

Information Transfer

Unbridled development and population growth can have detrimental impacts to water resources and ecosystem services. Rapid population growth is occurring in New Hampshire and state regulations, planning board decisions and zoning classifications all attempt to minimize the environmental impact of this rapid population growth. Most land use planning decisions are made at the local level on a town by town basis, often by volunteers who serve on various boards, commissions and committees. Decisions by these various resource managers are often made without a full understanding of the consequences that their decisions will have on water resources or ecosystem services.

This project provided salary for the Center's Director and Associate Director to meet with state representatives, local town officials, watershed groups, the general public and scientists to discuss WRRC findings that relate to population growth and land use change. The NH WRRC website (<http://www.wrrc.unh.edu/>) is also used to disseminate information on water resources, and is updated and maintained by salary provided by this project. The time of the Director and Associate Director is increasingly spent discussing current and future research in the Lamprey River Hydrologic Observatory, which is partially funded by the longstanding 104B project "Water Quality and the Landscape: Long-term monitoring of a rapidly developing suburban watershed." On January 7, 2011 the NH WRRC totally funded and organized the **Fourth Annual Lamprey River Symposium** (see also below). Presentations focused on water quality, hydrology, stormwater, thermal pollution, nitrogen cycling in coastal New Hampshire and remapping of the Lamprey River 100 year floodplain. The symposium attracted over 90 attendees, including scientists (37 from UNH and 1 from elsewhere), regional leaders (27), town officials (11), members of state agencies (8), and federal agencies (6). The agenda and presentations have been posted on the NH WRRC website at: <http://www.wrrc.unh.edu/lrho/symposium.htm>. This annual symposium and other discussions in which the Center's Director and Associate Director participate further the research and information transfer goals of the WRRC.

Examples of Information Transferred

The NH WRRC's long-term water quality data on the rapidly developing suburban Lamprey River watershed has been shared with local towns as they investigate new potential sources for public water supply. Several towns in the watershed are investigating new water supplies to support the increased demand for water from their growing populations. Newmarket, NH is under considerable pressure to develop new water supplies, as its surface water treatment plant was shut down several years ago due to high concentrations of dissolved organic carbon (DOC). This DOC, although of largely natural origin from wetlands in the Lamprey River basin, results in production of dangerous trihalomethanes upon chlorination. Trihalomethanes are known carcinogens and the town of Newmarket was required to shut down the water treatment plant and rely solely on the two town wells.

Newmarket has contracted with Emery & Garrett Groundwater, Inc (EGGI) to increase their town water supply. Emery & Garrett Groundwater, Inc has suggested that the town withdraw water from the Lamprey River in Lee NH during high flow periods and artificially "recharge" their town wells to generate an underground storage supply that would meet the town water needs even during dry summer conditions. The NH WRRC provided EGGI with long-term Lamprey River data to assess whether seasonality and year to year variability in water

quality (especially DOC) made it appropriate for artificial recharge. The town of Newmarket has not been able to appropriate funding to further develop this artificial recharge project, but the long-term dataset provided by the NH WRRC was instrumental in this water supply decision-making process.

The town of Durham (including the University of New Hampshire) relies heavily on the Lamprey River for water supply since the town's local surface water source, the Oyster River, is often unable to meet the town's demand. Like Newmarket, Durham has also contracted with EGGI to determine if artificial recharge of their Spruce Hole Aquifer with Lamprey River water is an appropriate and viable option to meet the town's water supply needs. The NH WRRC continues to provide EGGI with long-term water quality data on the Lamprey River to inform this water supply decision-making process in Durham. As more towns in the future look to the Lamprey for water supply, the long-term dataset provided by the NH WRRC will become increasingly valuable.

In addition to providing data on surface water quality, the NH WRRC has also identified water quality impairments in private wells within southeastern NH and presented the results to homeowners, local town officials, regional watershed groups and state agencies. Private wells are not regulated, even though they supply 40% of the NH population, and therefore it is up to the individual homeowner to test and treat their water if necessary. This puts the uninformed homeowner at risk of consuming contaminated water. We sampled 188 private wells to infer linkages between land use practices and groundwater quality and to educate the general public on the importance of private well testing. One private well that we sampled exceeded the US EPA public drinking water standard for nitrate (10 mg N/L), 10 wells were greater than levels associated with increased risk of gastric cancer (4 mg N/L; Ward et al. 1996), and 28 wells were elevated above 2 mg N/L, indicating anthropogenic sources of N contamination (e.g. fertilizers or septic system effluent). Nine percent of the wells exceeded the EPA secondary drinking water standard for chloride (250 mg/L) and 46% of the wells exceeded the EPA advisory level (20 mg Na/L) for persons with hypertension. It is likely that road salt application is the dominant source of such high sodium and chloride levels in groundwater. In summary, 21% of the wells exceeded the EPA MCL for either nitrate, arsenic, lead or uranium and 38% of the wells exceeded advisory levels for nitrate (4.0 mg N/L), chloride (250 mg/L) or sodium (20 mg/L). A total of 59% of private well users are exposed to contaminants that are cause for health concern. The NH WRRC has shown that even private wells drilled deep into bedrock fractures are subject to contamination from activities on the land surface. Local resources managers should take this into consideration when making land use planning decisions and these results were included within many of the outreach presentations listed below.

Over the two years, there has been significant focus on nitrogen loading to New Hampshire's largest estuary, the Great Bay estuary, and the impairment to aquatic life it has caused. In June 2009, numeric nitrogen criteria were established for Great Bay and in August 2009, Great Bay, Little Bay and the tidal rivers were added to the New Hampshire 2008 303d list of impaired waters rendering them in violation of the federal Clean Water Act. Based on a draft version of a waste load allocation report prepared by Philip Trowbridge (NH DES 2010), only 27% of the nitrogen entering Great Bay and Little Bay is from point sources; the majority (73%) enters via non-point sources of pollution. The Lamprey River is the largest tributary to Great Bay, and thus the long-term data provided by the NH WRRC from the LRHO are of considerable value for watershed management. The NH WRRC provides the best dataset in NH for assessing the spatial and temporal variability in N concentrations and export in response to suburbanization

and changes in land use. These 11+ years of data will be instrumental in assessing the success of current and future efforts to reduce non-point sources of nitrogen pollution reaching Great Bay. There is much interest in LRHO datasets from NH DES, the Piscataqua Region Estuaries Partnership (PREP), the Environmental Protection Agency (EPA) and other municipal, regional, state and federal agents. Many of the presentations and meetings listed below focused on transferring information on nitrogen cycling to stakeholders throughout NH's coastal watershed and beyond.

Symposia, Conferences and Seminars Organized and Funded

The NH WRRC totally funded and organized the "**Fourth Annual Lamprey River Symposium**" held January 7, 2011 in Durham, NH. The symposium is dedicated to exchanging the results of recent research on the water quality, hydrology, water resources issues, and management of the Lamprey River basin. The Symposium is a vehicle for researchers to share data and insights with other researchers, as well as those in the management and policy arena who would benefit from exposure to the latest research on the watershed. The symposium drew over 90 attendees, including researchers, legislators, water system operators, town officials, regional leaders and government officials. The symposium contained 13 presentations split up over three sessions. There was a break out session on nitrogen cycling and a poster session during lunch (5 posters and displays were exhibited). The day ended with an open discussion on research priorities in the Lamprey watershed and southeast NH. This event was totally funded and organized by the NH WRRC. Staff from UNH cooperative extension and Great Bay National Estuarine Research Reserve helped moderate the open discussions.

The NH WRRC sponsored the "**NH Water and Watershed Conference**" in Plymouth, NH on March 25-26, 2011. The conference is a unique, two-day event designed to meet the information and networking needs of lake, river, and watershed groups; environmental organizations; volunteer monitors; municipal board and staff members; elected officials; local and regional planners; policy makers; scientists; educators; consultants and students. The focus for the 2011 conference is on effective strategies at the local, regional, state, and federal levels that address the changing environmental and societal conditions and their effects on New Hampshire's aquatic environment. The NH WRRC co-Sponsored this conference along with FB Environmental Associates, GeoInsight Inc., Hach Hydromet, In-Situ Inc., New England EnviroStrategies, New Hampshire Department of Environmental Services, New Hampshire Fish and Game Department, Plymouth State University, Squam Lakes Association, United States Geological Survey Water Resources of NH and VT, Vanasse Hangen Brustlin, Inc. (VHB), Weston & Sampson Engineers Inc., Waterline Companies and the White Mountain National Forest. The conference contained 4 or 5 tracks each day including headwaters, streams and rivers; lakes wetlands and the coastal zone; wastewater and stormwater infrastructure; groundwater; land use change; local, regional, statewide and national strategies and skill building. The conference drew over 250 people, including researchers, legislators, water system operators, land use planners, and government officials.

The "**Road Less Salted**" water quality and salt reduction seminar was held on May 13, 2010 as a follow-up activity to the conference "Your Water, Your Wallet, Your Watershed - Why Working Together Across Town Boundaries Makes Sense For Protecting Our Water" (see below). The salt reduction seminar was co-sponsored by NH Department of Environmental Services, GBNERR Coastal Training Program, LRAC, LRWA, NH WRRC, and Hodgson Brook Restoration Project. The workshop drew over 80 people including members of local boards and

commissions, public works directors and road agents, municipal decision makers/planners, private contractors and landscapers who plow snow, property managers or owners, and local watershed or environmental organizations.

The NH WRRC sponsors a monthly **seminar series on water issues in New Hampshire** along with the USGS and the Department of Natural Resources at UNH. Five seminars were held during the academic year of this reporting period. Two seminars were held at the USGS office in Pembroke, NH and three were held at the University of New Hampshire in Durham, NH. Topics included biogeochemical cycles in watersheds and links to toxic algal blooms, engineering a solution to nitrogen impairments in NH's Great Bay, SPARROW modeling, climate change and geophysical methods used in water supply investigations.

Outcomes of Information Transferred

In June 2009, the NH WRRC together with the Great Bay National Estuarine Research Reserve (GBNERR) Coastal Training Program, Lamprey River Watershed Association (LRWA), Lamprey River Advisory Committee (LRAC) and Piscataqua Region Estuaries Partnership (PREP) formed the Lamprey River Watershed Outreach Collaborative and co-sponsored an outreach conference in June 2009 focusing on pressing water issues for the residents of the 14 towns that make up the watershed. The conference was titled "Your Water, Your Wallet, Your Watershed - Why Working Together Across Town Boundaries Makes Sense For Protecting Our Water" and drew over 70 people including teachers, legislators, town officials, regional leaders and government officials. Topics covered were 1) issues and challenges to land use decision making in the 14 towns that share the Lamprey watershed (presented by Erika Washburn, UNH PhD candidate) 2) water quality issues with road salt use and elevated nitrogen levels (presented by NH WRRC associate director) 3) consistency of environmental planning and regulation between towns in the watershed (presented by PREP).

The Lamprey River Outreach Collaborative conference highlighted the need for watershed wide land use planning and decision making and gave momentum to an earlier idea that the entire Lamprey should be nominated into the NH Rivers Management and Protection Program (RMPP). Currently, the Lamprey has 17.5 km (in Durham and Lee) of the 78 km mainstem reach designated into the NH RMPP. Following the Lamprey River Outreach Conference, a Lamprey River Nomination Committee (LRNC) was formed and in June 2010, a nomination package was submitted by the LRNC, LRWA and the LRAC to the NH Department of Environmental Services (DES) to designate the remaining portions of the Lamprey River and all its major tributaries into the NH RMPP. This nomination represented a total of 141 river km and the major tributaries included were the North Branch, Pawtuckaway, North, Little and Piscassic Rivers. Together, these nominated rivers capture 14 towns, two counties and 3 regional planning commissions that all share the Lamprey River watershed. This nomination package was the most complex nomination that the NH State Rivers Management Committee had ever seen and the first one to push for a watershed approach (as opposed to nominating a segment of a river or the main stem of a river, but not its tributaries). The committee was extremely impressed that elected officials from all of the watershed towns wrote letters of support and by the number and variety of individual support letters. On September 28, 2010, the NH State Rivers Management Committee voted to approve the nomination and the resulting House Bill has passed in both the House and the Senate. The Governor is expected to sign this bill into law this summer. At that point, a watershed wide local advisory committee will be formed and the designation will give the Lamprey watershed preferential eligibility over non-

designated rivers for state funding and technical resources. Conversations about the structure of this watershed wide committee have begun and the NH WRRC has been part of these conversations.

The progressive movement of this nomination represents significant outreach efforts of the NH WRRC, all the partners of the Lamprey River Outreach Collaborative (<http://www.wrrc.unh.edu/lrho/outreach.html>) and also the social science work of Erika Washburn (PhD dissertation “To pave or not to pave: a social landscape analysis of land use decision-making in the Lamprey River watershed”, December 2009). The LRNC, LRWA and LRAC made considerable efforts to put the nomination package together, but the public support for this nomination which is necessary for state designation would not have been possible without the extensive outreach of the Lamprey River Outreach Collaborative of which the NH WRRC plays a large role (<http://www.wrrc.unh.edu/lrho/outreach.html>). The concept of land use decision-making and natural resource management from a watershed perspective instead of solely by political boundaries with no regard to upstream or downstream neighbors is one that is gaining traction in southeast NH and is an outcome that the NH WRRC as well as other organizations is very proud of. This type of approach is the only to solve some of the current water quality impairments in New Hampshire (e.g. road salt contamination and elevated nitrogen and phosphorous in several water bodies).

Presentations:

- Bucci, J., McDowell, W.H., Daley, M.L., Potter, J.D., Hobbie, E., French, C. and Miller, C. 2011. Detecting nitrogen sources and flow paths in the Great Bay watershed and engaging decision makers in the Science. Annual Lamprey River Science Symposium. Durham, NH. January 2011.
- Daley, M.L. 2010. Road Salt Impacts to New Hampshire Streams and Groundwater. “The Road Less Salted” Water Quality & Salt Reduction Seminar. Greenland, NH. May 2010.
- Daley, M.L. 2010 Shared slides on nitrogen cycling from the Lamprey River watershed with Ted Diers for a presentation on nitrogen in the Great Bay watershed given by NH DES. May 2010.
- Daley, M.L. 2010. Water Quality in the Suburbanizing Lamprey River Basin. University of New Hampshire Inventory and Monitoring of Ecological Communities class. Durham, NH. September 2010.
- Daley, M.L. 2010. Suburbanizing NH watersheds and N Saturation. University of New Hampshire Watershed Water Quality Management class. Durham, NH. November 2010.
- Daley, M.L. 2010. Testified in support of nominating the remaining segments of the Lamprey River and its major tributaries into the State Rivers Management Protection Program. NH House of Representatives Resources, Recreation & Development Committee Public Hearing. Concord, NH. January 2011.
- Daley, M.L. and McDowell, W.H. 2010. Landscape controls on dissolved nutrients, organic matter and major ions in a suburbanizing watershed. American Geophysical Union Fall Conference, San Francisco, CA. December 2010.

- Daley, M.L. and McDowell, W.H. 2011. Declining nitrogen retention with increasing nitrogen inputs in the Lamprey and Oyster River watersheds. Annual Lamprey River Science Symposium. Durham, NH. January 2011.
- Daley, M.L., McDowell, W.H. and Bucci, J. 2011. Nitrogen inputs, outputs, retention and concentrations in watersheds of the Great Bay Estuary system. NH Water and Watershed Conference. Plymouth, NH. March 2011. Daley, M.L. 2011. Shared slides with Matt Liebman from the US EPA. March 2011.
- Davis, J.M., McDowell, W.H., Campbell, J.E., Hristov, A.N. 2010. Hydrological and biogeochemical investigation of an agricultural watershed, southeast New Hampshire, USA. American Geophysical Union Fall Conference, San Francisco, CA. December, 2010.
- Hope, A.J. and McDowell, W.H. Ecosystem Processes in a Piped Stream. Aquatic Sciences: Global Changes from Center to Edge. ASLO & NABS Joint Summer Meeting. Santa Fe, NM. June 2010.
- McDowell, W.H. 2010. Biogeochemistry of Suburban Basins – Putting People into the Landscape. Plymouth State University, April 2010.
- McDowell, W.H. 2010. Biogeochemistry of Suburban Basins – Putting People into the Landscape. Duke University, April, 2010.
- McDowell, W.H. 2010. Biogeochemistry of Suburban Basins – Putting People into the Landscape. Yale University, April 2010.
- McDowell, W.H. 2010. Nitrogen Impairment in a Suburban Basin: Can We Engineer a Solution? University of New Hampshire, September 2010.
- McDowell, W.H. 2010. Nitrogen Impairment in a suburban Basin: Can we engineer a solution? University of Connecticut, January 2011.
- McDowell, W.H. and Daley, M.L. 2011. Long-term water quality trends in the Lamprey River. Annual Lamprey River Science Symposium. Durham, NH. January 2010.

Press Releases

- Daley, M.L. 2010. “Scientists say time to cut nitrogen in estuary is now” by Aaron Sanborn asanborn@seacoastonline.com in <http://www.seacoastonline.com/> May 12, 2011.
- Daley, M.L. and McDowell, W.H. 2011. Nitrogen research at the NH Water Resources Research Center as it relates to the nitrogen impairment of Great Bay. Lee, NH Town Crier. January 2011.
- McDowell, W.H. 2010. “\$600K grant helps study nitrogen in estuary, bay” By Dave Choate dchoate@seacoastonline.com in <http://www.seacoastonline.com/> December 04, 2010.

McDowell, W.H. 2010. "Grant will seek pollution source in NH's Great Bay" by Associated Press in <http://www.bostonherald.com> December 6, 2010.

McDowell, W.H. 2010. "UNH's grant money may be a 'saving grace' for Great Bay" by Kristen Phelps in The New Hampshire (UNH newspaper) December 6, 2010.

McDowell, W.H. 2010. "New grant to address Great Bay's pollution 'hot spots'" on <http://www.fosters.com/> December 6, 2010.

Meetings Attended:

Daley, M.L. 2010 and 2011. Attended several of the Ecosystem Task Force meetings that occur monthly during the academic year at UNH. Durham, NH.

Daley, M.L. 2010 and 2011. Attended several of the PREP Technical Advisory Committee meetings that occur approximately bi-monthly in either Durham or Portsmouth, NH.

Daley, M.L. 2010. PREP Economic Valuation Study Meeting. NH Fish and Game Department, Durham, NH. December 2010.

McDowell, W.H. 2010. Attended a boat tour of Great Bay with NH DES and ME DEP commissioner and EPA Region 1 Representatives. September 2010.

McDowell, W.H. 2010. Attended meeting with BORWPP (Bellamy and Oyster River Protection Partnership). October 2010.

McDowell, W.H. 2010. Attended several of the Ecosystem Task Force meetings that occur monthly during the academic year at UNH. Durham, NH.

McDowell, W.H. 2010. PREP Monitoring Planning Review Committee. October 7, 2010.

McDowell, W.H. and Daley, M.L. 2010. Attended a cookout and field trip to Suncook River avulsion site with USGS staff, state representatives, scientists and other stakeholders interested in the Suncook River avulsion. July 2010.

McDowell, W.H. and Daley, M.L. 2011. Meet with Phil Trowbridge and Paul Currier from NH DES to discuss the Nitrogen Loading Model (NLM) that NH DES is developing. January 2011.