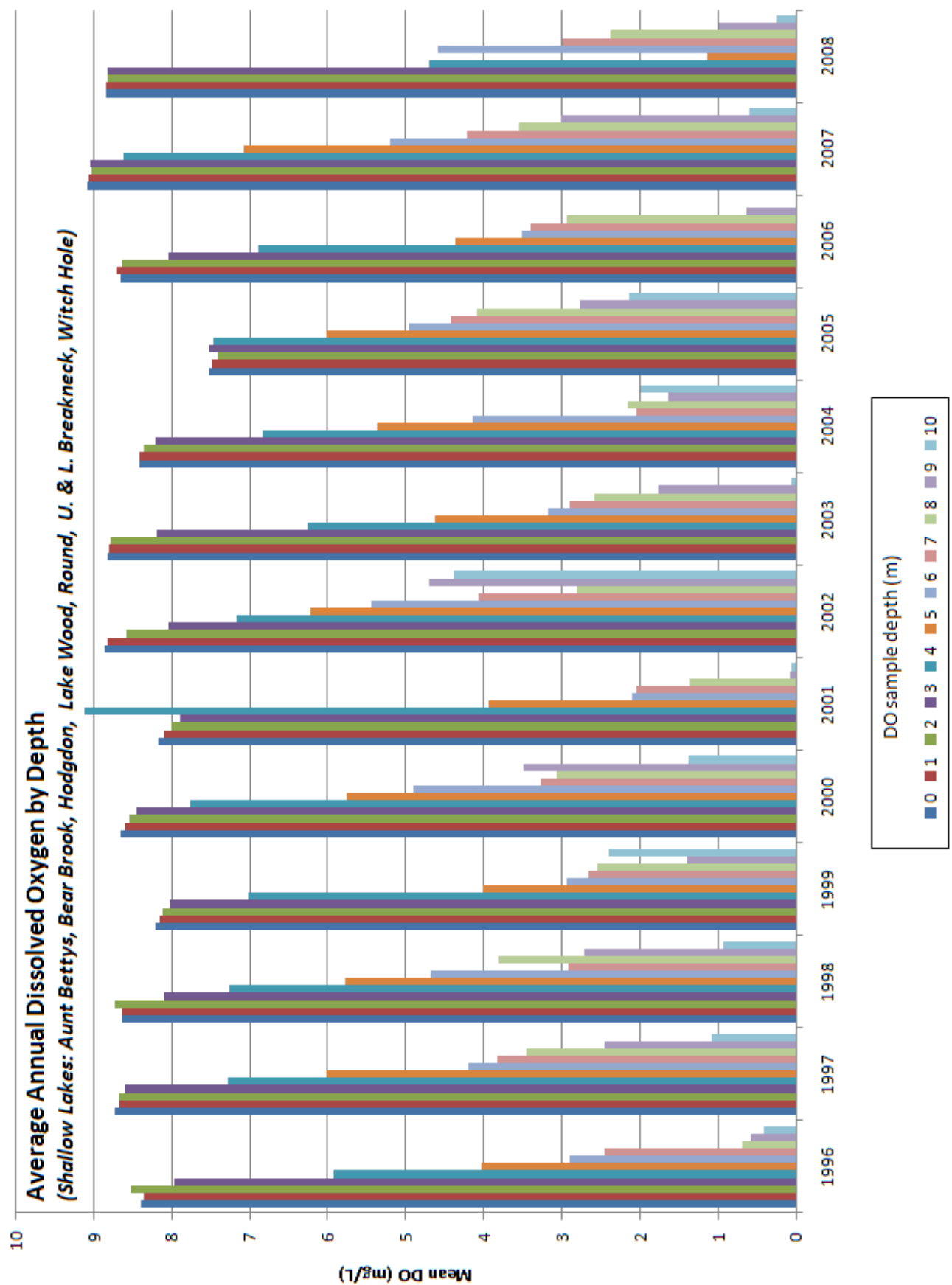




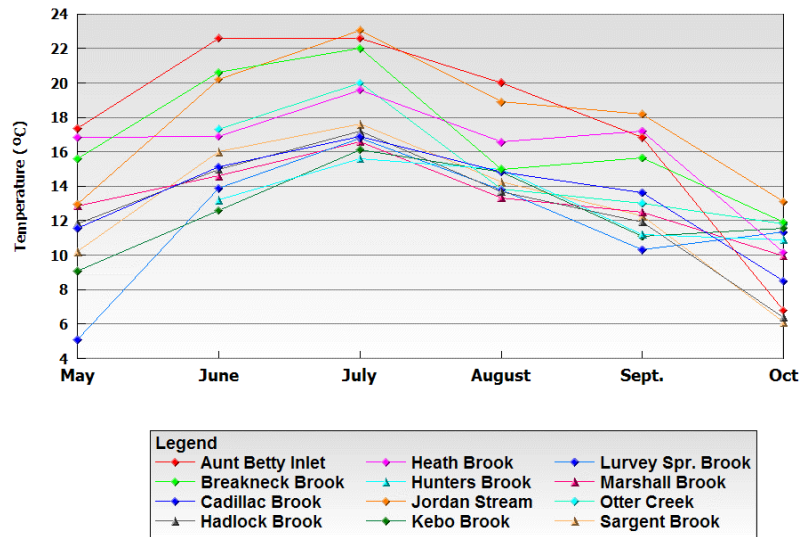
Error bars  
represent  $\pm 1$  Std.



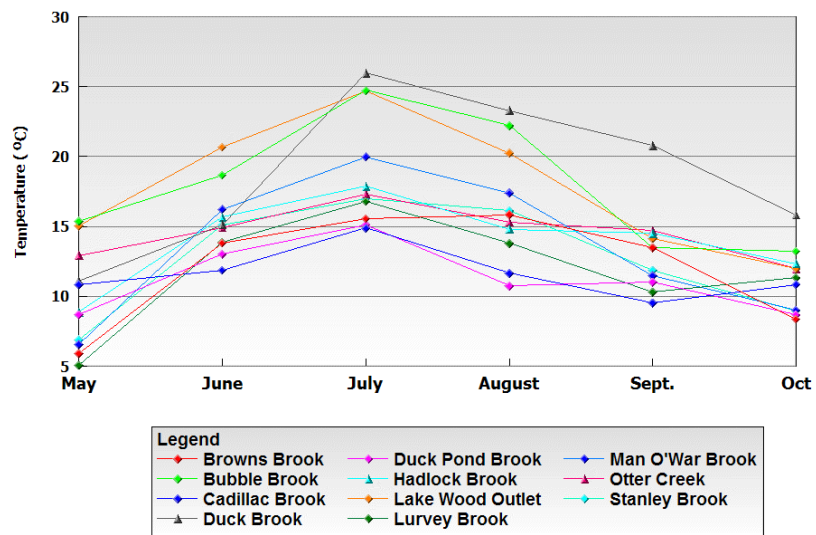




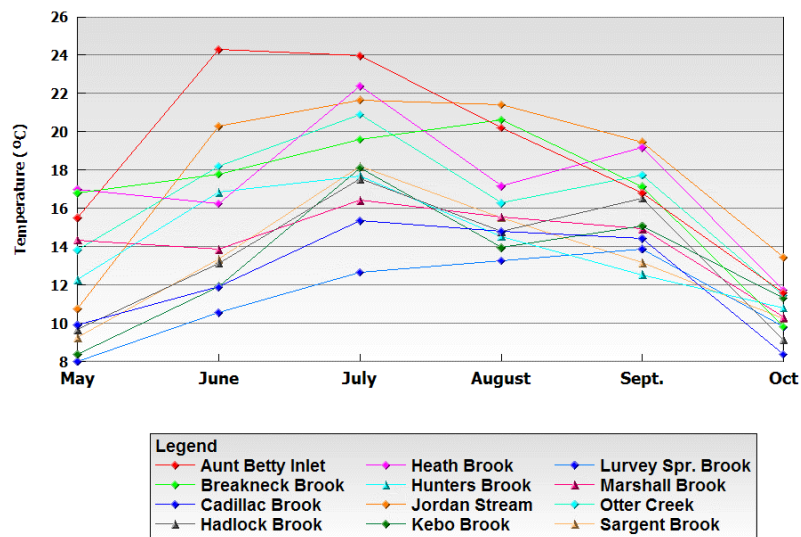
### Stream Temperature 2006

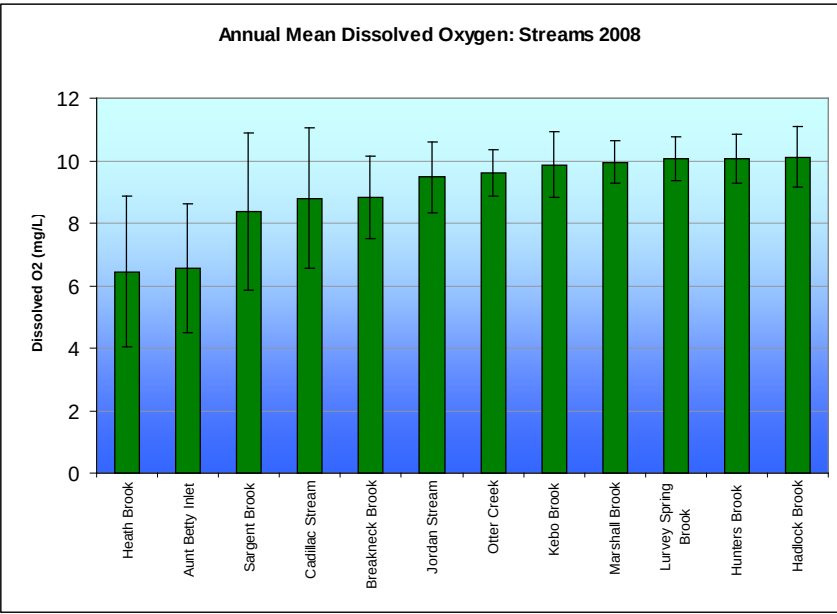
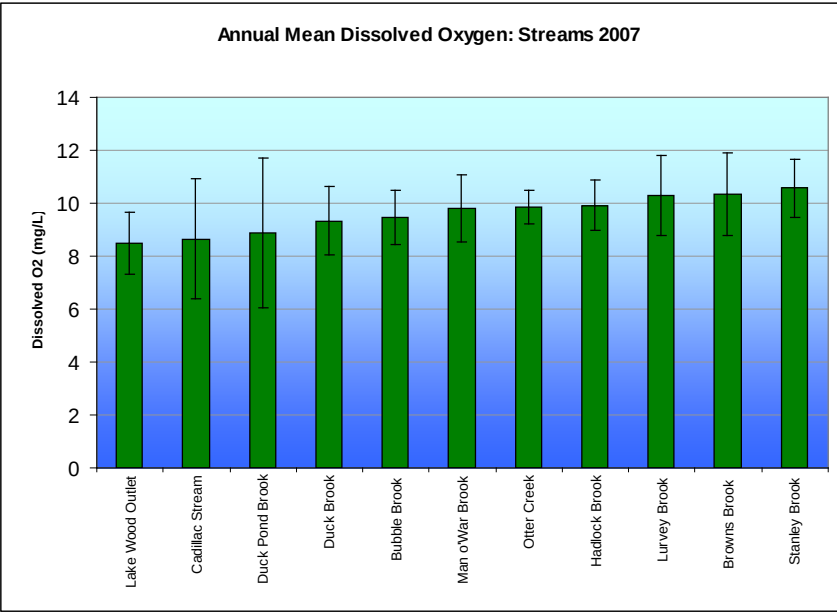
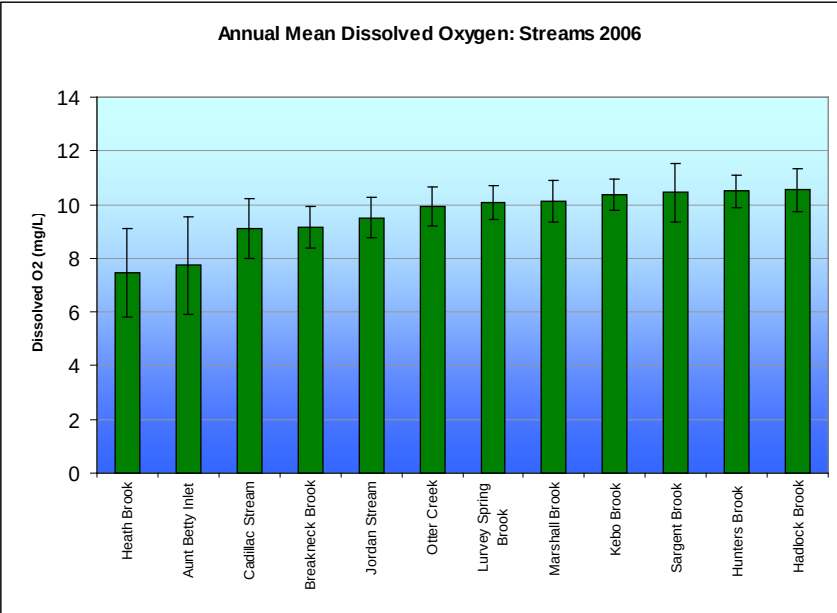


### Stream Temperature 2007



### Stream Temperature 2008





Error bars  
represent  $\pm 1$  Std.  
Dev.

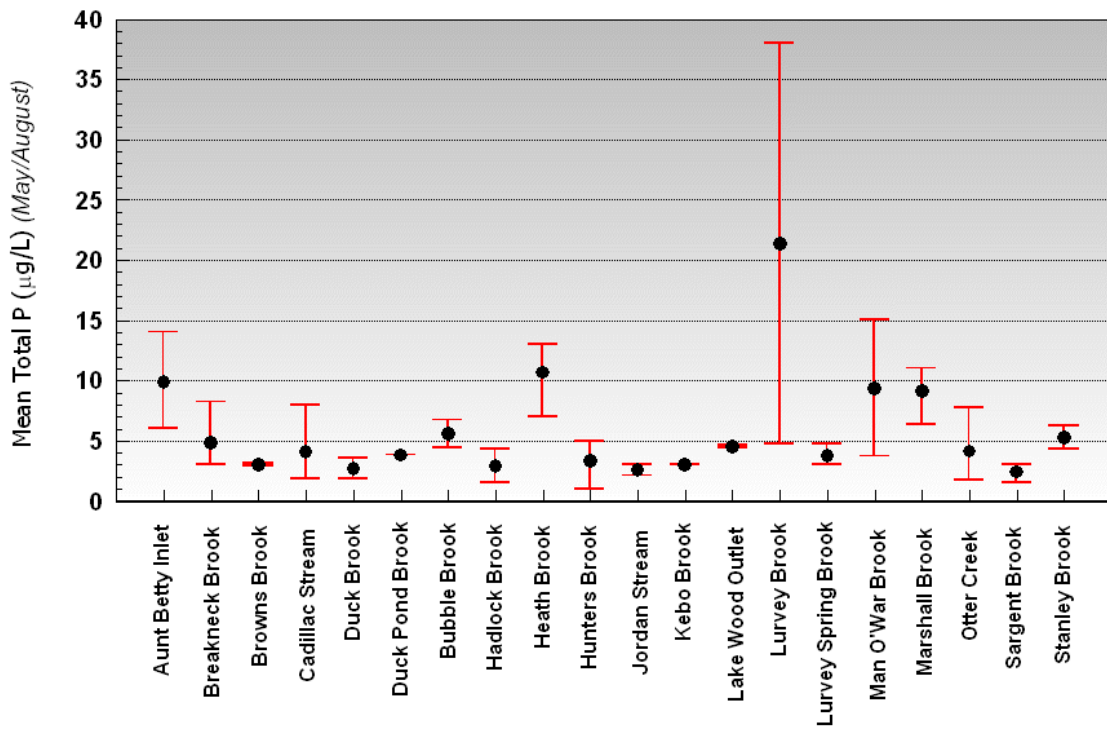


## **APPENDIX E**

Nutrient and Chlorophyll a Graphs: 2006-2008

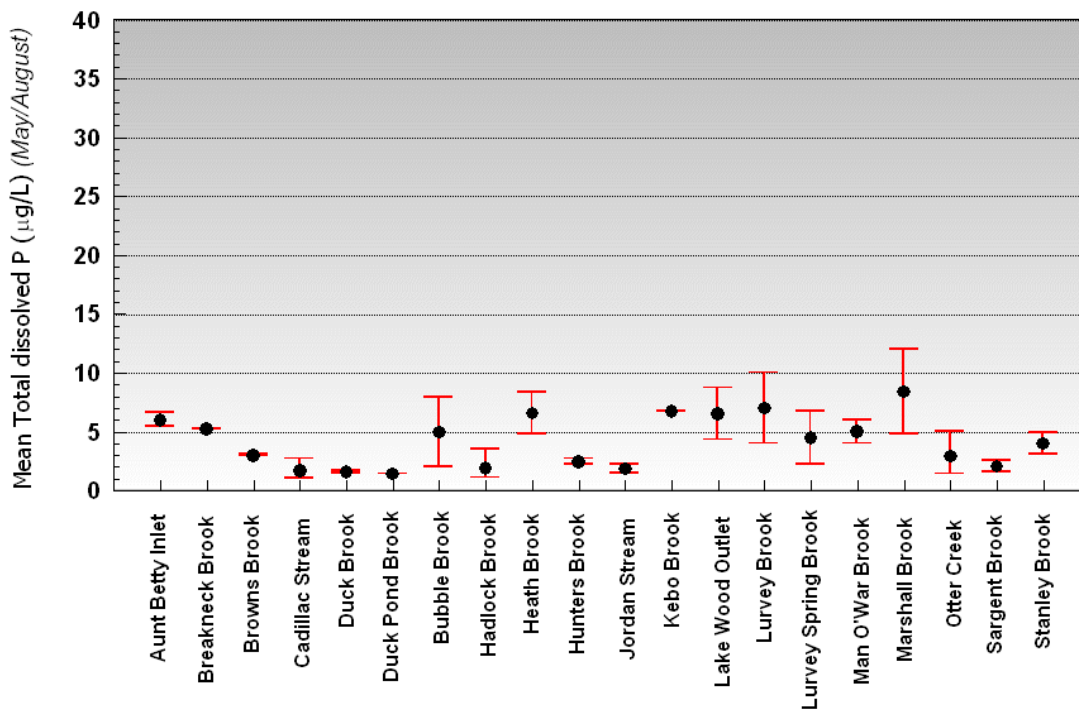


## Total Phosphorus: *All streams (2006-2008)*

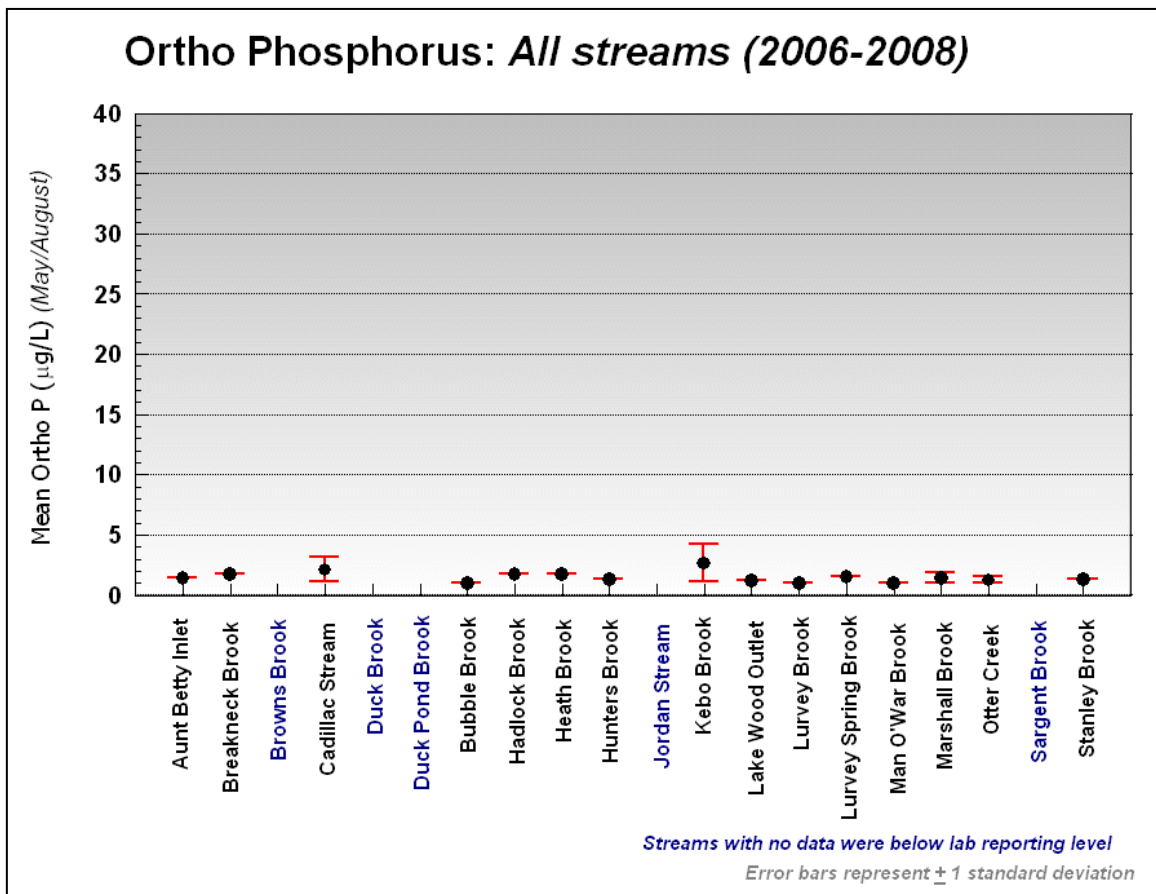


Error bars represent  $\pm 1$  standard deviation

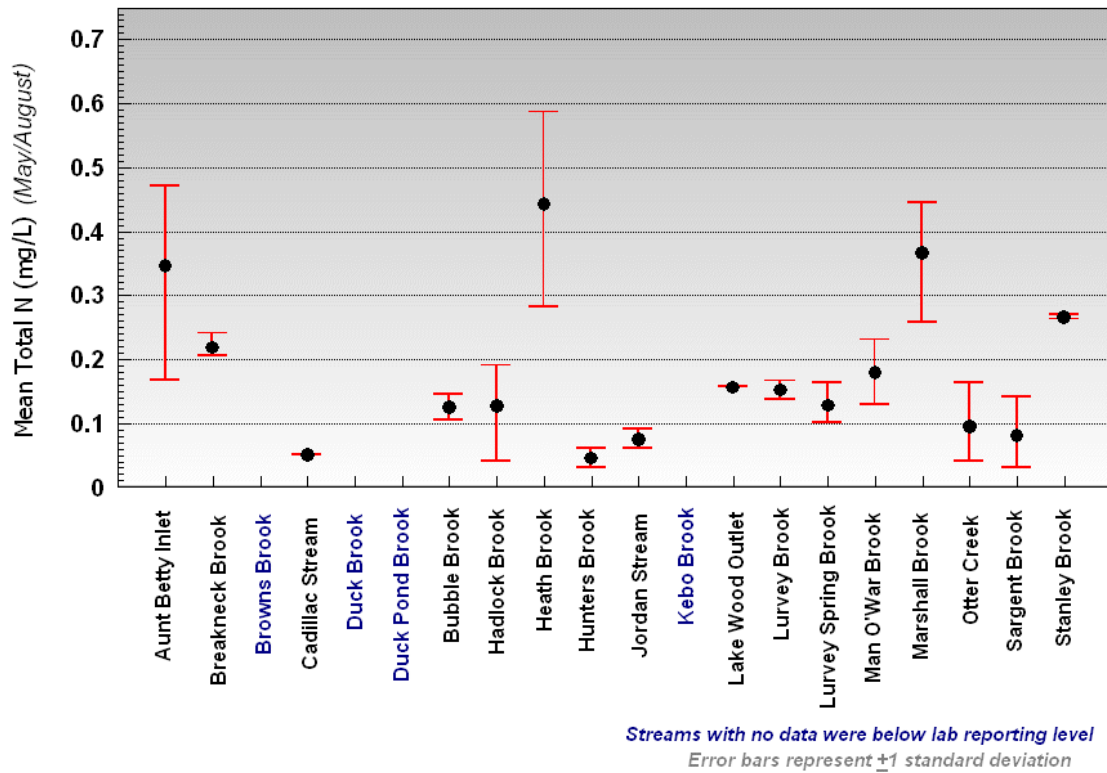
## Total Dissolved Phosphorus: *All streams (2006-2008)*



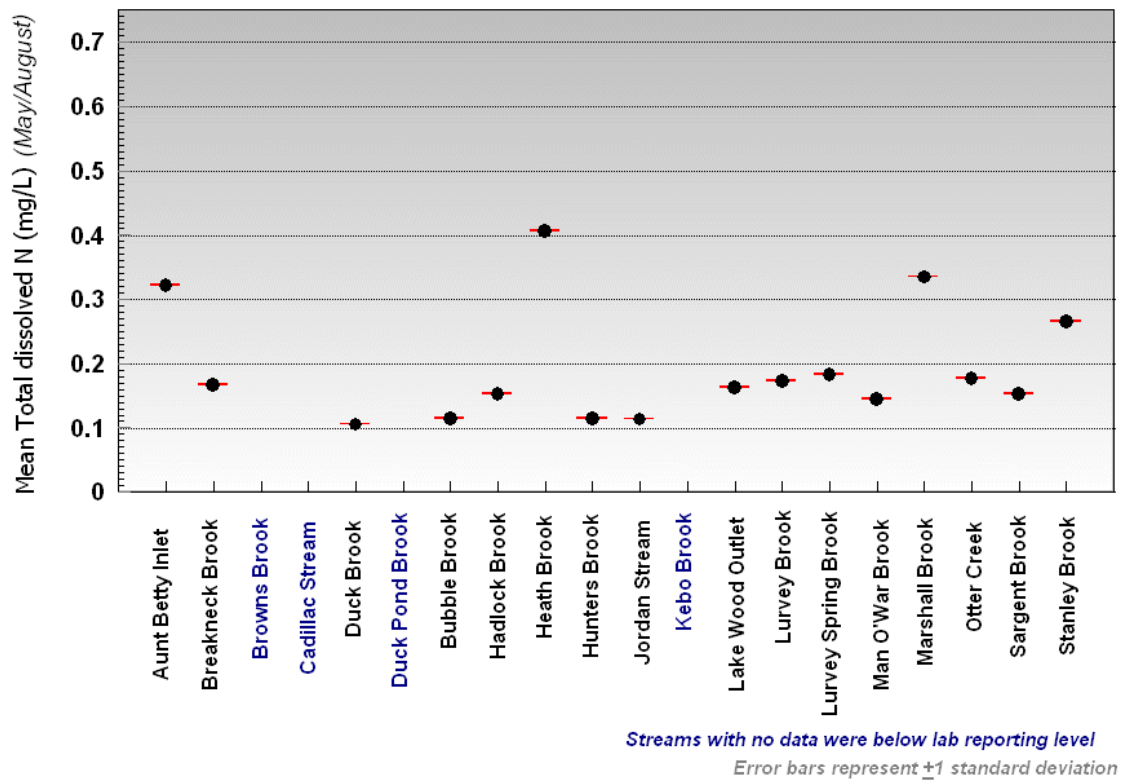
Error bars represent  $\pm 1$  standard deviation



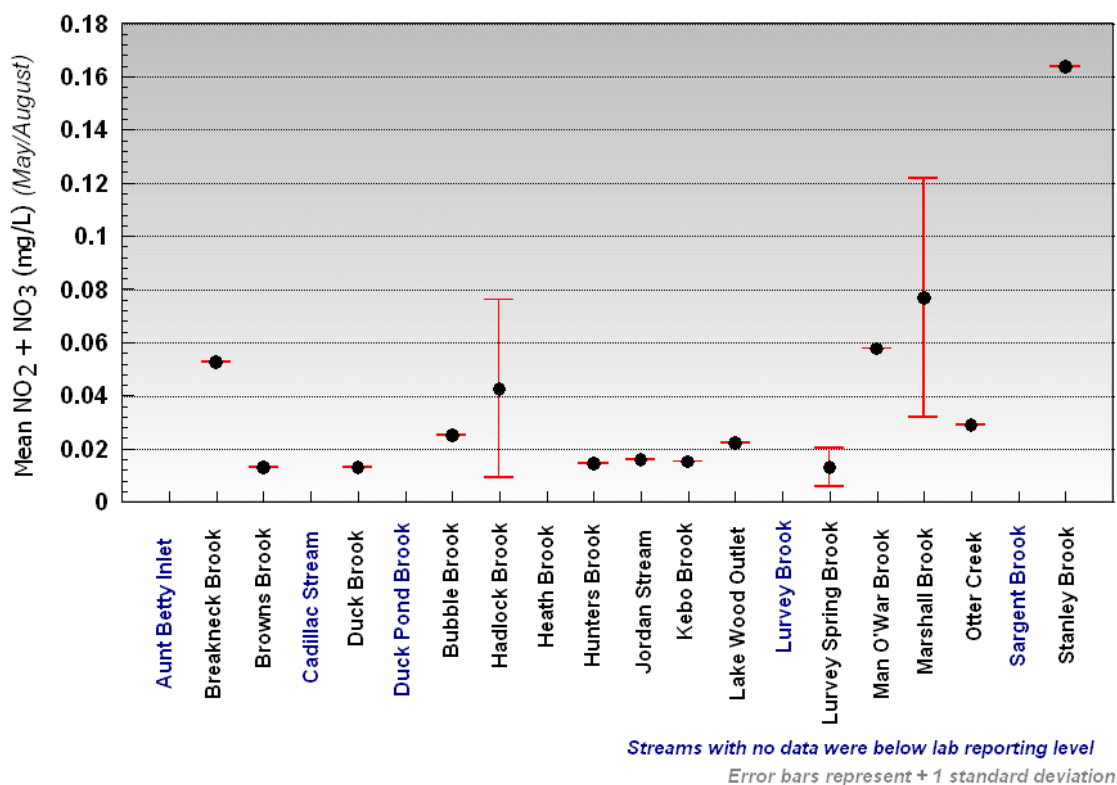
## Total Nitrogen: All streams (2006-2008)



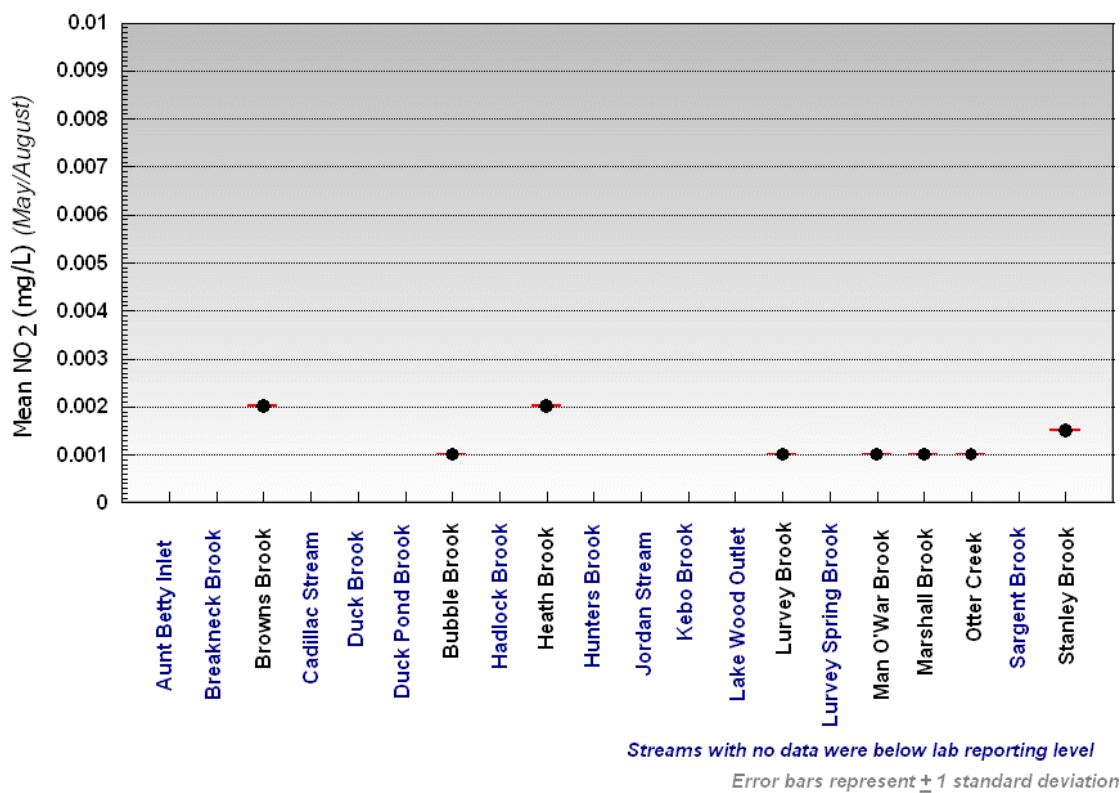
## Total Dissolved Nitrogen: All streams (2006-2008)



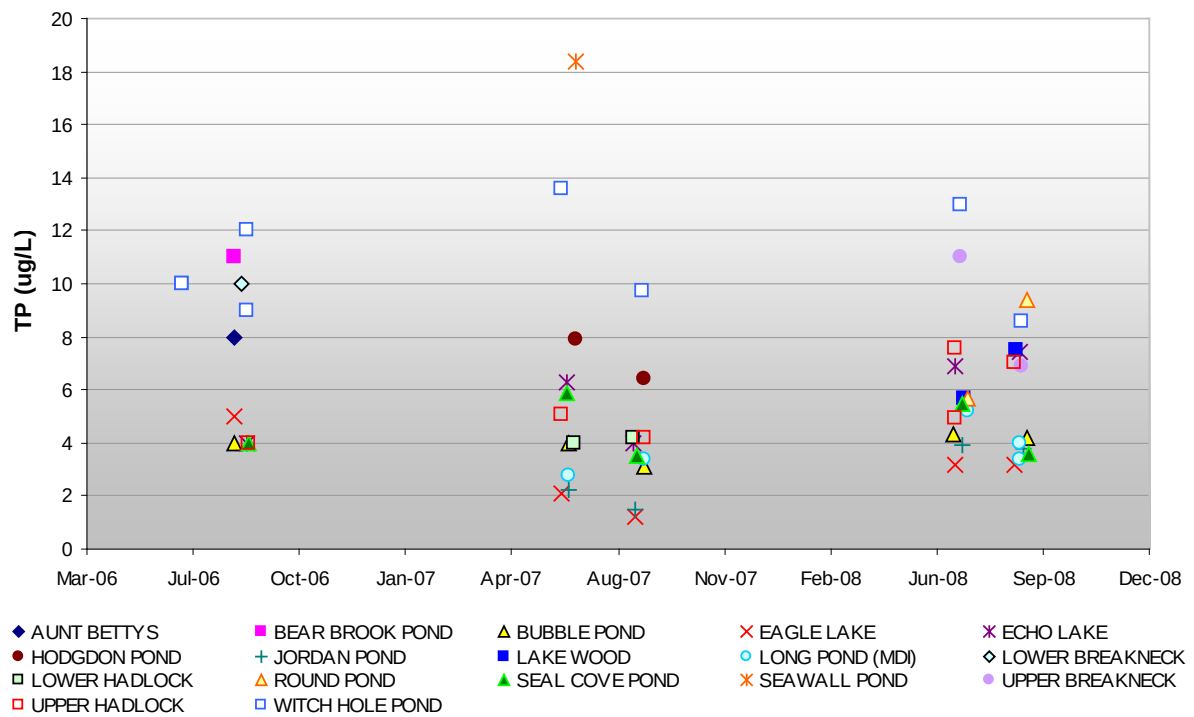
## NO<sub>2</sub> + NO<sub>3</sub> Nitrogen: *All streams (2006-2008)*



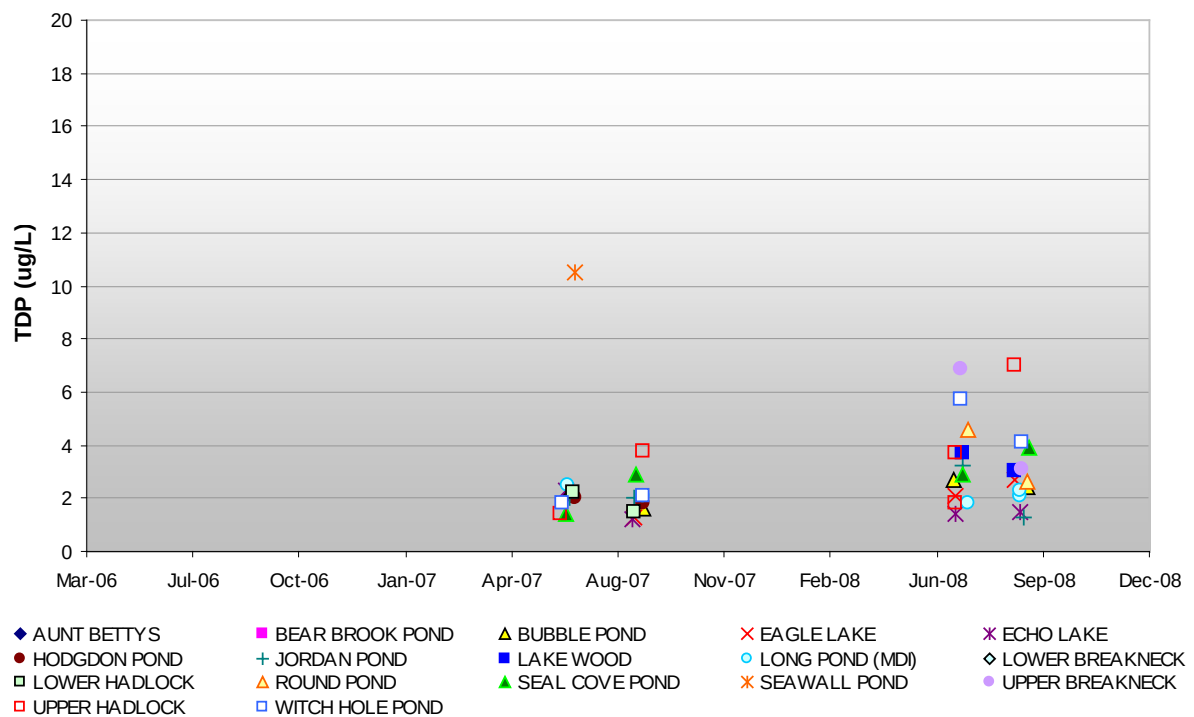
## Nitrite Nitrogen: *All streams (2006-2008)*



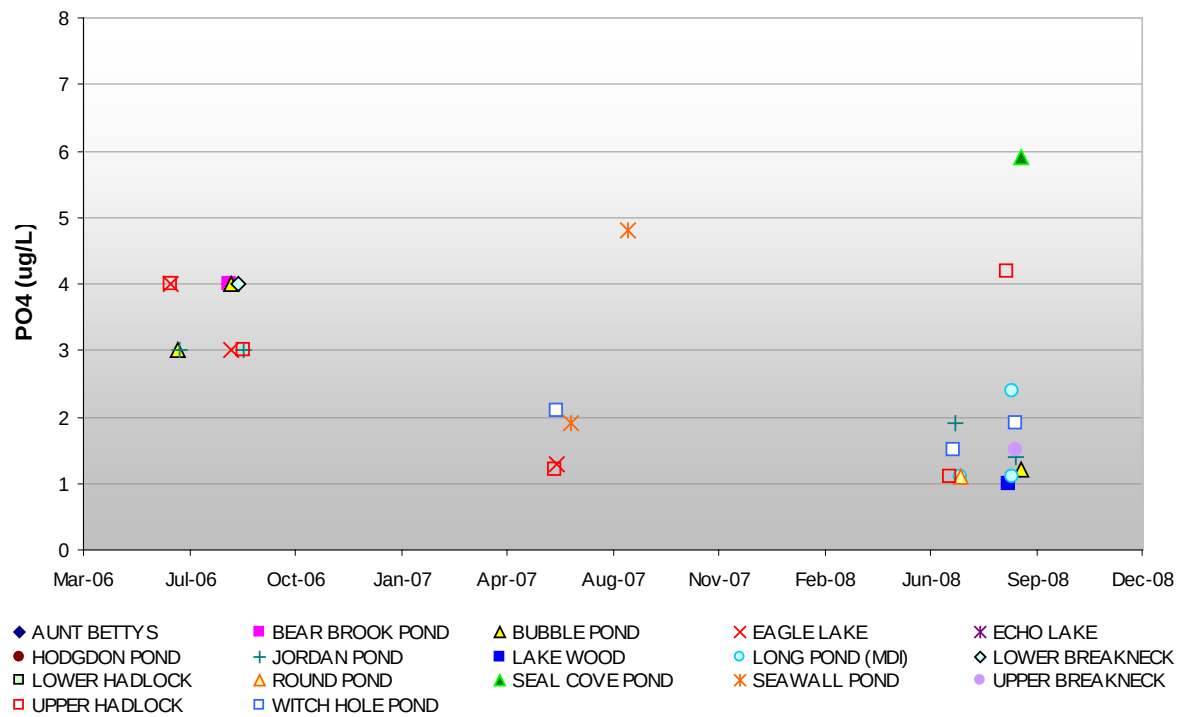
## Total Phosphorus: Lakes 2006-2008



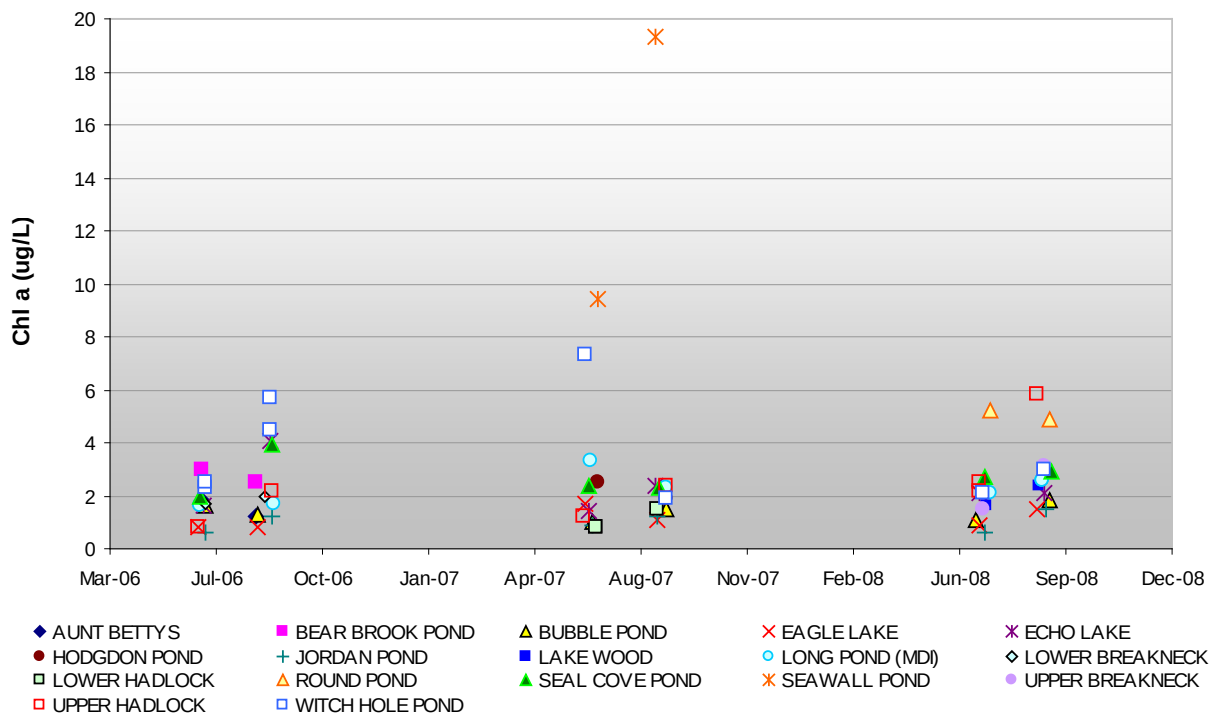
## Total Dissolved Phosphorus: Lakes 2006-2008



## Orthophosphate: Lakes 2006-2008



## Chlorophyll a: Lakes 2006-2008



Scatter plot showing Total Nitrogen (TN) concentrations (mg/L) over time (Mar-06 to Dec-08) for 14 ponds. The y-axis ranges from 0 to 2.5 mg/L. The x-axis shows dates from Mar-06 to Dec-08. Most data points are clustered near 0 mg/L, with a notable outlier at Seawall Pond in August 2007 reaching approximately 2.3 mg/L. The legend identifies the ponds by color and shape: Aunt Betty's (dark blue diamond), Bear Brook Pond (magenta square), Bubble Pond (yellow triangle), Eagle Lake (red cross), Echo Lake (purple asterisk), Hodgdon Pond (dark red circle), Jordan Pond (cyan plus), Lake Wood (blue square), Long Pond (MDI) (cyan circle), Lower Breakneck (black diamond), Lower Hadlock (green square), Round Pond (orange triangle), Seal Cove Pond (green triangle), Upper Hadlock (red square), and Witch Hole Pond (blue square).

TDN (mg/L)

Mar-06 Jul-06 Oct-06 Jan-07 Apr-07 Aug-07 Nov-07 Feb-08 Jun-08 Sep-08 Dec-08

◆ AUNT BETTYS  
 ● HODGDON POND  
 □ LOWER HADLOCK  
 □ UPPER HADLOCK

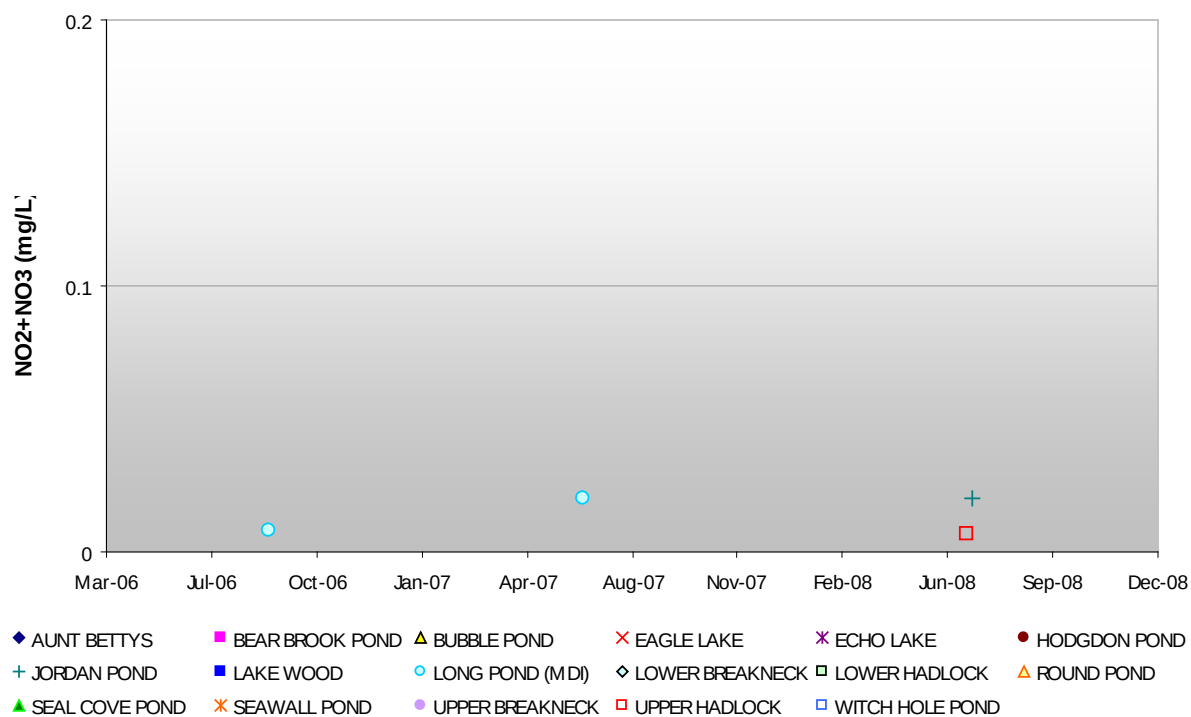
■ BEAR BROOK POND  
 + JORDAN POND  
 △ ROUND POND  
 □ WITCH HOLE POND

▲ BUBBLE POND  
 ■ LAKE WOOD  
 ▲ SEAL COVE POND

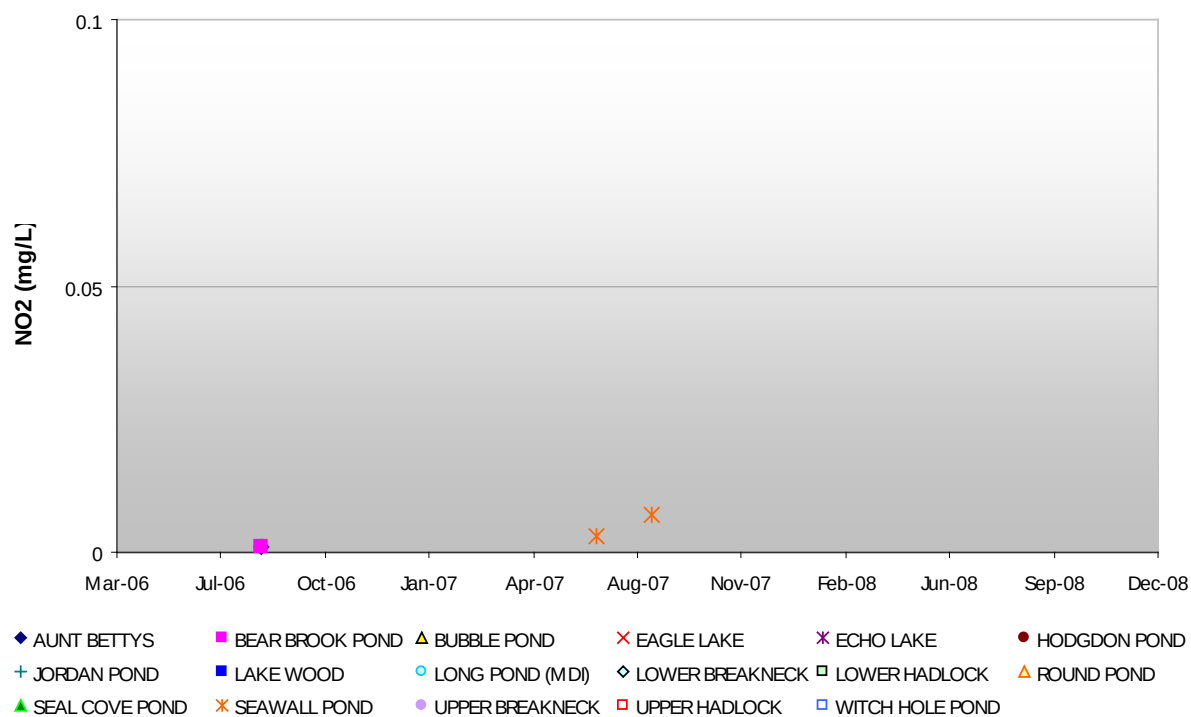
× EAGLE LAKE  
 ○ LONG POND (MDI)  
 × SEA WALL POND

× ECHO LAKE  
 ◇ LOWER BREAKNECK  
 ● UPPER BREAKNECK

## Nitrite+ Nitrate Nitrogen: Lakes 2006-2008



## Nitrite Nitrogen: Lakes 2006-2008



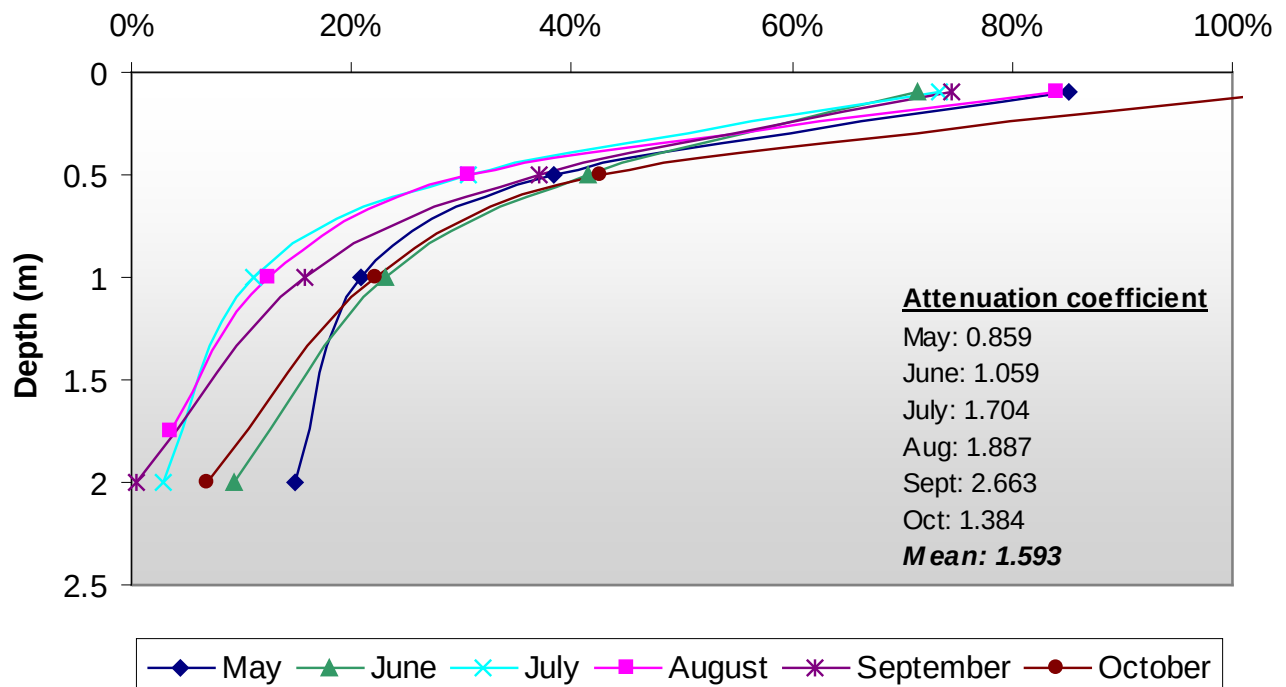
(Test values not represented on graphs were below laboratory testing/reporting levels)

## **APPENDIX F**

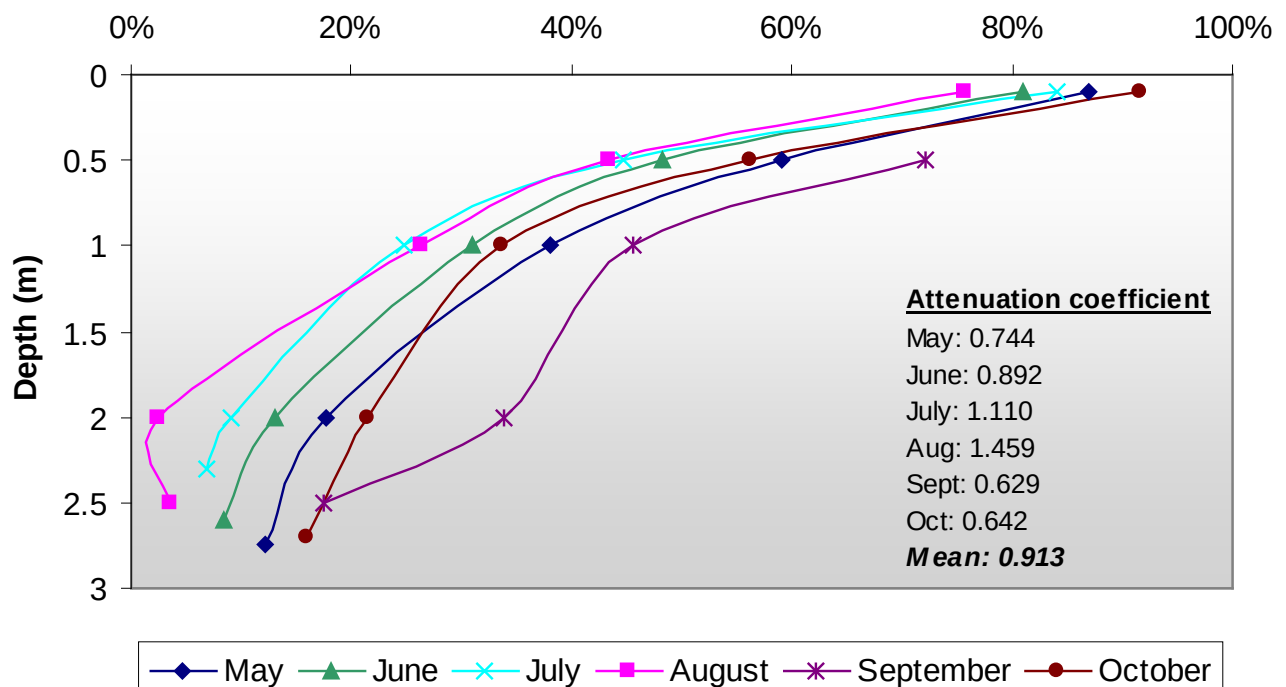
Light Penetration Profiles: 2006-2008



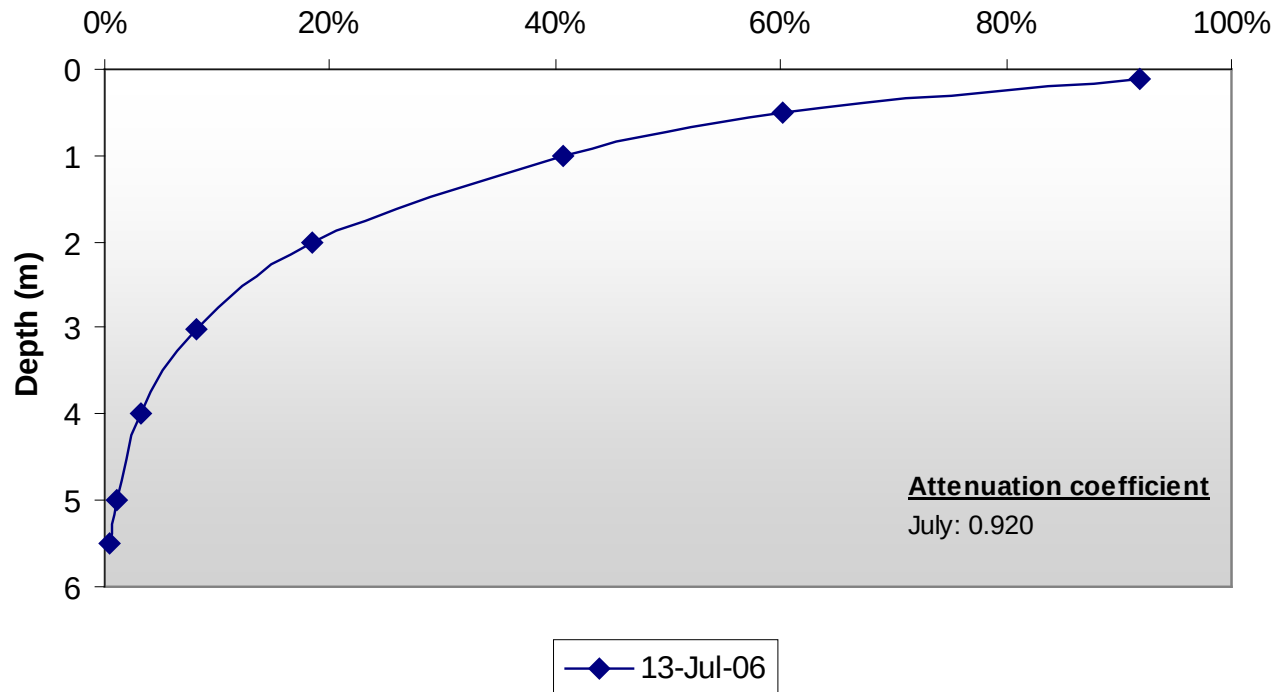
## 2006 Light Penetration: Aunt Betty Pond



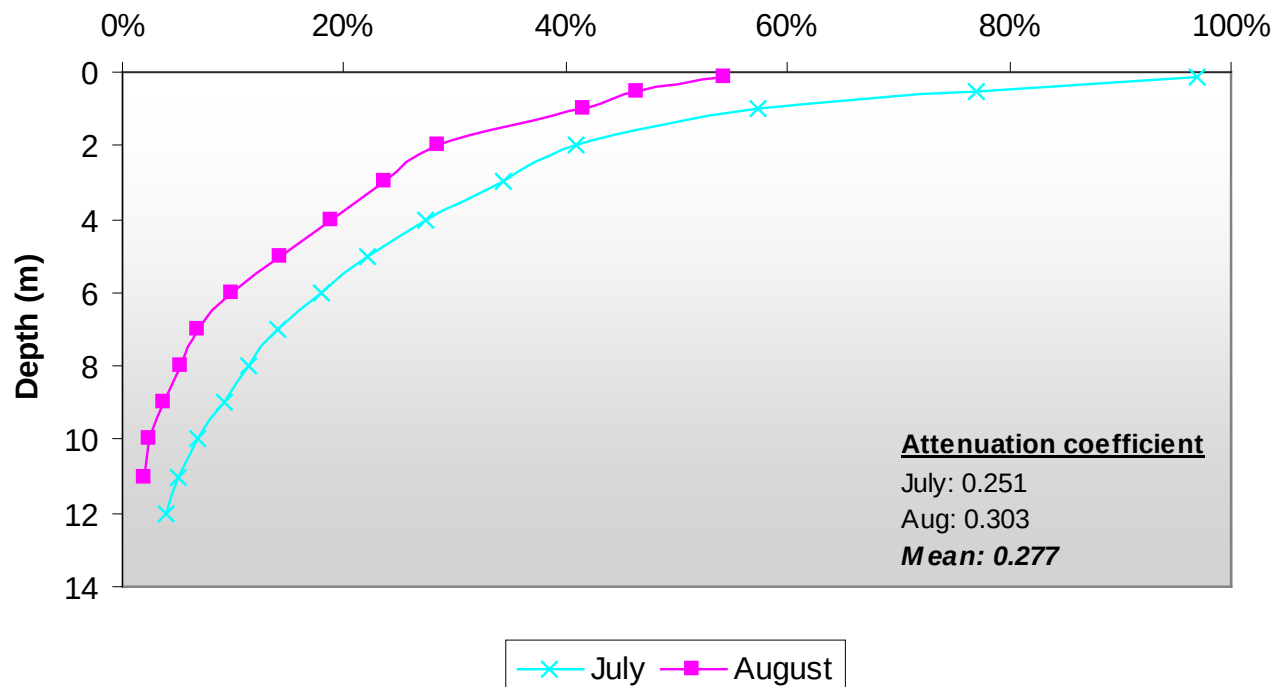
## 2006 Light Penetration: Bear Brook Pond



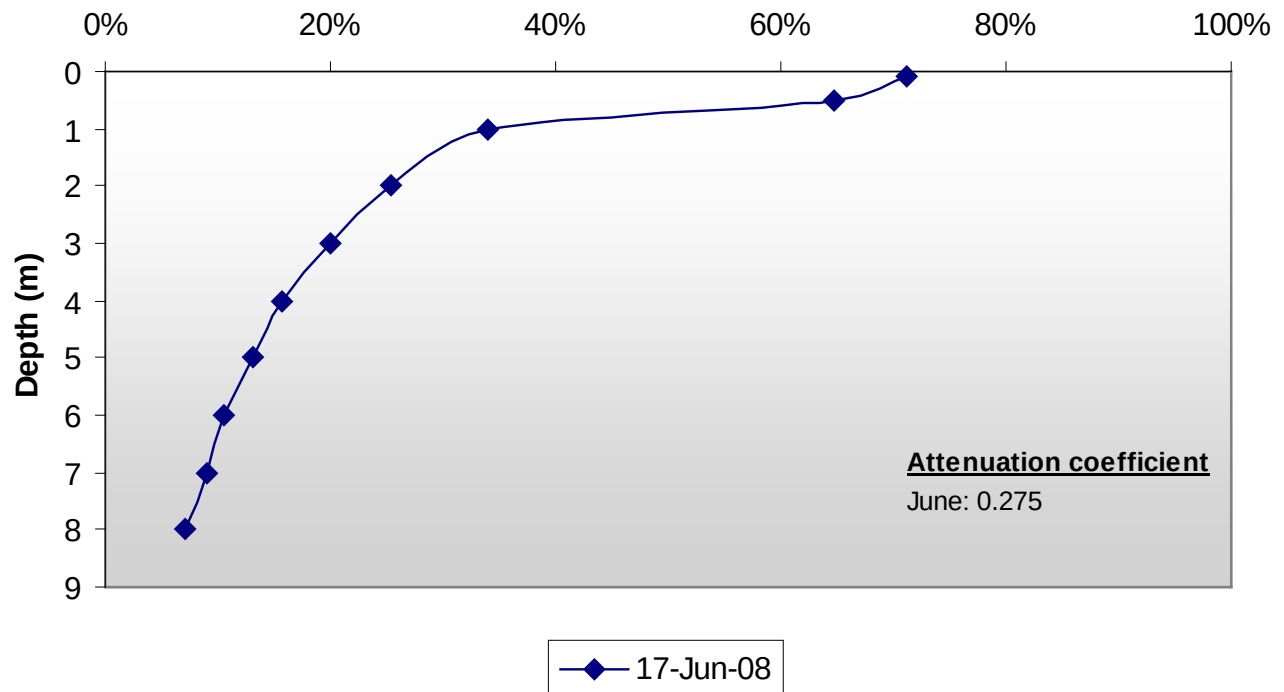
## 2006 Light Penetration: Lower Breakneck Pond



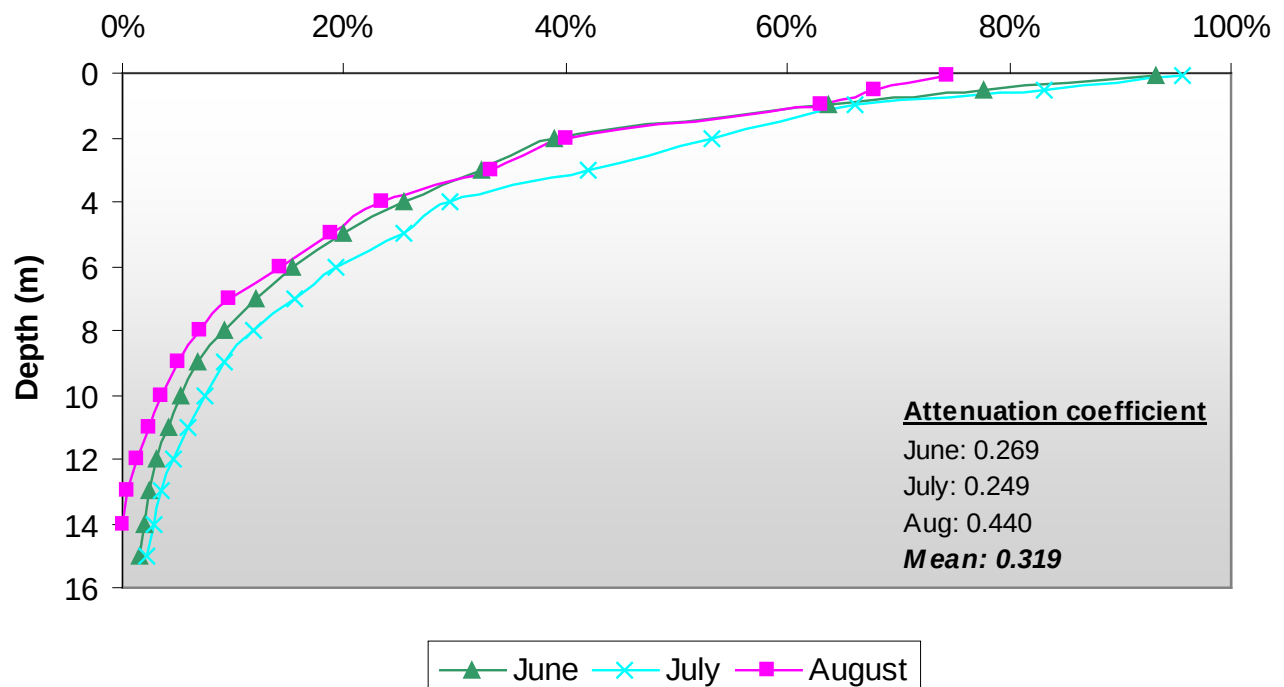
## 2007 Light Penetration: Bubble Pond



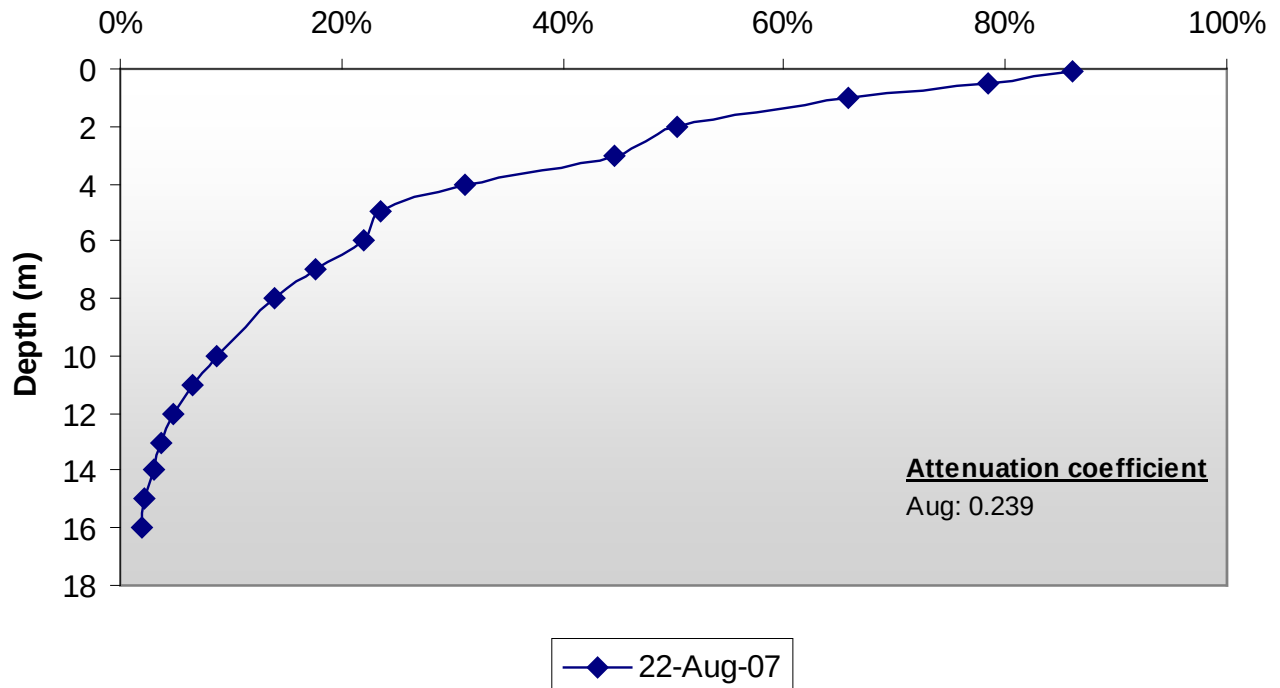
## 2008 Light Penetration: Bubble Pond



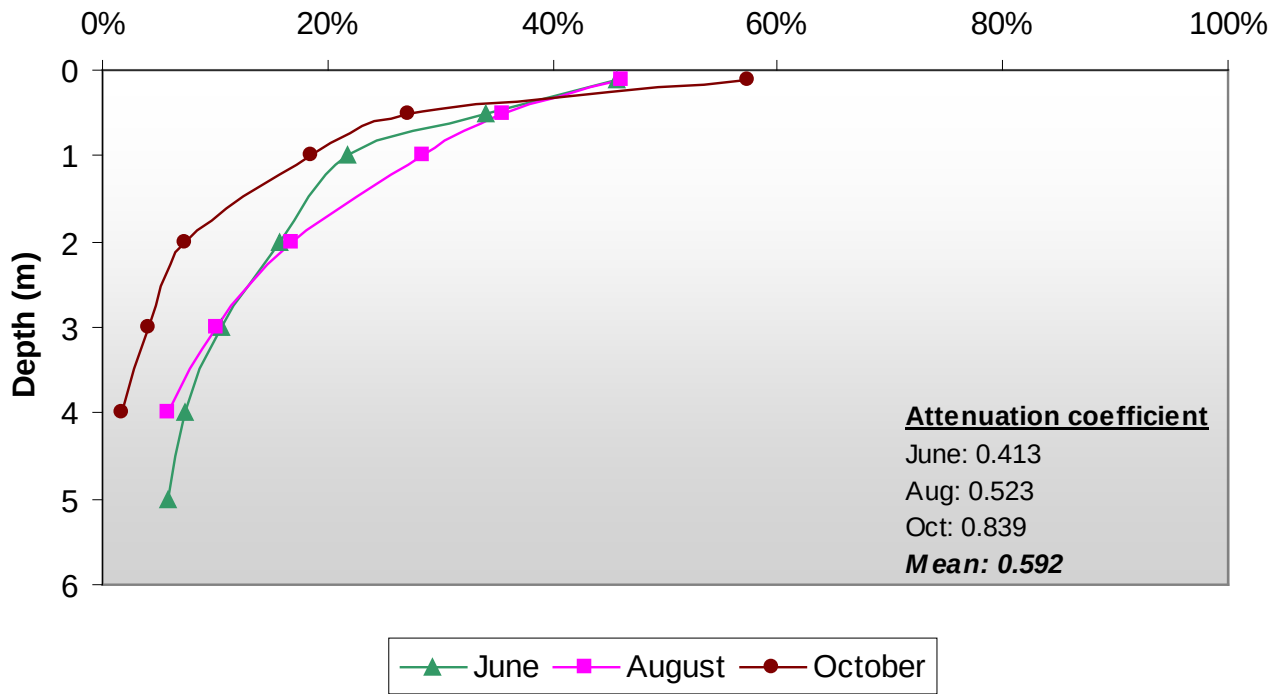
## 2007 Light Penetration: Eagle Lake



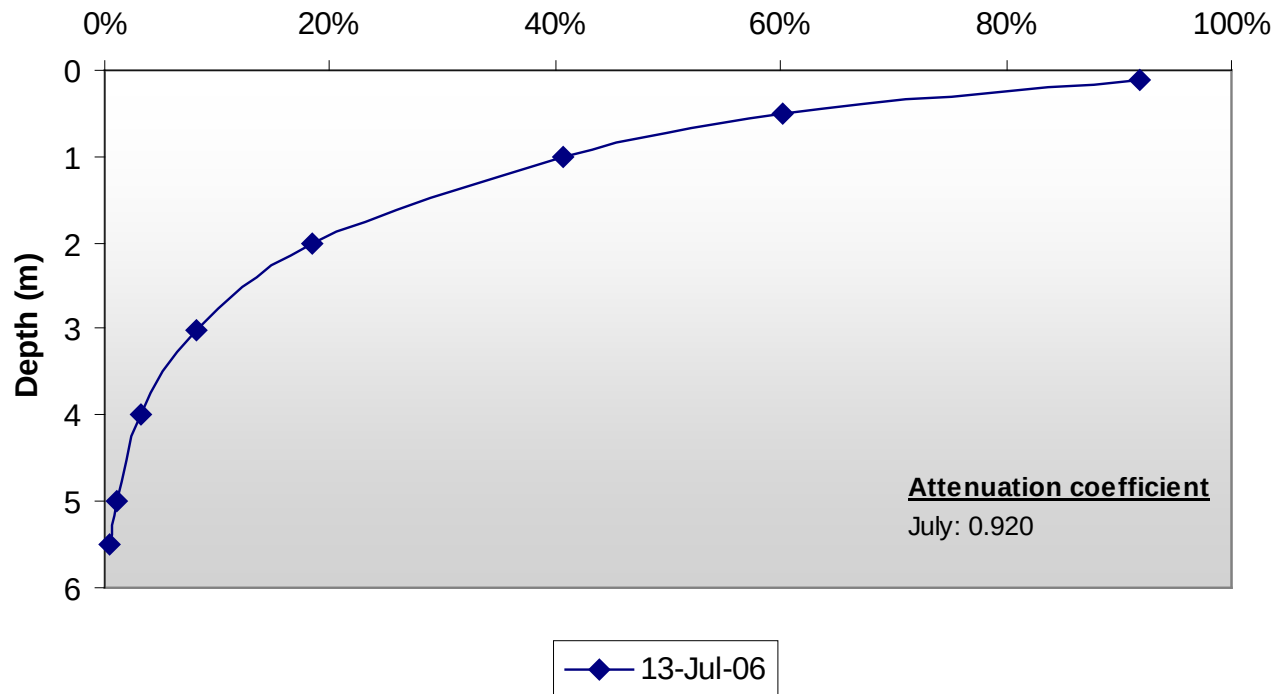
### 2007 Light Penetration: Jordan Pond



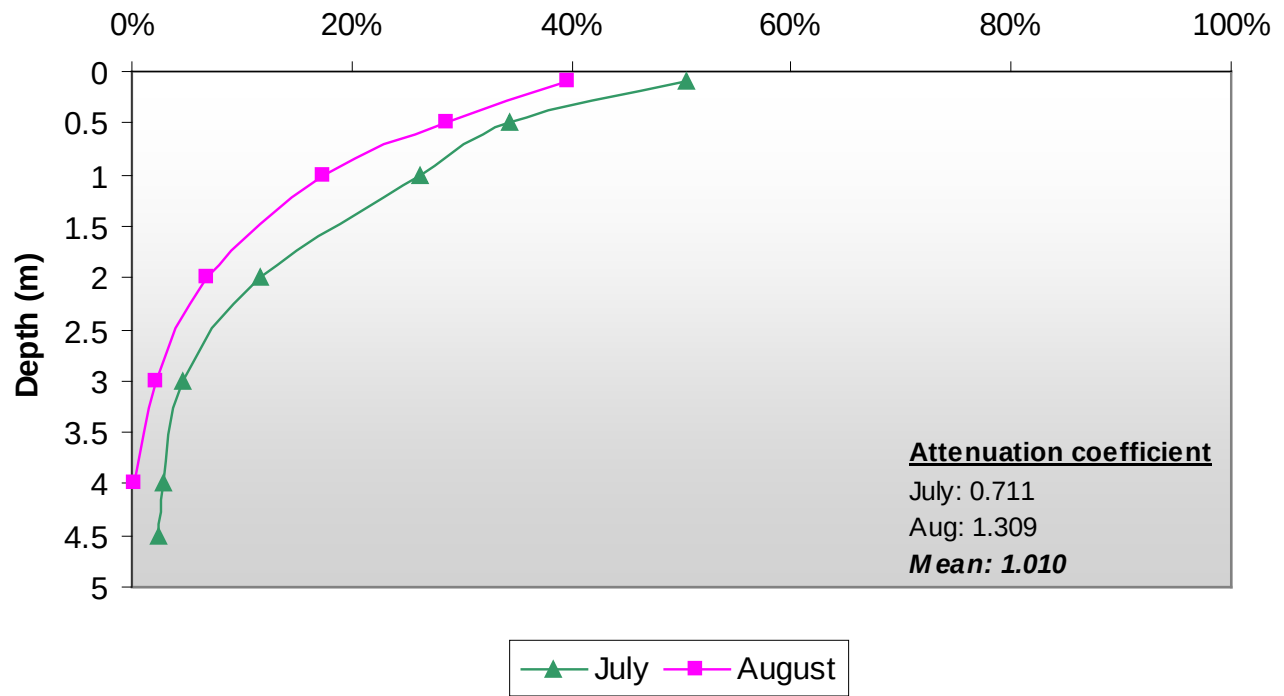
### 2008 Light Penetration: Lake Wood



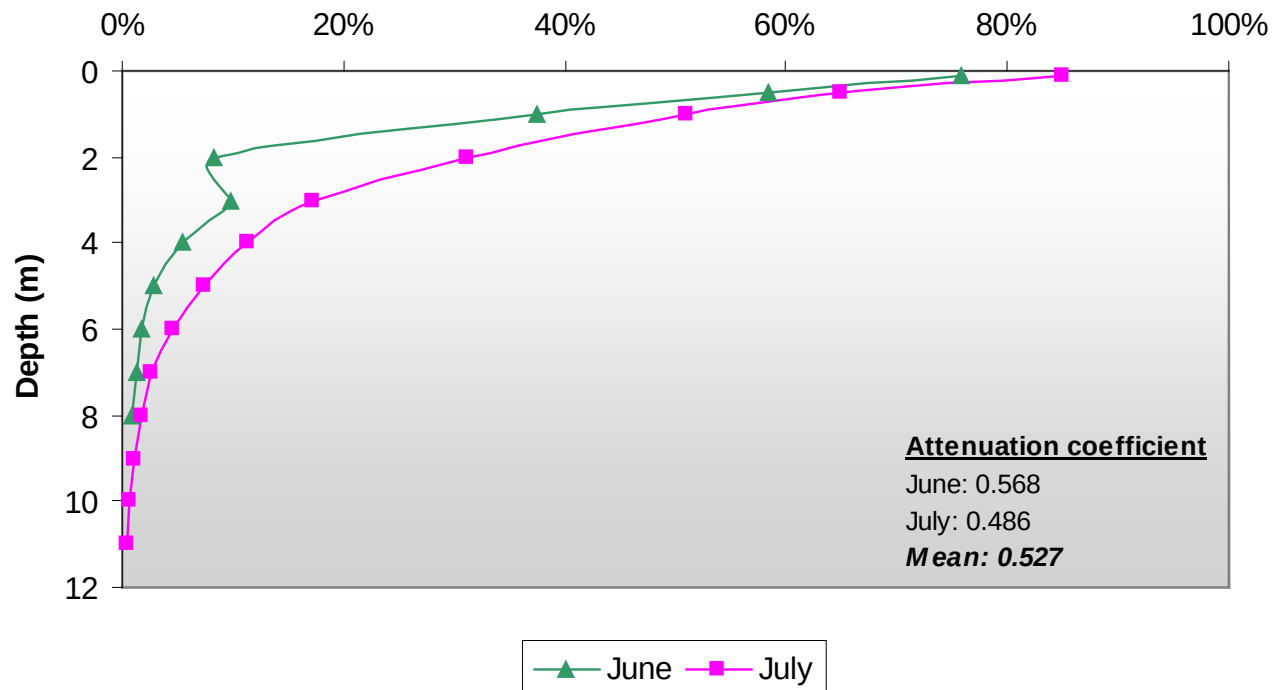
## 2006 Light Penetration: Lower Breakneck Pond



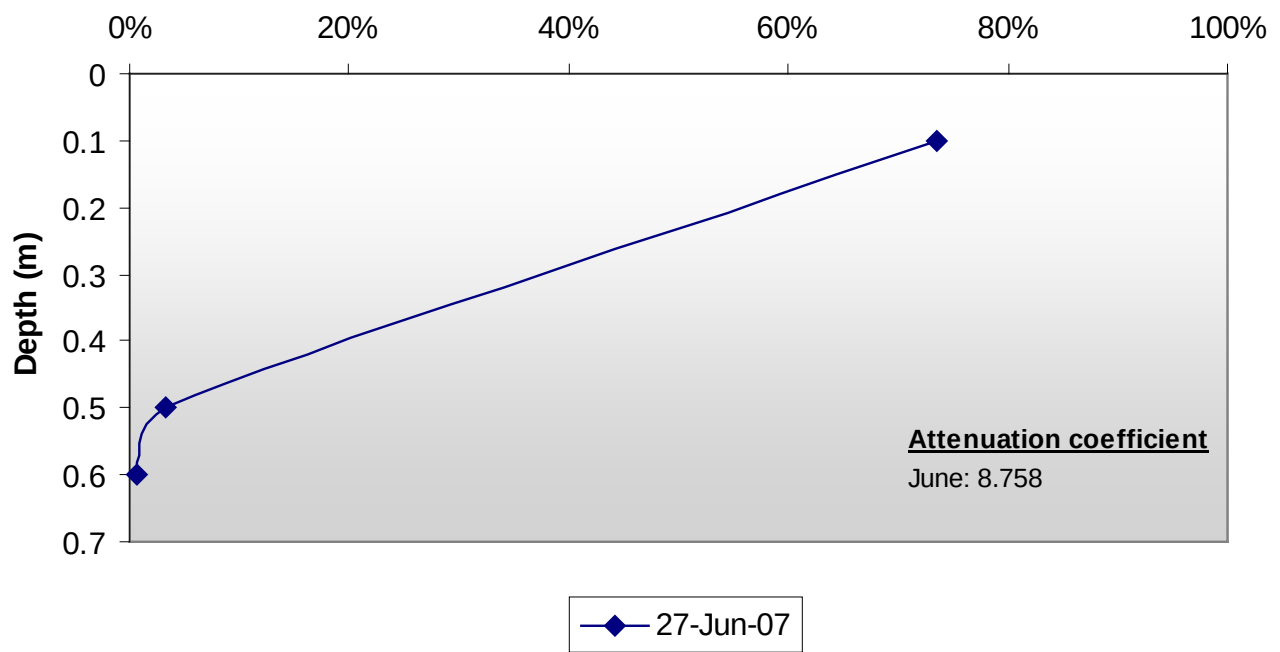
## 2008 Light Penetration: Round Pond



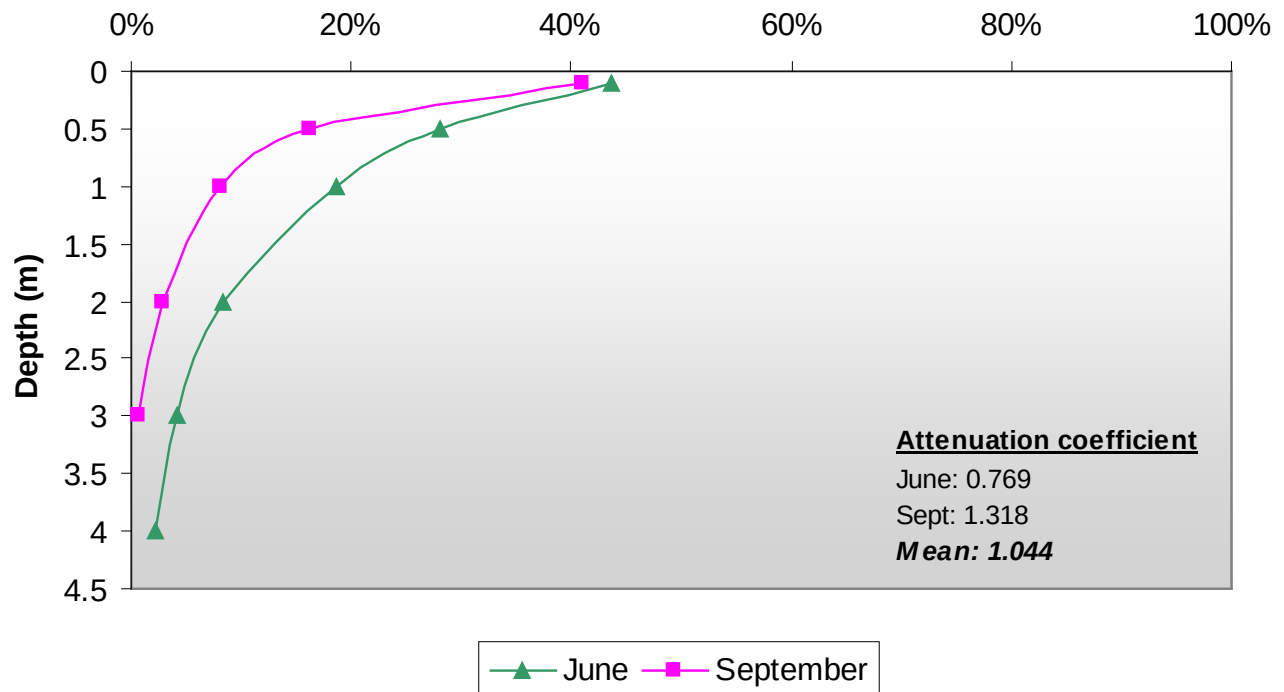
## 2007 Light Penetration: Seal Cove Pond



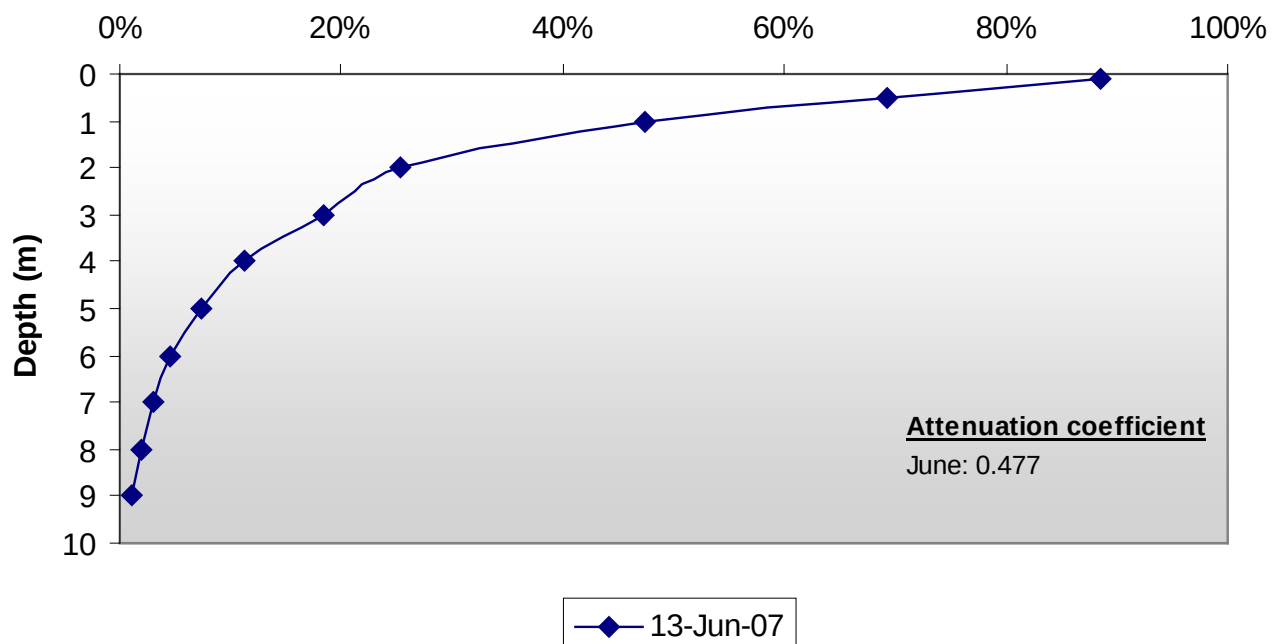
## 2007 Light Penetration: Seawall Pond

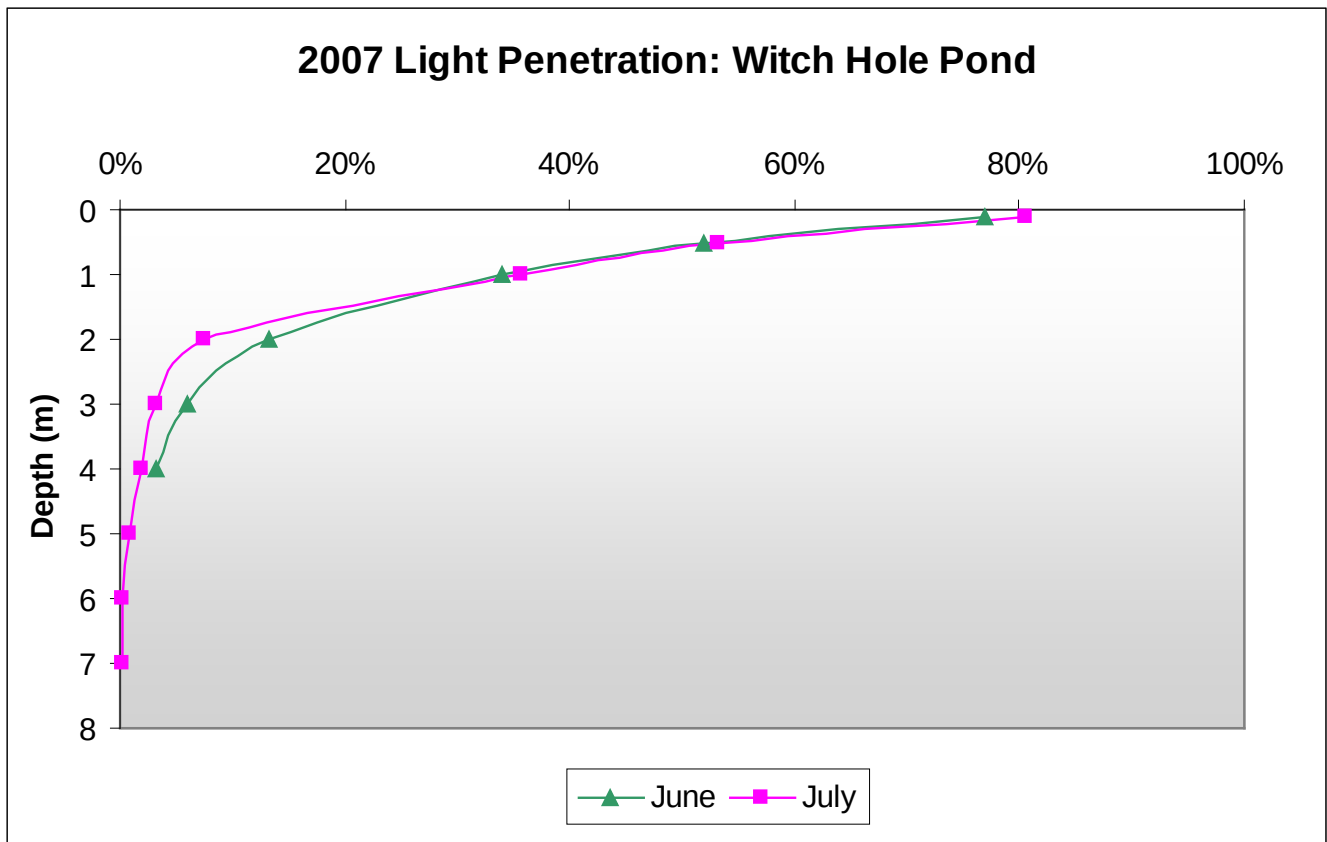


## 2008 Light Penetration: Upper Breakneck Pond



## 2007 Light Penetration: Upper Hadlock Pond





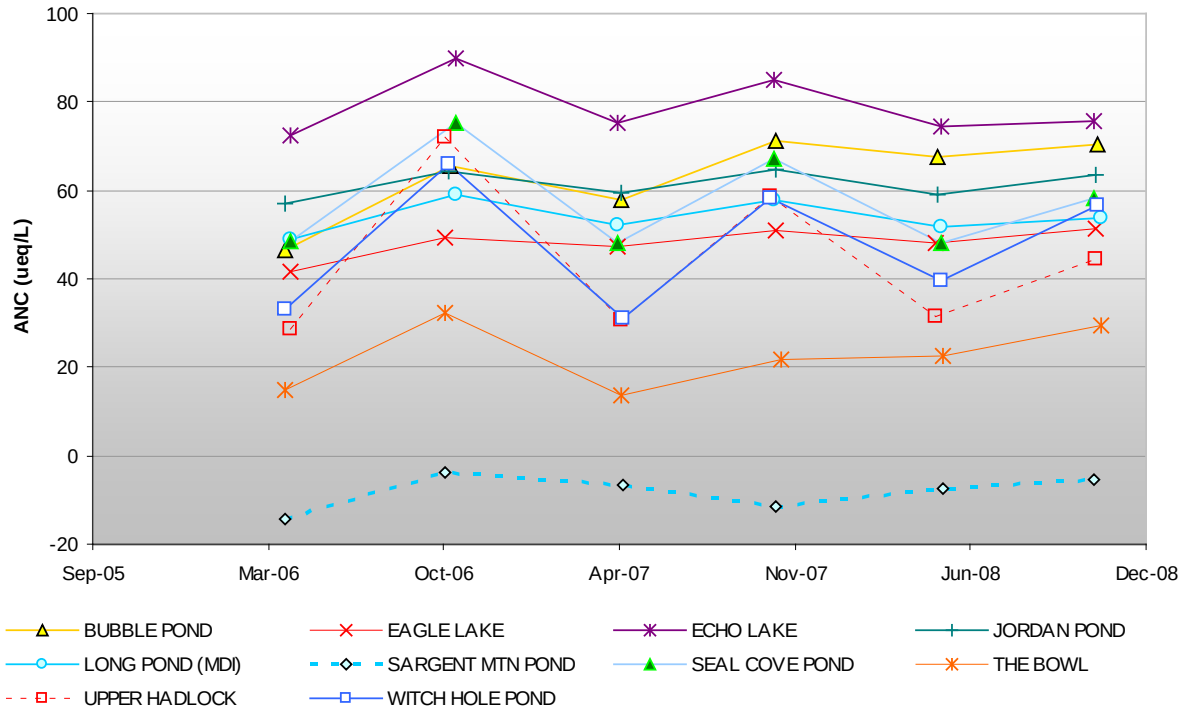
*Note: Attenuation coefficients calculated using methods from Kopp and Neckles, 2004.*

## **APPENDIX G**

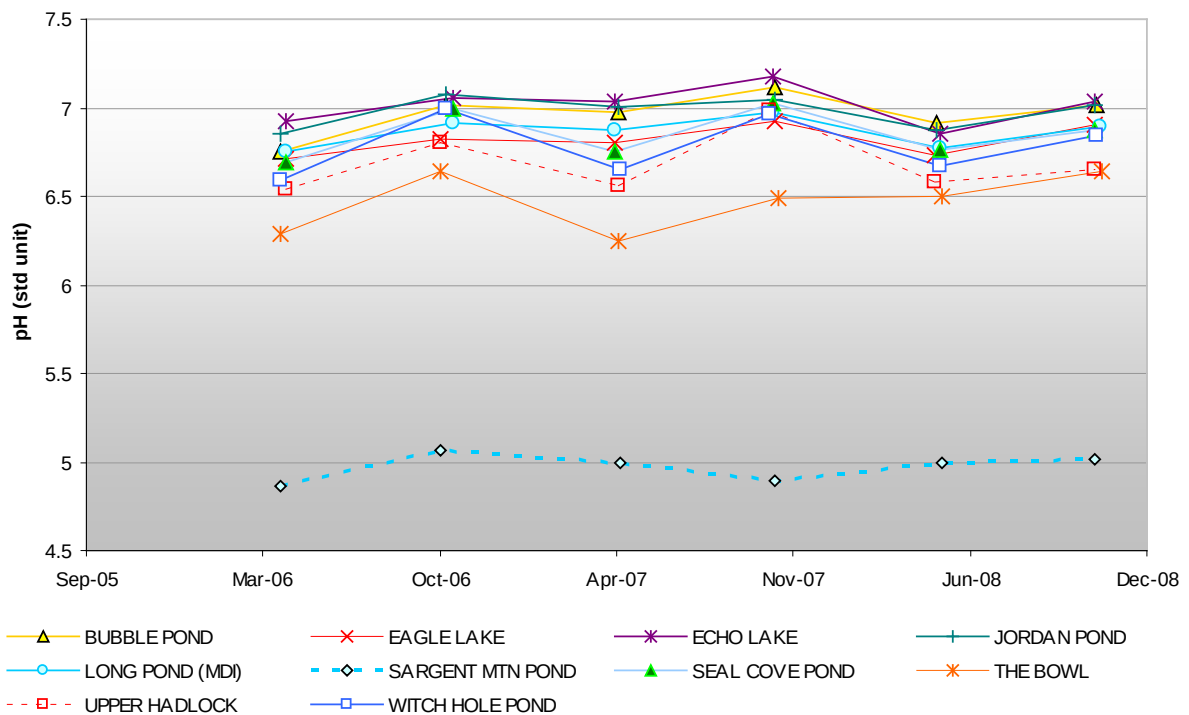
### **Acidification Chemistry Graphs: 2006-2008**



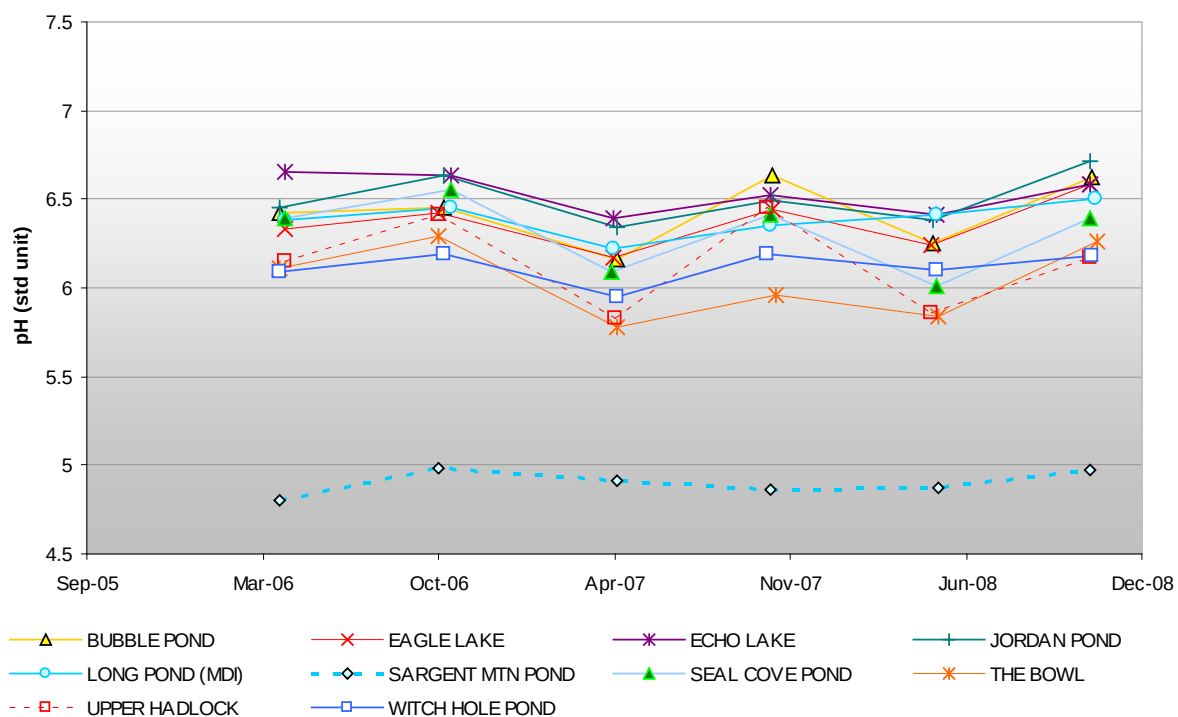
## Acid Neutralizing Capacity: Lakes 2006-2008



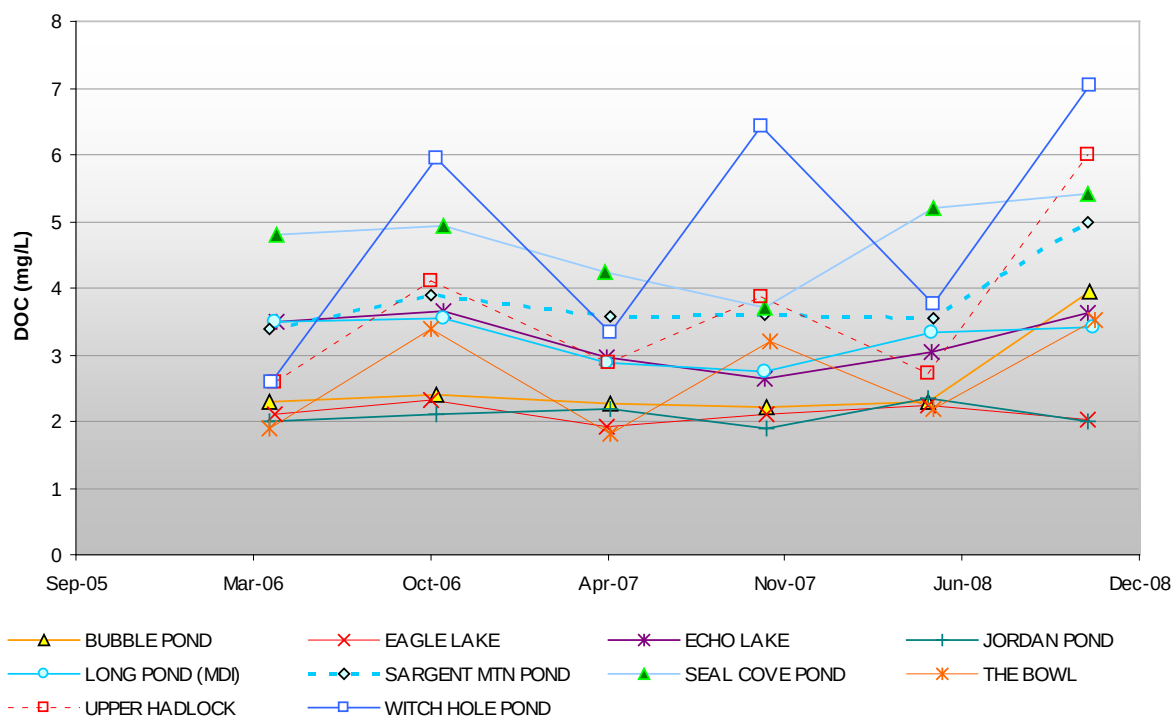
## Equilibrated pH: Lakes 2006-2008



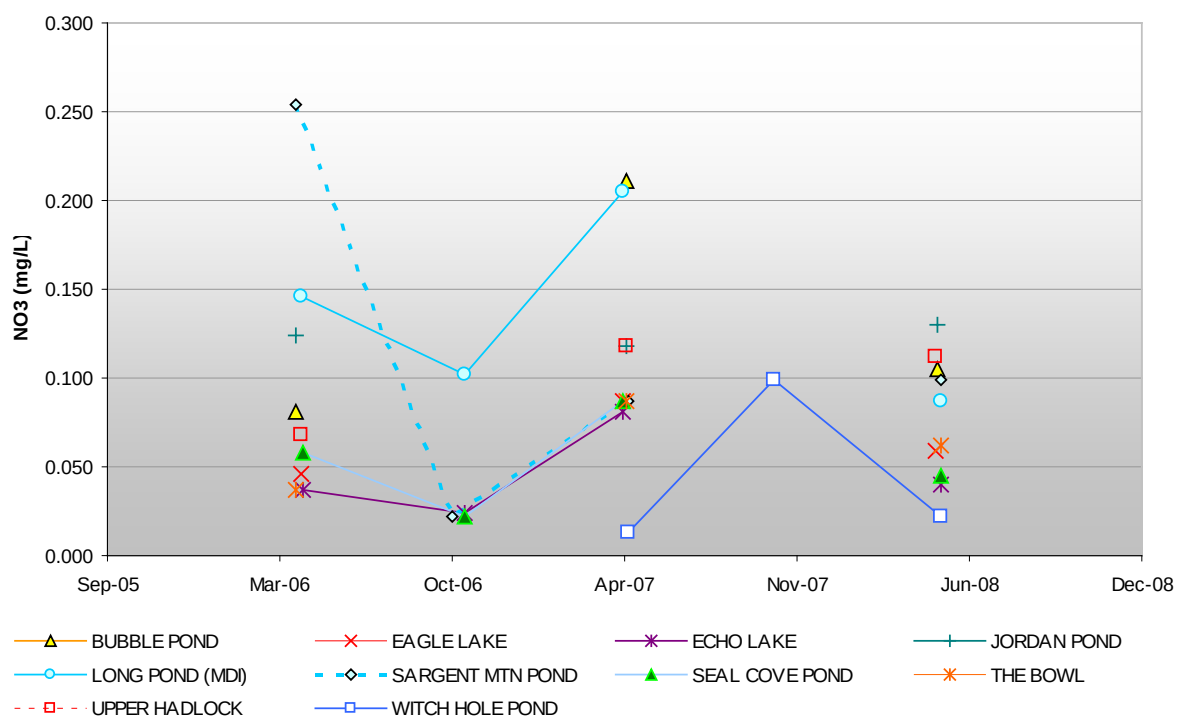
## Closed cell pH: Lakes 2006-2008



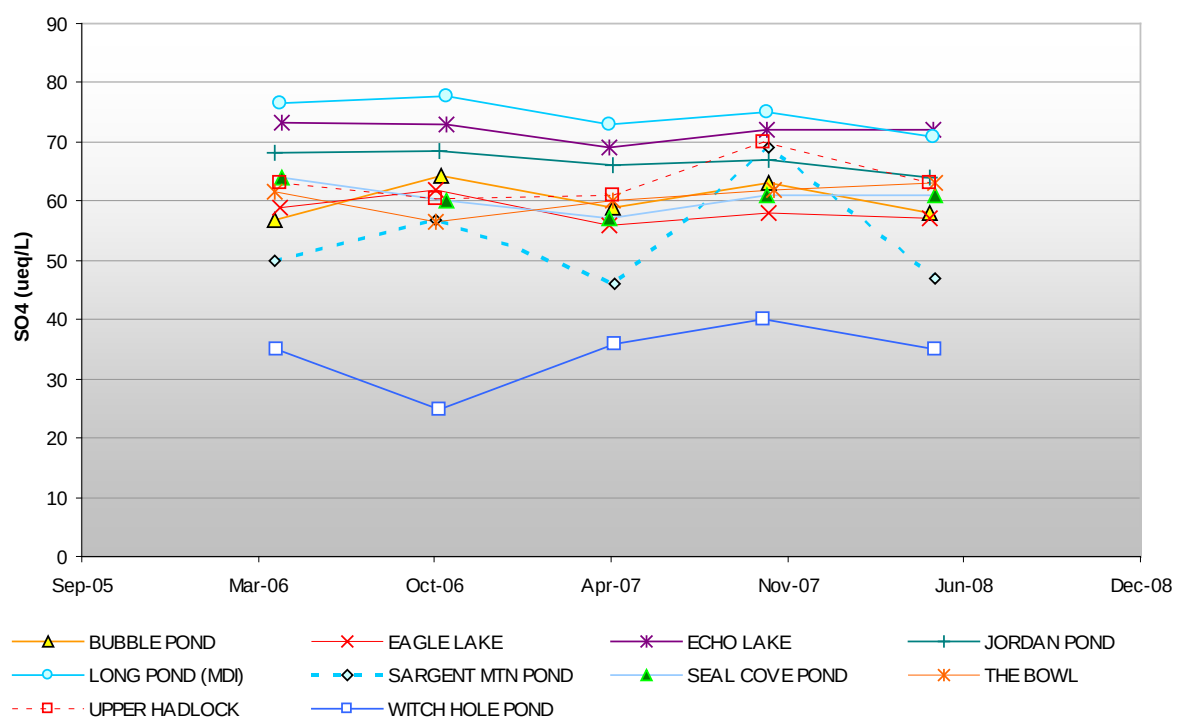
## Dissolved organic carbon (DOC): Lakes 2006-2008



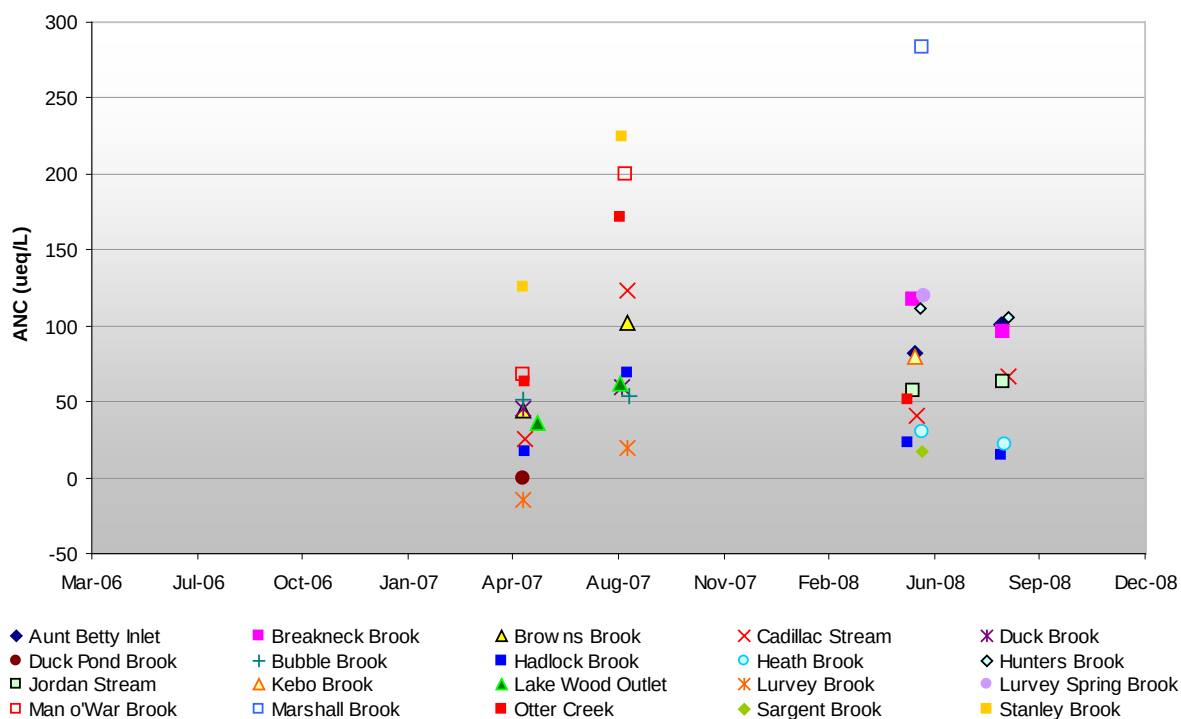
## Nitrate (NO<sub>3</sub>): Lakes 2006-2008



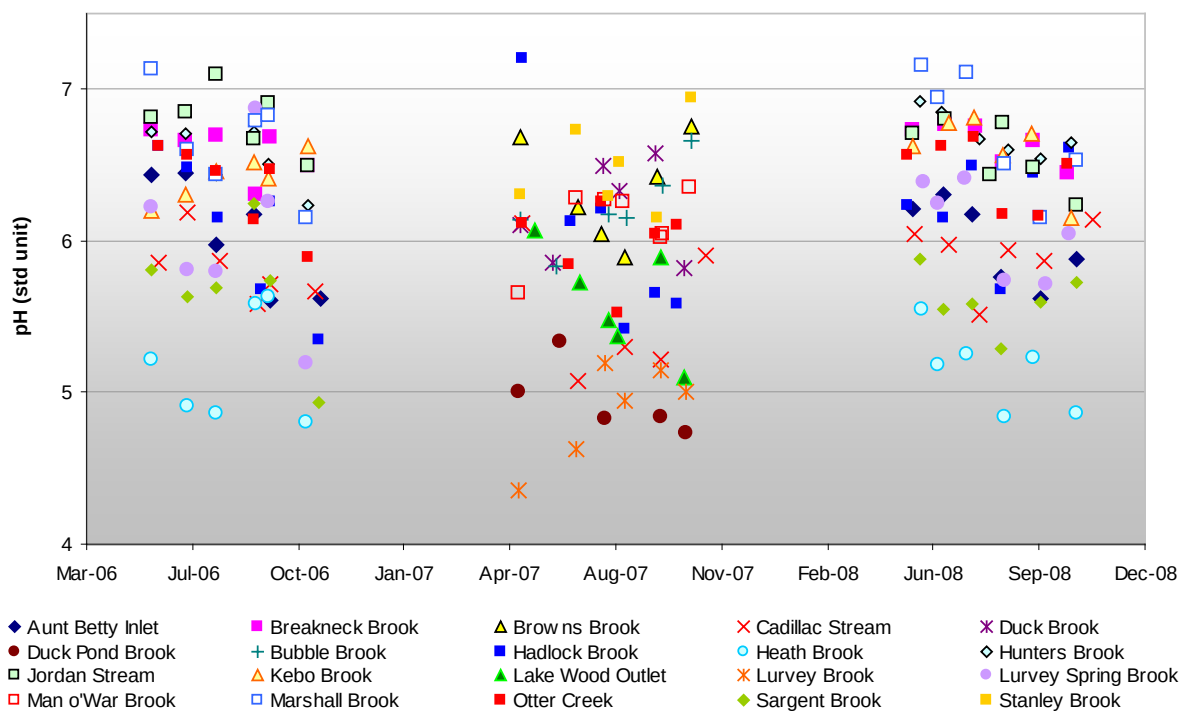
## Sulfate (SO<sub>4</sub>): Lakes 2006-2008



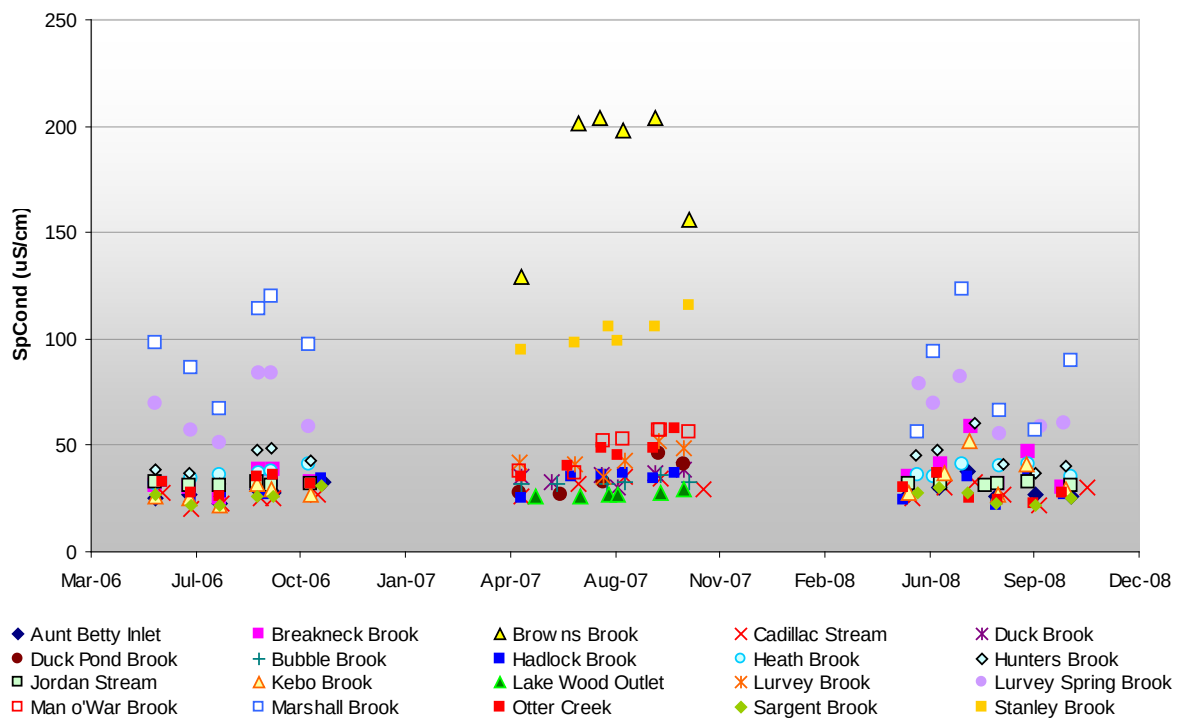
## Acid Neutralizing Capacity (ANC): Streams 2006-2008



## Field pH (YSI sonde): Streams 2006-2008



## Specific conductance (field): Streams 2006-2008





## **APPENDIX H**

Stream macroinvertebrate data: 2005-2007



## Summary of ANP Stream Macroinvertebrate Data 1997- 2007

| Site                            | Date        | Total Abundance | Generic Richness | EPT Gen Richness | Legislative Class | MDEP Model Class | Final Determination | Reason                                                                                                                                                                                 |
|---------------------------------|-------------|-----------------|------------------|------------------|-------------------|------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 |             |                 |                  |                  |                   |                  |                     |                                                                                                                                                                                        |
| Otter                           | 1997        | 9.66            | 8                | 5                | AA                | I                | I                   | Minimum requirement for total mean abundance not met. Resample.                                                                                                                        |
| Otter                           | 1998        | 32.96           | 23               | 9                | AA                | I                | I                   | Minimum requirement for total mean abundance not met. Resample.                                                                                                                        |
| Otter                           | 1999        | 74.97           | 29               | 15               | AA                | A                | A                   | Model.                                                                                                                                                                                 |
| Otter                           | 2000        | 46              | 26               | 9                | AA                | I                | I                   | Minimum requirement for total mean abundance not met. Resample.                                                                                                                        |
| Otter                           | 2001        | 26              | 24               | 13               | AA                | I                | I                   | Minimum requirement for total mean abundance not met. Resample.                                                                                                                        |
| <b>Otter</b>                    | <b>2006</b> | <b>100.67</b>   | <b>27</b>        | <b>11</b>        | <b>AA</b>         | <b>B</b>         | <b>B</b>            | <b>Model. Number of Rheotanytarsus in sample may have influenced model run.</b>                                                                                                        |
|                                 |             |                 |                  |                  |                   |                  |                     |                                                                                                                                                                                        |
| Duck                            | 1997        | 59.61           | 29               | 11               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| Duck                            | 1998        | 121.6           | 29               | 12               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| Duck                            | 1999        | 57.31           | 35               | 10               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| Duck                            | 2000        | 346.33          | 74               | 24               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| Duck                            | 2001        | 145.67          | 38               | 10               | AA                | C                | C                   | Model. Resample.                                                                                                                                                                       |
| Duck                            | 2002        | 169.67          | 41               | 16               | AA                | B                | B                   | Model. Class A probability at (.34)                                                                                                                                                    |
| Duck                            | 2003        | 245.67          | 50               | 18               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| Duck                            | 2004        | 137.33          | 46               | 21               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| Duck                            | 2005        | 73.67           | 31               | 13               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| <b>Duck</b>                     | <b>2006</b> | <b>31.17</b>    | <b>17</b>        | <b>9</b>         | <b>AA</b>         | <b>I</b>         | <b>A</b>            | <b>Minimum number ( total mean abundance ) for decision model not met but benthic macroinvertebrate community is indicative of a natural community in a small oligotrophic system.</b> |
|                                 |             |                 |                  |                  |                   |                  |                     |                                                                                                                                                                                        |
| <b>Duck</b>                     | <b>2007</b> | <b>30.5</b>     | <b>18</b>        | <b>7</b>         | <b>AA</b>         | <b>I</b>         | <b>I</b>            | <b>BPJ. Low Numbers. Resample</b>                                                                                                                                                      |
|                                 |             |                 |                  |                  |                   |                  |                     |                                                                                                                                                                                        |
| <b>Duck (Eagle Lake Outlet)</b> | <b>2007</b> | <b>100</b>      | <b>34</b>        | <b>8</b>         | <b>AA</b>         | <b>N/A</b>       | <b>N/A</b>          | <b>Low flow. Resample</b>                                                                                                                                                              |
|                                 |             |                 |                  |                  |                   |                  |                     |                                                                                                                                                                                        |
|                                 |             |                 |                  |                  |                   |                  |                     |                                                                                                                                                                                        |
| Hunters                         | 1997        | 54.33           | 23               | 14               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| Hunters                         | 1998        | 111             | 21               | 15               | AA                | A                | A                   | Model                                                                                                                                                                                  |
| Hunters                         | 1999        | 22.96           | 23               | 10               | AA                | I                | I                   | Minimum requirement for total mean abundance not met.                                                                                                                                  |

| Site                   | Date        | Total Abundance                                                               | Generic Richness | EPT Gen Richness | Legslative Class | MDEP Model Class | Final Determination | Reason                                                                                                                        |
|------------------------|-------------|-------------------------------------------------------------------------------|------------------|------------------|------------------|------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------|
|                        |             |                                                                               |                  |                  |                  |                  |                     | Resample.                                                                                                                     |
| Hunters                | 2000        | 36.33                                                                         | 22               | 11               | AA               | I                | I                   | Minimum requirement for total mean abundance not met. Resample.                                                               |
| Hunters                | 2001        | 54.67                                                                         | 24               | 10               | AA               | C                | C                   | Model. Resample resembles a class A community.                                                                                |
| Hunters                | 2002        | 43.33                                                                         | 32               | 17               | AA               | I                | A                   | BPJ.Minimum requirement for total mean abundance not met. But macroinvertebrate community is indictive of a natural community |
| Hunters                | 2003        | 81                                                                            | 34               | 18               | AA               | A                | A                   | Model                                                                                                                         |
| Hunters                | 2005        | 49.33                                                                         | 28               | 17               | AA               | I                | A                   | BPJ.Minimum numbers for decision model not met. But macroinvertebrate community is indictive of a natural community           |
|                        |             |                                                                               |                  |                  |                  |                  |                     |                                                                                                                               |
| Stanley (South)        | 1997        | 121                                                                           | 43               | 20               | AA               | A                | A                   | Model                                                                                                                         |
| Stanley (South)        | 1998        | 122.96                                                                        | 35               | 15               | AA               | A                | A                   | Model                                                                                                                         |
| Stanley (South)        | 1999        | 58.63                                                                         | 29               | 17               | AA               | A                | A                   | Model                                                                                                                         |
| Stanley (South)        | 2000        | 66.33                                                                         | 26               | 14               | AA               | I                | A                   | Model                                                                                                                         |
| Stanley (South)        | 2001        | 76.33                                                                         | 33               | 15               | AA               | A                | A                   | Model                                                                                                                         |
| Stanley (South)        | 2002        | 101.33                                                                        | 34               | 16               | AA               | A                | A                   | Model                                                                                                                         |
| Stanley (South)        | 2003        | 51.33                                                                         | 35               | 16               | AA               | A                | A                   | Model                                                                                                                         |
| Stanley (South)        | 2004        | Unable to process, as rock bags were covered by sand due to high flow events. |                  |                  |                  |                  |                     |                                                                                                                               |
| Stanley (South)        | 2005        | 202                                                                           | 43               | 21               | AA               | A                | A                   | Model                                                                                                                         |
| <b>Stanley (South)</b> | <b>2006</b> | <b>135.67</b>                                                                 | <b>36</b>        | <b>14</b>        | <b>AA</b>        | <b>A</b>         | <b>A</b>            | <b>Model</b>                                                                                                                  |
| <b>Stanley (South)</b> | <b>2007</b> | <b>103.43</b>                                                                 | <b>27</b>        | <b>14</b>        | <b>AA</b>        | <b>A</b>         | <b>A</b>            | <b>Model</b>                                                                                                                  |
|                        |             |                                                                               |                  |                  |                  |                  |                     |                                                                                                                               |
| Stanley (North)        | 2004        | 75                                                                            | 36               | 13               | AA               | A                | A                   | Model                                                                                                                         |
|                        |             |                                                                               |                  |                  |                  |                  |                     |                                                                                                                               |
| Heath                  | 1998        | 340.62                                                                        | 44               | 14               | AA               | B                | B                   | Model                                                                                                                         |
| Heath                  | 1999        | 23.31                                                                         | 16               | 5                | AA               | I                | I                   | Minimum requirement for total mean abundance not met. Resample.                                                               |
| Heath                  | 2000        | 115.33                                                                        | 27               | 4                | AA               | C                | C                   | Model.Resample.                                                                                                               |
| Heath                  | 2001        | 164.67                                                                        | 26               | 8                | AA               | A                | A                   | Model                                                                                                                         |
| Heath                  | 2002        | 71                                                                            | 26               | 5                | AA               | NA               | NA                  | Resample. Community may be effected by upstream wetland complex.                                                              |
| Heath                  | 2003        | 98                                                                            | 42               | 12               | AA               | B                | B                   | Model. Class A probability is (.33).                                                                                          |
|                        |             |                                                                               |                  |                  |                  |                  |                     |                                                                                                                               |
| Lurvey Spring          | 1998        | 167.29                                                                        | 45               | 16               | AA               | B                | B                   | Model                                                                                                                         |
| Lurvey Spring          | 1999        | 100.62                                                                        | 41               | 14               | AA               | B                | B                   | Model                                                                                                                         |
| Lurvey Spring          | 2000        | 201.33                                                                        | 46               | 16               | AA               | B                | A                   | BPJ. Indeterminant class A (.54) raised to class A based on the community structure.                                          |

## Appendix H

| Site                 | Date        | Total Abundance | Generic Richness | EPT Gen Richness | Legislative Class | MDEP Model Class | Final Determination | Reason                                                                                                                     |
|----------------------|-------------|-----------------|------------------|------------------|-------------------|------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------|
| Lurvey Spring        | 2001        | 308.67          | 44               | 19               | AA                | B                | B                   | Model. Class A probability is (.24).                                                                                       |
| Lurvey Spring        | 2002        | 222.33          | 38               | 15               | AA                | C                | C                   | Model. Resample resembles a class A community.                                                                             |
| Lurvey Spring        | 2003        | 73.67           | 32               | 9                | AA                | C                | B                   | BPJ. Indeterminant class B (.48) raised to class B based on the community structure. Model predicts class A at (.33)       |
| Lurvey Spring        | 2004        | 161.33          | 33               | 16               | AA                | A                | A                   | Model                                                                                                                      |
| Lurvey Spring        | 2005        | 50.33           | 37               | 16               | AA                | A                | A                   | Model                                                                                                                      |
| <b>Lurvey Spring</b> | <b>2006</b> | <b>156.33</b>   | <b>38</b>        | <b>17</b>        | <b>AA</b>         | <b>A</b>         | <b>A</b>            | <b>Model</b>                                                                                                               |
|                      |             |                 |                  |                  |                   |                  |                     |                                                                                                                            |
| Marshall             | 2000        | 209.33          | 44               | 19               | AA                | A                | A                   | Model                                                                                                                      |
| Marshall             | 2001        | 285.33          | 40               | 20               | AA                | A                | A                   | Model                                                                                                                      |
| Marshall             | 2002        | 216.33          | 37               | 15               | AA                | A                | A                   | Model                                                                                                                      |
| Marshall             | 2003        | 88              | 31               | 13               | AA                | C                | C                   | Model. Resample class A probability is (.28).                                                                              |
| Marshall             | 2004        | 253.33          | 34               | 20               | AA                | A                | A                   | Model                                                                                                                      |
| Marshall             | 2005        | 144.67          | 35               | 15               | AA                | A                | A                   | Model                                                                                                                      |
| <b>Marshall</b>      | <b>2006</b> | <b>522</b>      | <b>22</b>        | <b>8</b>         | <b>AA</b>         | <b>B</b>         | <b>B</b>            | <b>Model. Number of Rheotanytarsus in the sample may have influenced model run.</b>                                        |
|                      |             |                 |                  |                  |                   |                  |                     |                                                                                                                            |
| Richardson           | 2002        | 33.67           | 25               | 13               | AA                | I                | A                   | BPJ. Minimum numbers for total mean abundance not met but macroinvertebrate community is indicative of a natural community |
| Richardson           | 2003        | 51              | 36               | 16               | AA                | A                | A                   | Model                                                                                                                      |
|                      |             |                 |                  |                  |                   |                  |                     |                                                                                                                            |
| <b>Lake Wood</b>     | <b>2007</b> | <b>51.33</b>    | <b>18</b>        | <b>7</b>         | <b>AA</b>         | <b>C</b>         | <b>C</b>            | <b>Low numbers. Resample</b>                                                                                               |



