# Report as of FY2007 for 2006NH60B: "Water Quality Change-Effects of Development in Selected Watersheds"

## Publications

Project 2006NH60B has resulted in no reported publications as of FY2007.

## Report Follows

**2006 WRRC Report for project dates March 1, 2006 to February 28, 2007:**

Title- **Water Quality Change:-Effects of Development on Nutrient Loading in Selected Watersheds**

PI: Jeffrey Schloss, Extension Professor in Zoology (UNH Center for Freshwater Biology) and Water Resources Specialist, UNH Cooperative Extension.

Statement of regional or State water problem-

The waters of New Hampshire represent a valuable water resource contributing to the state's economic base through recreation, tourism, and real estate revenues. Some lakes and rivers serve as current or potential water supplies. For most residents (as indicated by boating and fishing registrations and shoreline re-development) our waters help to insure a high quality of life. As documented in the 2000 Census, New Hampshire currently leads all of the New England states in the rate of new development and redevelopment. The long-term consequences of the resulting pressure and demands on the state's precious water resources remain unknown. Of particular concern is the response of our waters to increasing non-point source pollutant loadings due to watershed development and land use activities.

Of all the in-depth watershed nutrient budget measurements and modeling efforts that have been attempted in NH none have primarily focused on change detection due to development as they were either base-line studies on relatively pristine lakes or focused on specific problems such as internal nutrient loading from past sewage outfalls, or septic systems in the water table of a seepage lake. In addition nitrogen species were only monitored for less than a handful of studies and the measurement technologies at the time were not sensitive enough to provide much usable data. The opportunity to add nitrogen monitoring and support GIS land change analysis to co-occurring externally funded phosphorus watershed nutrient budget studies on two lakes that had previous budgets done in the past provides a true cost-effective project that directly addresses Statewide concerns.

Alone, these watershed nutrient budgets represent only short-term examinations of non-point source pollution nutrient loadings to the lake. A longer-term monitoring program conducted through differing weather years at both shallow and deep sites is required to best estimate the lake response to the loadings due to development over time.

Nature, scope and objectives of the project and task status .-

This project has allowed for the continued collection of long-term water quality data over a substantial spatial and temporal scale. Both project components employed utilize a combination of students and volunteer citizen water quality monitors to collect samples (and preserve for analysis) from a wide range of lake and stream watersheds throughout the state which are part of the NH Lakes Lay Monitoring Program (LLMP), a 28 year long-term sampling effort.

Emphasis on LLMP efforts has been to maintain and expand tributary monitoring for participating lakes to allow for long-term change detection through a number of years with differing weather regimes.

As other funding sources are already available for water quality analysis costs and related expenses, funding from this project will provide support for student lab and field technicians and for supervision, data management and data analysis by the project director.

NOTE: We have envisioned this effort as providing the foundation to further assess the impacts of land use and the effectiveness of watershed management strategies using long-term data sets in future years.

To summarize, objectives of this study include:

1. To add nitrogen analysis to an already funded project developing a water and total phosphorus budget for a lake watershed that has experienced land cover change since a previous study was undertaken over a decade ago.

*Status: Project has been initiated, QAPP was approved by EPA New England in the Fall of 2006 and sampling was started in November of 2006.*

2- The continued collection and analysis of long-term water quality data in selected watersheds.
*Status: 12 new monitors trained directly, 20 indirectly; 50+ monitors re-trained and tested, thirty eight additional tributary sites added on Newfound Lake and Mendums Pond as part of a Water/Nutrient Budget for the respective lakes (to add to Winnipesaukee and Bow Lake efforts). Over 950 deep lake site trips by volunteers; 82 deep lake site trips by CFB field team (students and faculty),596 shallow lake and tributary site trips made by volunteers; 104 tributary sample trips made by CFB team.*

3- The dissemination of the results of the analysis to cooperating agencies, water managers, educators and the public on a local, statewide and regional basis.
*Status:*

*Reports:*

*30 Individual Reports produced for each lake and or watershed association participating;*
"Winnipesaukee Tributary Study Analysis Report" *provided to the Lake Winnipesaukee Association*

*Peer reviewed reports:*

"Quality Assurance Project Plan for the Mendum's Pond Watershed Study" *(November 2006)*

*Public Presentations:*

"The State of the Watershed" *to the Saco River monitoring program of the Green Mountain Conservation Group (Ossippee Watershe,) November 2006.*
"A Summary of the Winnipesaukee Tributary Sampling Effort Results" *to a joint public meeting of the Meredith, Laconia and Guilford Town Boards (October 2006).*
Over a Quarter Century of Lake Monitoring: What have we learned? Invited presentation NH Lakes Congress (June 2006)
"Meredith Bay, Winnipesaukee Monitoring Overview"-*special televised Selectman's meeting, Meredith NH (March 2006)*

*Class Presentations:*

*Introduction to Water Resources Management (Natural Resources)*- "NH Lakes: Issues and Concerns"
*Lake Biology (Zoology/Plant Biology)*- "The NH Lakes Lay Monitoring Program"
*Watershed Ecology (Natural Resources)*- "Lake Ecology", "Lake Water Quality Sampling" and "Following the Flow: Nonpoint Source Pollution in NH Watersheds"
*Multidisciplinary Lakes Management (Zoology/Plant Biology)*- "Analysis a long term datasets"

*Academia /Professional Societies:*

*Plymouth State University (invited seminar)* "The Squam Lakes Watershed: Analysis of 25 Years of Monitoring"
*North American Lakes Management Society/EPA (invited)* – Choosing a Sampling Scheme for the National Lakes Assessment: Stressors and Indicators" (April 2006)

4- To offer undergraduate and graduate students the opportunity to gain hands-on experience in water quality sampling, laboratory analysis, data management and interpretation.
*Status: See table below- 9 undergraduate and 4 graduate students were directly involved*

5- To further document the changing water quality in a variety of watersheds throughout the state in the face of land use changes and best management efforts.
*Status: See above – in process*

6- To determine next steps for further analysis of long-term data sets and GIS spatial data on land cover.
*Status: in process to be done at end of next study year.*

In addition we have secured additional funding to support a masters student (assistantship for two year) who will focus on the groundwater component of the Mendum's Pond Study and for extended sampling of total phosphorous in the Newfound Lake Watershed.

Expected Activity Timeline for 2007 effort:

| | |
|---|---|
| March - April 2007 | Continue to modify and update water quality and GIS databases.<br>Initiate run-off sampling and seepage (Mendums Pond). |
| April - June 2007 | Continue to manage volunteer, student and staff sampling efforts.<br>Analyze samples collected<br>Continue to modify and update water quality and GIS databases.<br>Work with NH DES to facilitate data sharing for:<br>Statewide database<br>Shared web site<br>STORET uploads |
| Sept 2007- Feb 2008 | Analyze results in lab, prepare summaries and reports |

Methods, procedures and facilities:-

An EPA approved QAPP (Schloss 2006) for the watershed water/nutrient budget is being followed that includes volunteer sample collection and gage readings and student technicians sampling and conducting stream flow measurements using a Doppler water velocity meter (SonTek/YSI).

Lake and stream monitoring through the LLMP generally involves a minimum of monthly sampling starting at spring runoff through to lake stratification and weekly to bi-weekly sampling through to fall mixis. Water clarity, chlorophyll a, acid neutralizing capacity, dissolved organic color, dissolved oxygen and nutrients (total N, total P and nitrate) will be the default suite of parameters measured for lakes while nutrients, turbidity, dissolved organic color and flow will be the parameters of choice for the lake tributary work. On occasion, student field teams will travel to join the volunteer monitors to perform quality assurance checks and do more in-depth analysis and lake profiling.

As stated above the primary scope of this project is to maintain the long-term data collection effort but in addition, land cover changes to study subwatersheds will be documented on our established GIS data base and any new management practices or conservation efforts will also be documented

This project will be coordinated from the University of New Hampshire, which will supply the office and laboratory space (analytical and computer). The Center for Freshwater Biology Analytical Water Quality Laboratory has a Quality Assurance Project Plan for surface water analysis on file with the US Environmental Protection Agency Region 1 Office (EPA New England). Besides nutrient analysis (Total Phosphorus, Total Nitrogen, Nitrate), other water quality capabilities include chlorophyll a, dissolved oxygen, dissolved CO2, acid neutralizing capacity, specific conductivity, pH, ORP, turbidity, water clarity, iron and E.coli. The lab can also provide field sampling, field water quality instruments, automated data loggers and water velocity measurement equipment. The lab can also provide the use of Real-Time Differential GPS units for watershed surveying and ground truth sampling.

The Water Resource Center Laboratory, which follows standard methods, has the capability to perform ion chromatography for a variety of anions and cations, organic carbon analysis and total nitrogen analysis. It also can provide field and automated sampling equipment.

UNH Cooperative Extension will provide vehicles for travel for PI's, students and interns at a cost (mileage) basis. A dedicated GIS PC Windows XP workstation will be provided for use including ArcGIS and ArcView Software, ArcView Extensions: Spatial Analyst, 3-D Analyst, Image Analysis and ArcPress. This will be used in addition to other data input PC stations, laser printers and a large format (36" wide) ink jet plotter that will be made available for the project.

The project will utilize an extensive GIS database for the study subwatersheds created through previous WRRC funding to the PI. Updated and additional GIS data can be made available through the UNH Complex Systems Research Center, which manages the NH GRANIT statewide GIS data depository. The extensive data directory contains statewide GIS data layers (usually at 1:24,000 scale) including hydrology, geology, soils, National Wetlands Inventory, land-use, land cover, and digital elevation models. Also available are Landsat Thematic Mapper, SPOT Panchromatic and digital orthophoto imagery.

Students impacted for 2006-2007 (supported by and/or worked on aspects of project)

| Field of Study | Undergraduate | Masters | Ph.D. | **Total** |
|---|---|---|---|---|
| Marine and Freshwater Biology (Plant Biology or Zoology) | 2 | 1 | | 3 |
| Microbiology | 1 | | | 1 |
| Environmental Conservation | 1 | | | 1 |
| Water Resources (Natural Resources or Hydrology Dept.s) | 2 | 1 | 1 | 4 |
| Extension Education (Colorado State) | | 1 | | 1 |
| English | 1 | | | 1 |
| Psychology | 1 | | | 1 |
| Undecided | 1 | | | 1 |
| **TOTAL:** | **9** | **3** | **1** | **13** |

Major Findings:

As the study is currently in the data collection phase we do not have any major findings to report to date.