New Hampshire Water Resources Research Center

University of New Hampshire

Program Evaluation Report
Fiscal Years 2008 - 2010

Submitted by:

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To:

Office of External Research
Water Resources Discipline
U.S. Geological Survey

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Preface

The New Hampshire Water Resources Research Center receives an annual Federal matching grant as authorized by §104 of the Water Resources Research Act of 1984 (Public Law 98-242) as amended by Public Laws 101-397, 104-147, 106-374, and 109-471. §104 of the Act requires that the Secretary of the Interior "conduct a careful and detailed evaluation of each institute at least once every 3 years to determine that the quality and relevance of its water resources research and its effectiveness at producing measured results and applied water supply research as an institution for planning, conducting, and arranging for research warrants its continued support under this section." The U.S. Geological Survey (USGS), Department of the Interior, administers the provisions of the Act. This evaluation report describes, in the format prescribed by the USGS, the research, training, and information transfer activities supported by the §104 grants and required matching funds in fiscal years 2008 through 2010. Prior to 2008, the Act required an evaluation of the program at least once every 5 years. The last evaluation was conducted in 2007, covering fiscal years 2003 through 2007.

New Hampshire Water Resources Research Center
EVALUATION REPORT
FY 2008 - FY 2010

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Introduction

The New Hampshire Water Resources Research Center (NH WRRC), located on the campus of the University of New Hampshire, is an institute that serves as a focal point for research and information on water issues in the state. The NH WRRC actually predates the Federal program. In the late 1950s Professor Gordon Byers (now retired) began a Water Center at UNH. This Center was incorporated into the Federal program in 1965 as one of the original 14 state institutes established under the Water Resource Research Act of 1964. During this reporting period (FY2008-FY2010) the NH WRRC was directed by Dr. William McDowell with administrative and technical assistance from Michelle Daley (associate director) and Jody Potter (Water Quality Analysis Lab manager). Currently, Michelle Daley serves as the acting director.

The NH WRRC is a stand-alone organization, in that it is not directly affiliated with any other administrative unit at UNH. With the present director, it reports administratively to the Associate Dean for Research of the College of Life Sciences and Agriculture. The WRRC has an administrative office in Nesmith Hall on the UNH campus. The website (www.wrrc.unh.edu) serves as the focal point for information dissemination, and includes NH WRRC publications and results of past research, as well as links to other sites of interest to NH citizens and researchers.

The Water Resource Issues and Problems of New Hampshire

New Hampshire's surface waters are a very valuable resource, contributing to the state's economic base through tourism and recreation (fishing, boating, and swimming), enhanced real estate values and drinking water supplies. Maintaining sufficient water quality to support these uses is imperative to sustaining the state's economy and quality of life. New Hampshire is experiencing rapid growth in several counties and from 2000 to 2010 New Hampshire was the fastest growing state in New England with a state-wide average population increase of 6.5%. New Hampshire grew twice as fast as the entire northeast region during that 10 year period (Census 2010). New Hampshire watersheds rank among the most highly threatened watersheds in the nation because of the high potential for conversion of private forests to residential development. In fact, three of the four most threatened watersheds in the US which could experience the largest change in water quality as a result of increased residential development in private forests occur at least partially in New Hampshire (Stein et al. 2009).

A survey of NH water resource stakeholders was conducted in 1998 to get a sense of New Hampshire's most significant water resource problems and concerns and to develop a list of research priorities for the NH WRRC (Table 1). Almost all of the issues can be included into the broad category of Land Use and Water Quality. Similar results were obtained from the 2009 NH State Water Survey, which showed that 82% of those responding were very concerned or somewhat concerned about the effects of development on water quality, and 77% were concerned about potential contamination of aquifers and drinking water wells. This is not terribly surprising based on the rapid development and population pressures of the recent decades, particularly in southern areas of the state. The long-term effects of development and land use change are uncertain, with potential impacts on water quantity, in-stream flows, and water quality. Of particular concern are the impacts of non-point sources of pollution such as septic systems, urban runoff, stormwater, application of road salt and fertilizers, deforestation, and wetland conversion.

Table 1. NH WRRC research priority issues, based on a survey of stakeholders.

Surface Water

- Land use impact on surface water quality
- Non-point source pollution

- Effects of urban development and storm water runoff on surface water quality
- Impacts of highway and road maintenance on surface water quality
- Low flow wastewater flow interactions and effect on surface water quality
- Linking water quality data and biological functions
- Effect of septic systems on surface water quality

Groundwater

- Bedrock aquifer delineation and protection
- Mapping aquifers for GIS data base
- Effects of sand and gravel extraction, landfills or municipal transfer stations on groundwater quality
- Effects of septic systems on groundwater quality
- Groundwater availability
- Artificial recharge

Land Use/Application

- Impact of development/land use on surface and groundwater quality
- Biosolids in land farming
- Buffer zone/riparian zone effectiveness with different land use
- BMP effectiveness

Management/Planning Issues

- Impact of development
- Level of sustainable development

Watershed

- Watershed approach to management decisions
- Watershed approach to studying water quality
- Systems approach on a watershed scale to management: economic factors and quality of life
- Watershed resilience and ecosystem services

Technology Transfer

- Water quality and water use
- Water conservation education

Water Supply

- Quantity and quality issues
- Reliability and resilience
- Effects of climate change
- Planning and conservation
- Management, regulation and allocation
- Infrastructure improvement

Institute Mission and Vision: An Overview

The primary charges of each institute are: research, information transfer and education of new professionals. The institutes accomplish these charges through Federal and state funding mechanisms. Annually, the NH WRRC supports several research projects with its 104b funding, often hiring one or more students to help perform the research. Several lake and watershed monitoring groups have also been involved in research projects, allowing for an information exchange between researchers and the public. Recent research topics include: effects of suburban development on stream water and groundwater quality which includes long-term monitoring of rapidly developing NH basins, effects of development on lake water quality which includes a volunteer monitoring program for NH lakes, evaluating the efficiency of vegetated roofs to manage stormwater, determining the impact of coal tar based driveway sealant on water quality, understanding natural controls on the temporal variability of arsenic in groundwater, and various other aspects of water resources. A list of current and previous research projects can be found at our NH WRRC website (http://www.wrrc.unh.edu/research-projects). All research results are published and available online at the Center's website (http://www.wrrc.unh.edu/nh-wrrc-publications). Information and technology transfer also occur through phone conversations, public appearances, fact sheet development and press releases in local newspapers. WRRC staff make public presentations on watershed management, effects of suburbanization on water quality, and various aspects of water quality management. They also make presentations at national and international meetings on a variety of scientific topics.

The Water Quality Analysis Lab (WQAL) is affiliated with the NH WRRC and facilitates water resources research through technical assistance and sample analysis. The WQAL was established by the Department of Natural Resources in 1996 to meet the needs of various research and teaching projects both on and off the UNH campus. It is currently administered by the NH WRRC and housed in James Hall. The mission of the WQAL is to provide high-quality, reasonably priced analyses in support of research projects conducted by scientists and students from throughout the University, state, and nation. Past clients have included numerous research groups on the UNH campus, Federal and state agencies, scientists from other universities, and private firms. Many thousands of analyses are conducted each year.

To further encourage and support water resources research and education, the NH WRRC has led the development of a hydrologic observatory centered on the Lamprey River of southeastern NH. The entire Lamprey River basin is referred to as the Lamprey River Hydrologic Observatory (LRHO) and serves as a platform for research, student training, and community engagement and outreach. The LRHO captures many of the most important water issues facing the state including water withdrawals and transfers for public drinking water supply, wastewater disposal, numerous dams, low dissolved oxygen levels, arsenic contamination of groundwater, and pressures from rapid population growth and land use change. The LRHO contains lakes with high recreational value, discharges to the state's largest estuary (Great Bay) which is currently impaired by elevated nitrogen, and has both an active watershed association and local advisory committee.

The LRHO currently involves faculty, staff and students from the Department of Natural Resources & the Environment, the Department of Earth Science, the Department of Civil Engineering, the Climate Change Research Center, the Complex Systems Research Center and the Institute for the Study of Earth, Oceans, and Space at the University of New Hampshire. Research topics addressed as part of the LRHO include the hydrology, biology, biogeochemistry and management of a suburban basin. The NH WRRC has provided laboratory equipment and technical advice needed for various research projects and long-term monitoring of the Lamprey River. The NH WRRC also organizes annual symposia for LRHO researchers and local managers to promote information transfer. A small part of the annual 104b funding supports LRHO monitoring and the annual symposium. Other LRHO research is funded by a wide variety of state, University, and federal grants.

Section 104 Objectives

The primary emphasis of the 104b funding is water resources research and education of undergraduate and graduate students through support of research projects. Matching funds are also used to support research and education of students, but a large portion of the matching funds are used for information transfer. The NH WRRC research objectives are primarily dictated by the list of research priorities in table 1, but do vary based on the interests of the principle investigators applying for funding. Additional NH WRRC goals are to:

1. Plan, conduct or otherwise arrange for competent research that fosters:
    - ♦ Training and education of future water scientists, engineers and technicians
    - ♦ The preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena
    - ♦ The dissemination of research results to water managers and the public
2. Cooperate closely with other colleges and universities in the State that have demonstrated capabilities for research, information dissemination and graduate training

Allocation of Federal Grant and Matching Funds Among Program Activities: FY2008 through FY2010	
Activity	**Percent**
Research	41
Information Transfer	31
Education	19
Administration	9
Other (please specify)	0
Total	100

Administration and Coordination

Institute Directors during Evaluation Period

Name	Academic Discipline	Term
William H. McDowell	Biogeochemistry	Feb. 2000 - Aug. 2013
Michelle L. Daley	Biogeochemistry of suburban basins	Aug. 2013 - Present

Advisory Committees

During the 2008-2010 evaluation period our advisory/review committee was made up of Dr. Scott Bailey (USDA Forest Service), Dr. Stephen Jones (Marine Science Director, UNH Center for Marine Biology), Dr. Beth Boyer (Penn State University, Pennsylvania Water Resources Research Center Director) and Keith Robinson (U.S. Geological Survey). The committee was contacted on an individual basis for scientific peer review of proposals submitted for 104b funding and on as needed for program development and guidance.

In December 2010, we received the external panel evaluation of the 2003-2007 NH WRRC activities. Overall the evaluation was quite positive with the exception of the absence of an organized advisory committee. In 2011, we formed a formal organized advisory committee that is scheduled to meet twice a year with the director and associate director and members are asked to participate in person or via conference call (depending on travel availability). The first meeting is scheduled for late summer to review and comment on the annual NH WRRC request for 104b proposals (RFP) and the overall NH WRRC program. The second meeting is scheduled for late November/early December to discuss reviews of the submitted 104b proposals and to select proposals for inclusion in the annual NH WRRC section 104 proposal to the U.S. Geological Survey (USGS). A list of advisory committee members since 2011 is below:

- Keith Robinson, USGS, NH/VT Water Science Center, Director, 2011-Present
- Ted Diers, NH Dept. of Environmental Services, Water/Watershed Bureau Administrator, 2011-Present
- Alison Watts, University of New Hampshire, Assistant Research Professor, 2011-Present
- Jacquie Colburn, NH Dept. of Environmental Services, Water/Watershed Bureau Rivers and Lakes Coordinator, 2011-Present
- Dan Sundquist, Society for the Protection of New Hampshire Forests, Director of Land Conservation Planning, 2011-2013
- Matt Davis, University of New Hampshire, Associate Professor of Hydrogeology, 2011-Present

Research Proposal Review and Selection Process

The request for NH WRRC 104b proposals is distributed in late August/early September each year, with a submission deadline of mid-late October. Proposals are reviewed in November by non-conflicted members our advisory committee and additional subject matter experts as necessary based on the scientific research proposed. Each proposal receives at least 3 independent reviews critiquing the proposal for relevance to NH WRRC goals and state water resource issues, scientific merit, qualifications of the investigator(s), likelihood of success and the investigator's past record of publication and dissemination of results. The director and associate director meet with the advisory committee and any additional reviewers late November/early December to discuss the independent peer reviews and select proposals for inclusion in the annual NH WRRC

section 104 proposal. Proposal selections and written review summaries are shared anonymously with PIs in early December. Proposals selected for inclusion in the NH WRRC section 104 proposal are then revised as necessary in response to reviewer comments and the budgets are finalized, with final proposals due to the NH WRRC mid/late December.

Peer Review of Institute Publication

Institute manuscripts are reviewed by the director and associate director as well as subject matter experts (from the advisory committee and/or external scientists) prior to acceptance and posting on our website. Comments are made to the authors, who then make any necessary changes. Non-technical publications intended for local managers and decision makers are reviewed by Steve Miller (Great Bay National Estuarine Research Reserve), Charlie French (UNH Cooperative extension) and/or Chris Keely (NH Sea Grant).

Number of Principal Investigators Supported, by Rank and Year

Principal Investigators on Research Projects Supported by §104 Grants and Matching Funds, by Academic Rank and Year: FY2008 through FY2010			
Academic Rank	**2008**	**2009**	**2010**
Assistant Professor and below	2	1	2
Associate Professor	2	3	2
Professor	3	3	2
unknown	0	0	0
Total	7	7	6

Significant Impact

Awards

The Center's Director Dr. Bill McDowell was one of three professors appointed as a University of New Hampshire Presidential Char (2008-2018). The recipients of the University Presidential Chairs represent the high level of excellence for which UNH is known and further the University's efforts to attract and retain talented faculty. Presidential Chairs are a new way for UNH to recognize faculty members' many contributions and are awarded to full professors who have demonstrated the highest levels of excellence in teaching, scholarship, and service during an extended period of tenure at UNH.

Jeff Merriam, former WQAL manager, received the Distinguished Alumni award from the Department of Natural Resources & the Environment at the University of New Hampshire, Durham, NH. May 2009.

Several high-visibility national presentations have been made by the NH WRRC. They include:

McDowell, W.H. and M.L. Daley. 2008. Suburbanization and water quality in SE New Hampshire – The Lamprey River Hydrologic Observatory. Second Symposium on Urbanization and Stream Ecology, Salt Lake City, Utah, May 23, 2008.

Salisbury, J., J. Campbell, B. Jonsson, A. Mahadevan, D. Vandemark, C. Hunt, and W.H. McDowell. 2008. Spatial and temporal variability of the colored organic matter fluorescence - salinity relationship in plume waters and its relevance to remote sensing of coastal salinity and DOC. Ocean Sciences Meeting, American Society of Limnology and Oceanography, Orlando, FL March 2008.

Gregory, T.K, J.R. Morrison, M.G. Novak and B. McDowell. 2008. Progress in observing estuarine and coastal ocean processes with the Great Bay Coastal Buoy. Ocean Sciences Meeting, American Society of Limnology and Oceanography, Orlando, FL March 2008.

William H. McDowell, WRRC Director, was invited to speak at the University of Georgia (October 2009) and University of Reading, UK (November 2009), on "Biogeochemistry of a Suburban Basin: Putting People into the Landscape", a presentation based on WRRC research.

Jeffrey Schloss, PI for research project "Water Quality Change-Effects of Development in Selected Watersheds", was invited to speak at several state, national and international meetings on lake and riparian management.

Jennifer Jacobs, PI for research project "Urbanization Impacts on NH Streamwater Thermal Loading", was invited to give several seminars and speak at various meetings. Dr. Jacobs also received follow on funding for the grants listed below:

NSF ADVANCE (internal), 2009-2010: "Stormwater and Streams – Optimizing Stormwater Management to Protect the Thermal Regime in Streams." Co-PI. PI: A. Watts. $38,582.

USEPA, 2009-2012: "Temperature Regime Characteristics of High-Quality Coldwater Streams in New England." PI. $90,000.

NSF, 2008: "Understanding Hyporheic Zone Extent and Exchange in a Coastal New Hampshire Stream Using Heat as a Tracer." (LIDAR Aircraft Flight Time). PI.

Dr. Kahl, co-PI PI for information transfer project “Public information digests in support of the UNH Stormwater Center and the NH Stormwater Commission” received the following follow on funding: DEP and the Bangor Area Stormwater Group, a muni organization: ‘Feasibiilty Study for stormwater management funding options’ to Steve Kahl and LaMarr Clannon, James Sewall Company, 136 Center St, Old Town, ME 04468. $16,500.

Doogan, C. (M.S. Student partially supported by 2008 research project: “The role of landscape controls on stream chemistry variability and inorganic aluminum mobilization in the White Mountains of New Hampshire”) received the Joe and Gail White Graduate Fellowship (an environmental education fellowship) to assist in the completion of Doogan’s Master’s program.

In 2009, a conference focused on the Lamprey River watershed (titled "Your Water, Your Wallet, Your Watershed - Why Working Together Across Town Boundaries Makes $ense For Protecting Our Water") was co-sponsored by the NH WRRC. The 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). Until recently, the Lamprey only had 17.5 km (in Durham and Lee, NH) of the 78 km mainstem reach designated into the NH RMPP. Following the 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 captured 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 NH State Rivers Management 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. The NH State Rivers Management Committee voted to approve the nomination and the resulting House Bill passed in both the House and the Senate in 2011. The Governor signed this Bill into law on June 7, 2011. A watershed wide local advisory committee has now been formed with representatives from each of the 14 towns. This designation will give the Lamprey watershed preferential eligibility over non-designated rivers for state funding and technical resources. 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 of outreach efforts made by the NH WRRC and other organizations and individuals. This outcome is one that the NH WRRC is very proud of.

Results from long-term water quality monitoring in the LHRO supported by the project “Water Quality and the Landscape: Long-term monitoring of rapidly developing suburban watersheds” have helped leverage funding for additional research on nitrogen cycling in NH’s coastal watersheds. Because of the significant interest in nitrogen loading to the impaired Great Bay estuary, existing information on the spatial and temporal variability of nitrogen concentrations in the LRHO that are driven by population growth and land use change and the relationships that the NH WRRC has formed with various stakeholders in NH, the NH WRRC faculty and staff received a $600,000 grant from NOAA and the National Estuarine Research Reserve System (NERRS) in 2010. The grant is a collaborative science project to study nitrogen sources and transport pathways in watersheds of the Great Bay estuarine system. The project involves a significant amount of integration and collaboration with local stakeholders throughout the entire research process to ensure that the scientific results will be useful to local managers and decision makers. This new project complements the information transfer goals of the NH WRRC.

Research, Information Transfer, and Education

As part of the 2003NH21B "**Water Quality and the Landscape: Long-term monitoring of rapidly developing suburban watersheds**" project, the NH WRRC has collected long-term water quality data on a rapidly developing suburban watershed in southeastern NH, the Lamprey River watershed. Several towns in the watershed are investigating new water supplies to support the increased demand for water with the growing human population and monitoring data from this project have been useful in the water supply decision making process. For example, Newmarket, NH's surface water treatment plant was shut down in recent years because the quality of the treated water did not meet federal standards for public water supplies. Known carcinogens (trihalomethanes) were produced during the disinfection process because of the high amounts of wetland derived dissolved organic carbon (DOC) in the river that the water supply relied on (a tributary to the Lamprey River). Newmarket contracted with Emery & Garrett Groundwater, Inc (EGGI) to increase their town water supply and EGGI 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 (particularly DOC) made it appropriate for artificial recharge for public water supply. The town of Newmarket is still working towards approval for this project, but the long-term dataset provided by the NH WRRC has been instrumental in this water supply process.

The objectives of the 2010NH128B project "**Hydrologic and Isotopic Investigation of Base Flow Generation in the Headwaters Lamprey River Watershed**" was to use natural environmental tracers (water isotopes (2H and 18O), silica and organic carbon) combined with hydrometric measurements to assess the fraction of baseflow generated by groundwater and surface water in the headwaters of the Lamprey River watershed. End-member mixing analysis showed that groundwater provided 18-30% (<50% at 95% confidence) of the direct volumetric discharge from the Lamprey River headwaters. The remainder of streamflow was derived from an upstream wetland reservoir. An isotopic mass balance model for the wetland confirmed that groundwater inflows were <35% of total surface discharge and that most streamflow leaving the wetland was likely the result of a loss from surface storage. This study reveals that wetlands in the region may provide critical water supplies needed to meet water resource demands, especially as the climate changes and we experience greater seasonality. Because of the small fraction of groundwater contribution to summer baseflow, this study suggests that groundwater extractions for water supply may have limited impact on the streamflow leaving the Lamprey headwaters. Understanding the sources of baseflow greatly improves our ability to manage watersheds and insure sustained water supply and water quality in the face of ongoing environmental change. Furthermore, data from this project will be used to validate a priori estimates of impounded reach (wetland, ponds, and lakes) mixing processes as a chapter of a PhD dissertation (Shan Zuidema, Earth & Environmental Science, University of New Hampshire).

In addition to facilitating increased public water supplies, the NH WRRC has also helped identify water quality impairments in private wells within the Lamprey River watershed. The water quality of private wells is not regulated even though they supply 40% of the NH population. Results from a Master's student's thesis indicated that out of 188 private wells sampled, 21% exceeded the EPA maximum contaminant level for either nitrate (10 mg N/L), arsenic (10 µg/L), lead (15 µg/L) or uranium (30 µg/L). These results suggest that the uninformed private well user is at risk of consuming contaminated drinking water.

Budget Information

104 Program Federal and Required Matching Funds

Total Federal and Required Matching Funds Available to the New Hampshire Water Resources Research Center under §104 of the Water Resources Research Act of 1984

	2008	2009	2010	Total Federal	Total Match	Total Funds
104(b) Total Federal	$92,335	$92,335	$92,335	$277,005	X	X
104(b) Total Match	$185,155	$184,670	$184,670	X	$554,495	X
104(b) Total Funds	$277,490	$277,005	$277,005	X	X	$831,500
104(g) Total Federal	$0	$0	$0	$0	X	X
104(g) Total Match	$0	$0	$0	X	$0	X
104(g) Total Funds	$0	$0	$0	X	X	$0
Total	$277,490	$277,005	$277,005	$277,005	$554,495	$831,500

Discretionary Base Funding

Appropriated or Other Discretionary Funds Available to the Institute: FY2008 through FY2010			
Source of Discretionary Funds	**2008**	**2009**	**2010**

Other Water Resources Research Funding

Total and Average Value of Water Resources Grants, Contracts, and Cooperative Agreements in Which the Institute Had a Major Role During the Evaluation Period: FY2008 through FY2010	
Total Value of Awards, in dollars	$5,599,944
Number of Awards	20
Average Value of Awards	$279,997

Please list in the table below the 10 largest grants (other than section 104 grants), contracts, and cooperative agreements for which the Director or staff of the institute played a major role in assembling the proposal or otherwise obtaining the grant or contract. Include the dollar amount of the contract, grant, or cooperative agreement, the year that it was initiated, and the source of the funds. USGS-Water Resources Research Institute Internships and funds from other federal agencies passed through to your institute by the USGS should be included here.

The Ten Largest Water Resources Grants, Contracts, and Cooperative Agreements in Which the Institute Had a Major Role during the Period of the Evaluation: FY2008 through FY2010			
Title/Topic	**Source of Fundings**	**Year Initiated**	**Amount**
Assessing the Effectiveness of the Clean Air Act	EPA ORD	2006-2011	$1,006,087
Luquillo LTER Program 4: Understanding Change in the Ecosystems of Northeastern Puerto Rico", $376,000	NSF LTER, DEB-0620919	2006-2012	$376,000

(subcontract from University of Puerto Rico)			
Watershed Assessment of the New Boston Air Force Station	DOD USAF	2007-2009	$126,213
UNH Organic Dairy Farm Agroecosystem Study (w/J. Aber, PI)	USDA Northeastern SARE	2008-2011	$379,087
OPUS: Synthesis of 25 yrs of data on the biogeochemistry of a tropical rainforest	NSF Ecosystems – DEB 0816727	2008-2011	$150,000
Administration of the Northern States Research Cooperative (w/J. Aber, PI)	USDA	2008-2013	$797,046
Administration of the Northern States Research Cooperative (w/J. Aber, PI)	USDA	2009-2014	$797,046
CZO: Luquillo Critical Zone Observatory	NSF EAR – EAR 0722476	2009-2014	$225,000
Nitrogen Sources and Transport Pathways: Science and Management Collaboration to Reduce Nitrogen Loads in the Great Bay Estuarine Ecosystem	NOAA NERR	2010-2014	$599,701
Administration of the Northern States Research Cooperative	USDA	2010-2015	$797,000

Research

Summary of Research Projects

Number of Research Projects and Percentage of Research Funds, by Research Category: FY 2008 through FY 2010		
Research Category	**Number**	**Percent of Funds**
Biological Sciences	0	0
Climate and Hydrologic Processes	3	13
Ecological Processes	0	0
Engineering	0	0
Ground-water Flow and Transport	0	0
Social Sciences	0	0
Water Quality	10	87
Not Applicable	3	0

Research Projects

Project Number	Title	PI	Total budget
2008NH87B	Urbanization Impacts on NH Streamwater Thermal Loading	Jennifer Jacobs	$45,784
2008NH90B	The role of landscape controls on stream chemistry variability and inorganic aluminum mobilization in the White Mountains of New Hampshire.	Kevin McGuire	$60,530
2003NH21B	Water Quality and the Landscape: Long-term monitoring of rapidly developing suburban watersheds	William McDowell	$58,663
2006NH60B	Water Quality Change-Effects of Development in Selected Watersheds	Jeffrey Schloss	$20,556
2006NH86S	Grant--Determining the Effectiveness of the Clean Air Act and Amendments for the Recovery of Surface Waters in the Northeastern U.S.	Steve Kahl	$0
2007NH102S	Grant--Watershed Assessment of New Boston Air Force Base	William McDowell	$0
2008NH87B	Urbanization Impacts on NH Streamwater Thermal Loading	Jennifer Jacobs	$49,675
2003NH21B	Water Quality and the Landscape: Long-term monitoring of rapidly developing suburban watersheds	William McDowell	$57,820
2006NH60B	Water Quality Change-Effects of Development in Selected Watersheds	Jeffrey Schloss	$23,584
2009NH117B	A pilot study of septic impacts on water quality using Boron concentrations and isotopes as a source tracer	Jeffrey Schloss	$84,719
2006NH86S	Grant--Determining the Effectiveness of the Clean Air Act and Amendments for the Recovery of Surface Waters in the Northeastern U.S.	Steve Kahl	$0
2007NH102S	Grant--Watershed Assessment of New Boston Air Force Base		$0

		William McDowell	
2003NH21B	Water Quality and the Landscape: Long-term monitoring of rapidly developing suburban watersheds	William McDowell	$75,090
2006NH60B	Water Quality Change-Effects of Development in Selected Watersheds	Jeffrey Schloss	$19,203
2010NH128B	Hydrologic and Isotopic Investigation of Base Flow Generation in the Headwaters Lamprey River Watershed	John Davis	$74,449
2006NH86S	Grant--Determining the Effectiveness of the Clean Air Act and Amendments for the Recovery of Surface Waters in the Northeastern U.S.	Steve Kahl	$0

Research Publications

Craycraft, R. and J.A. Schloss, 2008, New Hampshire Lakes Lay Monitoring Program Yearly Report 2007. 35 individual lake reports. UNH Center for Freshwater Biology. University of New Hampshire, Durham, NH.

Craycraft, R. and J.A. Schloss, 2009, "Mendum's Pond Watershed Study Final Report" submitted to the NH DES and the Al Wood Road Association (February 2009).

Craycraft, R. and J.A. Schloss, 2009, New Hampshire Lakes Lay Monitoring Program Yearly Report 2008. 28 individual lake reports. UNH Center for Freshwater Biology. University of New Hampshire, Durham, NH. 18 to 160 pages each.

Craycraft, R. and J.A. Schloss, 2009, Newfound Watershed Assessment Project 2007 and 2008. Special report in fulfillment for the NH DES 319 Watershed Assistance Grant. UNH Center for Freshwater Biology. University of New Hampshire, Durham, NH. 170 pages.

Craycraft, R. and J.A. Schloss, 2009, Newfound Lake Watershed Assessment Project Quality Assurance Project Plan Amendment for 2010 Sampling Program. UNH Center for Freshwater Biology. University of New Hampshire, Durham, NH. 28 pages.

Daley, M.L., J.D. Potter and W.H. McDowell, 2009, Salinization of urbanizing New Hampshire streams and groundwater: impacts of road salt and hydrologic variability. Journal of the North American Benthological Society. 28(4):929–940.

Daley, M.L. and W.H. McDowell, 2009, Nitrogen Saturation in Highly Retentive Watersheds? American Geophysical Union Fall Conference, San Francisco, CA. December, 2009.

DiFranco, E, 2009, Spatial and temporal trends of dissolved nitrous oxide in the Lamprey River watershed and controls on the end-products of denitrification. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 108 pages.

Kahl, J.S., 2009, Changes in base cations related to long-term changes in Cl distribution in northeastern lakes. Gordon Research Conference, Forested Catchments, July 12-17, 2009, Proctor Academy, NH.

Lemay, G. and J.M. Jacobs, 2009, "Impacts of Culverts and Impervious Areas on Stream Temperature in Coastal NH Streams" North Atlantic Chapter of the Society for Environmental Toxicology and Chemistry Annual Conference, June 10-12, 2009, Durham, NH.

Wilderman, S.E., 2009, Contributions of Groundwater Seepage to the Water and Nutrient Budget of Mendums Pond Barrington, New Hampshire. Master's Thesis. University of New Hampshire. Durham, NH. May 2009.

Craycraft, R. and J.A. Schloss, 2010, New Hampshire Lakes Lay Monitoring Program Yearly Report 2009, 27 individual lake reports, UNH Center for Freshwater Biology, University of New Hampshire, Durham, NH. 18 to 160 pages each.

Craycraft, R. and J.A. Schloss, 2010, Newfound Lake Watershed Assessment Project Quality Assurance Project Plan Amendment Sampling Program, UNH Center for Freshwater Biology, University of New Hampshire, Durham, NH. 20pp. (approved 3/8/2010)

Craycraft, R. and J.A. Schloss, 2010, Acton/Wakefield Watershed Alliance Quality Assurance Project Plan Amendment, UNH Center for Freshwater Biology, University of New Hampshire, Durham, NH, 77 pp. (approved 3/10/2010)

Craycraft, R. and J.A. Schloss, 2010, Newfound Lake Culvert Assessment and Site Specific Project Plan, UNH Center for Freshwater Biology, University of New Hampshire, Durham, NH, 16pp. (approved 8/18/2010)

Craycraft, R. and J.A. Schloss, 2010, New Hampshire Center for Freshwater Biology and Lakes Lay Monitoring Programmatic Quality Assurance Project Plan, UNH Center for Freshwater Biology, University of New Hampshire, Durham, NH, 80 pp. (approved 10/20/2010)

Craycraft, R. and J.A. Schloss, 2010, Mirror Lake Water Quality Site Specific Project Plan, UNH Center for Freshwater Biology, University of New Hampshire, Durham, NH, 14 pp. (approved 11/9/2010)

Daley, M.L. and W.H. McDowell, 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.

Davis, J.M., W.H. McDowell, J.E. Campbell and A.N. Hristov, 2010, Hydrological and biogeochemical investigation of an agricultural watershed, southeast New Hampshire, USA, American Geophysical Union Fall Conference, San Francisco, CA, December, 2010.

Doogan, C.B., 2010, Landscape Controls on Stream Chemistry Variability in the Hubbard Brook Experimental Forest and White Mountains of New Hampshire. M.S. Dissertation, Plymouth State University. Plymouth, NH. 128 pages.

Dunlap, K., 2010, Seasonal Nitrate Dynamics in an Agriculturally Influenced NH Headwater Stream, M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 102 pages.

Galvin, M., 2010, Hydrologic and nutrient dynamics in an agriculturally influenced New England floodplain, M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 94 pages.

Harvey, R., 2010, Pharmaceuticals and Personal Care Products in the Environment Master's Thesis. Plymouth State University Center for the Environment, Plymouth, NH, 93pp.

Jacobs, J.M., T. Richard, and R. Abele, 2010, Summer Water Temperatures in NH and MA Coldwater Streams. New England Association of Environmental Biologists Conference. March 17-19. Newport, Rhode Island.

Jacobs, J.M., D. Truslow, and G. Lemay. 2010. Multi-Scale Influences of Groundwater Discharge and Hyporheic Exchange on the Temperature of Two New England Streams: Experimental results using Fiber Optic Distributed Temperature Sensing. AGU, Fall Meeting Suppl., Abstract H31D-1029.

Lemay, G. 2010. Stream Temperature Impacts of Culverts and Impervious Areas. Department of Civil Engineering, University of New Hampshire. Master's Thesis. 162 pages.

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Norton, S., I. Fernandez, J.S. Kahl, L. Rustad, T. Navratil and H. Almquist, 2010, The evolution of the science of Bear Brook Watershed in Maine, USA. Environmental Monitoring and Assessment, 171(1-4): 3-21.

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Torgersen, C.E., G.E. Likens, D.C. Buso, K.J. McGuire and W.H. Lowe, 2010, Linking network patterns and processes of streamwater chemistry across scales in Hubbard Brook Valley, Joint Meeting of the North American Benthological Society and the American Society of Oceanography and Limnology, June 6-11, 2010, Santa Fe, NM.

Truslow, D.B. and J.M. Jacobs. 2010. Using Stream Heat Budgets to Quantify Groundwater Discharge and Hyporheic Exchange. 2010 Ground Water Summit and 2010 Ground Water Protection Council Spring Meeting. April 11-15, 2010, Denver, Colorado.

Jacobs, J.M., D. Truslow, and G. Lemay, 2011, Multi-Scale Stream Temperature Measurements using Fiber Optic Distributed Temperature Sensing (FO DTS): Observations in Two New England Streams. New England Association of Environmental Biologists Conference. March 16-18, 2011, Sturbridge, Massachusetts.

Zuidema, S., 2011, Identifying groundwater contributions to baseflow in a temperate headwater catchment, M.S. Thesis, University of New Hampshire, Durham, NH.

Daley, M.L. and W.H. McDowell. In Preparation. Human impacts on stream nitrogen chemistry and watershed N retention across a wide range of rural to urban catchments. For Ecosystems.

Davis, J.M., Frades, M.C., Zuidema, S., Bryce, J.G. In Preparation. Hydrologic interpretation of river water isotopes in temperate coastal watersheds. For Journal of Hydrology.

Liptzin, D., McDowell, W.H., M.L. Daley, B. Sive and R. Talbot. In Preparation. Factors controlling atmospheric deposition at a coastal suburban site. For Journal of Geophysical Research Atmospheres.

Information Transfer

Project Number	Title	PI	Total budget
2008NH97B	New Hampshire WRRC Information Transfer	William McDowell	$55,923
2008NH97B	New Hampshire WRRC Information Transfer	William McDowell	$40,096
2008NH97B	New Hampshire WRRC Information Transfer	William McDowell	$40,069
2010NH131B	Public information digests in support of the UNH Stormwater Center and the NH Stormwater Commission	Robert Roseen	$47,101

Audio-Visual Productions

Several PowerPoint presentations have been produced and delivered to various local watershed and lake associations, town planners, managers and conservation members and the general public using NH WRRC funding. PowerPoint presentations that focus on the Lamprey River Hydrologic Observatory (LRHO) are posted on the LRHO website under the Annual Symposium (http://www.wrrc.unh.edu/lamprey-river-symposium) and Outreach links.

Newsletter

The NH WRRC did not produce a newsletter during the 2008-2010 evaluation period. Instead we relied on our website to disseminate information and the website is updated frequently to include items of interest to the public and researchers. The NH WRRC has also contributed to various press releases published in local newspapers, town newsletters and on NH Public Radio.

Conferences

Lead Sponsor

The NH WRRC is the lead sponsor of the **Annual Lamprey River Symposium**. The NH WRRC Information Transfer project provided salary for the NH WRRC associate director to organize the symposium and provided support for room fees, light refreshments and printing materials. The goal of the Annual Lamprey River Symposium is to facilitate discussion and collaboration between scientists and students working in the LRHO and to engage state & local officials, watershed organizations, and concerned citizens with the science and its implications for Great Bay and the entire coastal watershed. Presentations typically focus on water quality, hydrology, flooding, stormwater, nitrogen cycling in coastal New Hampshire and future climate and land use change effects on water quality and quantity. The annual symposium attracts approximately 90 attendees, including scientists, regional leaders, town officials, state legislators, members of state agencies, and federal agencies. The symposium is held in January on the University of New Hampshire campus. The agenda and presentations are posted on the NH WRRC website at: http://www.wrrc.unh.edu/lamprey-river-symposium. Feedback from participant evaluations of the symposium is used to make improvements to the annual event.

Cosponsor

The NH WRRC Information Transfer project provided salary for the NH WRRC Director and Acting Director to help organize and co-sponsor the various conferences and seminars below.

2008 Annual NH Water Conference (April 2008, in Concord, NH)
The conference drew over 150 people, including researchers, legislators, water system operators, land use planners, and government officials. The conference theme was the Integration between Science, Policy, and Management in the State. The current knowledge of the quality, quantity and use of water was examined through talks and sessions on the current conditions of New Hampshire's water resources, water demand trends and flood forecasting, planning and response. The day closed with a panel discussion on Developing a State Water Council.

2008 Annual NH Watershed Conference (November 2008, Concord, NH)

The conference drew approximately over 150 people including researchers, legislators, water system operators, land use planners, and government officials. The conference contained 6 tracks including organizational development, effecting change, tech time, managing our watersheds, ecology and the GIS track which was facilitated solely by the UNH cooperative extension and the NH WRRC.
http://des.nh.gov/media/pr/documents/081015.pdf

Your Water, Your Wallet, Your Watershed - Why Working Together Across Town Boundaries Makes $ense For Protecting Our Water (June 2009, Nottingham, NH)

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 this 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 held in Nottingham, NH on Saturday June 13, 2009 and drew over 70 people including teachers, legislators, town officials, regional leaders and government officials. http://www.wrrc.unh.edu/outreach-0

NH Water and Watershed Conference (November 2009, Concord, NH)

In 2009, the organizing committees of the annual New Hampshire Water Conference and the annual New Hampshire Watershed Conference joined forces to offer a single, comprehensive event: the "Joint NH Water and Watershed Conference". The merger combined the talent, resources, and audiences from both events into 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. This conference provided a state-wide forum for learning and networking about issues related to water resources in New Hampshire and drew over 200 people, including researchers, legislators, water system operators, land use planners, and government officials. The NH WRRC participated on the organizing committee and co-Sponsored this conference which occurred on November 20-21, 2009 in Concord, NH. The conference contained 6 tracks each day including stormwater, climate change, water infrastructure, organizational development, watershed management, land use/ land conservation and a GIS track that was facilitated solely by the UNH cooperative extension and the NH WRRC.
http://des.nh.gov/organization/divisions/water/wmb/rivers/watershed_conference/proceedings.htm

Road Less Salted (May 2010, Greenland, NH)

The "Road Less Salted" water quality and salt reduction seminar was held on May 13, 2010 as a follow-up activity to the 2009 conference "Your Water, Your Wallet, Your Watershed - Why Working Together Across

Town Boundaries Makes $ense For Protecting Our Water" (see awards section). Other sponsors included the NH Department of Environmental Services, GBNERR Coastal Training Program, LRAC, LRWA 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. http://www.wrrc.unh.edu/outreach-0

The NH WRRC co-sponsored a monthly **seminar series in 2010 on water issues in New Hampshire** along with the USGS and the Department of Natural Resources at UNH. 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.

Internet Services

The official Web site of the New Hampshire Water Resources Research Center, hosted by University of New Hampshire, appears at http://www.wrrc.unh.edu.

Information Transfer Publications

IT Publication Type	IT Publication Citation
Conference Proceedings	Daley, M.L., 2009, Nitrogen Sources and Retention within the Lamprey River Watershed and Implications for Management. State of the Estuaries Conference. Somersworth, NH. October 2009.
Other Publications	Daley, M.L., J.D. Potter and W.H. McDowell, 2010, Nitrogen Assessment for the Lamprey River Watershed, Report prepared for the New Hampshire Department of Environmental Services. http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/unh_nitrogenassessment.pdf
Other Publications	Roseen, R. and J.S. Kahl, May 10 2011, NH Stormwater Commission Final Report. NH Water Resources Research Center, University of New Hampshire, Durham, NH, 9 pages.
Other Publications	Roseen, R. and J.S. Kahl, April 2011, Stormwater Commission Summary Fact Sheet, NH Water Resources Research Center, University of New Hampshire, Durham, NH, 1 page.
Other Publications	Roseen, R. and J.S. Kahl, April 2011, Winter Maintenance Fact Sheet, NH Water Resources Research Center, University of New Hampshire, Durham, NH, 1 page.
Other Publications	Roseen, R. and J.S. Kahl, April 2011, Thermal Impacts of Stormwater BMPs Fact Sheet, NH Water Resources Research Center, University of New Hampshire, Durham, NH, 2 pages.
Other Publications	Roseen, R. and J.S. Kahl, April 2011, Greenland Meadows LID Case Study: Economics, NH Water Resources Research Center, University of New Hampshire, Durham, NH, 4 pages.
Other Publications	Roseen, R. and J.S. Kahl, April 2011, Greenland Meadows LID Case Study: Water Quality, NH Water Resources Research Center, University of New Hampshire, Durham, NH, 4 pages.
Other Publications	Roseen, R. and J.S. Kahl, April 2011, Boulder Hills LID Case Study: Economics, NH Water Resources Research Center, University of New Hampshire, Durham, NH, 4 pages.

Education

Number of students supported by base-level grants				
Educational Level	**2008**	**2009**	**2010**	**Total**
Undergraduate	14	13	14	41
Masters	8	12	8	28
Ph.D.	1	1	1	3
Post-Doc.	0	0	0	0
Total	23	26	23	72

Theses and Dissertations

Number of Theses and Dissertations Resulting from Student Support: FY2008 through FY2010	
Master's Theses	7
Ph.D. Dissertations	0

Student Grants-in-Aid and Summer Fellowships

Additional Information for the Evaluation Panel

Attachments

Attachment A: Individual Project Descriptions

'Urbanization Imp ...': 2008NH87B Research Description

Title	Urbanization Impacts on NH Streamwater Thermal Loading
Project Number	2008NH87B
Start Date	3/1/2008
End Date	2/28/2010
Research Category	Water Quality
Focus Categories	Surface Water; Non Point Pollution; Water Quality
Principal Investigators	Jennifer Jacobs; Thomas Ballestero; Robert Roseen

The goal of the proposed research is to quantify the impact of urbanization on NH stream water temperature. We propose to 1) augment existing datasets from the UNH Stormwater Center s (UNHSC) stream temperature and conductivity monitoring locations. The methodology s target domain is headwater (primarily first order) streams in New England Coastal streams. For this project, there are four existing sites that are currently being monitored and an additional six sites will be identified and instrumented. 2) We will compare the magnitude and timing of heat input upstream and downstream of road crossings and impervious areas. 3) We will characterize the thermal loadings and concentrations longitudinally downstream of the source using a One-Dimensional Solute Transport with Inflow and Storage (OTIS) model. The model will be calibrated using continuous temperature measurements and fiber optic distributed temperature sensing (FO-DTS). The research results will determine if and when road crossings and impervious areas elevate background levels of temperature and the longitudinal extent of the impact. Recognizing that stormwater is managed using a variety of strategies and systems, the proposed research will characterize the thermal input to such stormwater facilities.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2008	$15,238	$30,546

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate	3	
Masters	3	
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Jacobs, J.M., T. Richard, and R. Abele. 2010. Summer Water Temperatures in NH and MA Coldwater Streams. New England Association of Environmental Biologists Conference. March 17-19. Newport, Rhode Island.

Awards and Achievements

[None reported in IPRS.]

Title	The role of landscape controls on stream chemistry variability and inorganic aluminum mobilization in the White Mountains of New Hampshire.
Project Number	2008NH90B
Start Date	3/1/2008
End Date	2/28/2009
Research Category	Water Quality
Focus Categories	Hydrogeochemistry; Acid Deposition; Surface Water
Principal Investigators	Kevin McGuire; Scott Bailey; Christian Doogan; Robert Estabrook; Steve Kahl

Surface waters in the White Mountain region of New Hampshire largely emanate from headwaters dominated by shallow soils and short water residence time. Aluminum mobilization associated with these conditions has been a concern due to impacts on aquatic organisms and habitat. Even though some reduction in aluminum concentrations have been observed for surface waters in a few well-studied experimental watersheds, the extent of impacted systems in the White Mountain region remains unknown, especially with regards to aluminum species considered to be most toxic (e.g., inorganic monomeric aluminum). The goal of this study is to develop a regional assessment of the extent of toxic aluminum mobilization and predict stream chemistry variability at the landscape scale using easily measured watershed features such as basin size and topographic indices as an organizing framework. We will develop a new comprehensive regional dataset that can be used to address the extent and distribution stream chemistry, scale-related structure of water chemistry, and landscape controls on aluminum mobilization and speciation. Sites for additional monitoring will be objectively identified through a meta-analysis of existing data in the White Mountain region. Expected results include a model capable of predicting the spatial distribution of water chemistry within a stream network using map information and downstream sample locations and an overall improved understanding of how landscape attributes affect stream chemistry within the White Mountains. These results will allow for better management of aquatic habitat, assessment and design of mitigation for land management impacts (e.g. timber harvesting) and appreciation of natural controls on stream chemistry across the landscape as systems are in the process of recovery from anthropogenic acid deposition impacts. While toxic aluminum mobilization addresses an important water quality issue in this and other similar regions, knowledge gained from networking watersheds of varying scale and landscape attributes will be applicable to a wide range of hydrologic and hydrochemical issues.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2008	$19,569	$40,961

Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	1	
Masters	1	1
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**

	Doogan, C.B., in preparation. Using terrain indices to explore controls on stream chemistry variation and inorganic aluminum mobilization in the Hubbard Brook Experimental Forest and White Mountains of New Hampshire, M.S. Thesis, Plymouth State University, Plymouth, NH.

Awards and Achievements

[None reported in IPRS.]

Title	New Hampshire WRRC Information Transfer
Project Number	2008NH97B
Start Date	3/1/2008
End Date	2/28/2009
Research Category	Water Quality
Focus Categories	Nitrate Contamination; Non Point Pollution; Water Quality
Principal Investigators	William McDowell

This project will provide salary for the Center's Director and Associate Director as they meet with state representatives, local town officials, watershed groups, scientists and the general public to discuss the research findings from the Lamprey River Watershed Hydrologic Observatory and other issues related to water quality in New Hampshire and the region. Salary for website maintenance is also included.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2008	$30,797	$25,126

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate		
Masters		
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Baillio, J. 2012. 2012. Controls on variability of dissolved greenhouse gas concentration and emissions from small streams in southeastern New Hampshire. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 111 pages.
	Daley, M.L. and W.H. McDowell, In Preparation, Human impacts on stream nitrogen chemistry and watershed N retention across a wide range of rural to urban catchments, Ecological Applications.
	Hope, A.J., W.H. McDowell, W.M. Wollheim, Submitted, Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream, Biogeochemistry.
	Liptzin, D., M.L. Daley, and W.H. McDowell. Accepted. A comparison of wet deposition collectors at a coastal rural site. Submitted to Water, Air, & Soil Pollution. April 2013.
	Parham, L. 2012. Spatial and temporal variation in degradation of dissolved organic carbon on the main stem of the Lamprey River. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 66 pages.

Awards and Achievements

[None reported in IPRS.]

Title	Water Quality and the Landscape: Long-term monitoring of rapidly developing suburban watersheds
Project Number	2003NH21B
Start Date	3/1/2003
End Date	2/28/2009
Research Category	Water Quality
Focus Categories	Non Point Pollution; Surface Water; Nutrients
Principal Investigators	William McDowell

The proposed work will continue documentation of long-term changes to water quality in response to changing land use and management practices as a result of population growth. There are several components to this project, drawing from the efforts of local watershed monitoring groups, as well as on-going research projects by UNH staff and students, all leading to long-term datasets of water quality in New Hampshire. These datasets can be used to assess the impacts of human development, land use changes and management practices in rapidly growing areas of the state and New England. Further, these data could be used to test and refine water quality models and aid in the development of best management practices and restoration efforts across the state and region.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2008	$8,133	$50,530

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate	3	
Masters	3	
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	Daley, M.L., J.D. Potter, W.H. McDowell. 2009. Salinization of urbanizing New Hampshire streams and groundwater: Impacts of road salt and hydrologic variability. Journal of the North American Benthological Society, submitted.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	Daley, M.L., J.D. Potter and W.H. McDowell. 2009. Salinization of urbanizing New Hampshire streams and groundwater: impacts of road salt and hydrologic variability. Journal of the North

	American Benthological Society 28(4):929-940.
	DiFranco, E. 2009. Spatial and temporal trends of dissolved nitrous oxide in the Lamprey River watershed and controls on the end-products of denitrification. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 108 pages.
	Daley, M.L. and W.H. McDowell. In Preparation. Nitrogen saturation in highly retentive coastal urbanizing watersheds. Ecosystems.
	Daley, M.L. 2009. Nitrogen Sources and Retention within the Lamprey River Watershed and Implications for Management. State of the Estuaries Conference. Somersworth, NH. October 2009.
	Daley, M.L. 2009. Water Quality of Private Wells in Suburban NH and Impacts of Land Use. Northeast Private Well Symposium. Portland, ME. November, 2009.
	Daley, M.L. 2009. Spatial and Temporal variability in nitrogen concentrations, export and retention in the Lamprey River watershed. Joint NH Water and Watershed Conference. Concord, NH. November, 2009.
	Daley, M.L. and W.H. McDowell. 2009. Nitrogen Saturation in Highly Retentive Watersheds? American Geophysical Union Fall Conference, San Francisco, CA. December, 2009.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	Daley, M.L., J.D. Potter and W.H. McDowell, 2010, Nitrogen Assessment for the Lamprey River Watershed, Report prepared for the New Hampshire Department of Environmental Services. http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/unh_nitrogenassessment.pdf
	Dunlap, K, 2010, Seasonal Nitrate Dynamics in an Agriculturally Influenced NH Headwater Stream, M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 102 pages.
	Galvin, M, 2010, Hydrologic and nutrient dynamics in an agriculturally influenced New England floodplain, M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 94 pages.
	Daley, M.L., W.H. McDowell, B. Sive, and R. Talbot, In Preparation, Factors controlling atmospheric deposition at a coastal suburban site, Journal of Geophysical Research (Atmospheres).
	Daley, M.L. and W.H. McDowell, 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.
	Davis, J.M., W.H. McDowell, J.E. Campbell and A.N. Hristov, 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. 2010. Ecosystem Processes in a Piped Stream. Plum Island Ecosystems Long Term Ecological Research All Scientists Meeting, Woods Hole, MA. April 8, 2010.
	Hope, A.J. and W.H. McDowell, 2010, Ecosystem Processes in a Piped Stream, Aquatic Sciences: Global Changes from Center to Edge, ASLO & NABS Joint Summer Meeting, Santa Fe, NM, June 2010.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.

	McDowell, W.H., M.L. Daley and J.D. Potter, 2011, Dissolved organic matter dynamics in a suburban basin: wetlands and people drive quantity and quality, North American Benthological Society Meeting, Providence, RI, May 2011.
	McDowell, W.H. and M.L. Daley, 2011, Net Manageable Nitrogen: Definition and Rationale for a new approach to nitrogen management in moderately impacted watersheds, American Geophysical Union Fall Conference, San Francisco, CA, December, 2011.
	McDowell, W.H. and M.L. Daley, 2011, Net Manageable Nitrogen: Definition and Rationale for a new approach to nitrogen management in moderately impacted watersheds, National Academy Keck Futures Initiative Ecosystem Services Conference, Irvine, CA, November, 2011.
	Daley, M.L. and W.H. McDowell, In Preparation, Nitrogen saturation in highly retentive coastal urbanizing watersheds, Ecological Applications.
	Baillio, J., 2012, Controls on variability of dissolved greenhouse gas concentration and emissions from small streams in southeastern New Hampshire, MS Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 111 pages.
	Daley, M.L. and W.H. McDowell, In Preparation, Human impacts on stream nitrogen chemistry and watershed N retention across a wide range of rural to urban catchments, Ecological Applications.
	Liptzin, D., M.L. Daley, and W.H. McDowell. Accepted. A comparison of wet deposition collectors at a coastal rural site. Submitted to Water, Air, & Soil Pollution. April 2013.
	Parham, L., 2012, Spatial and temporal variation in degradation of dissolved organic carbon on the main stem of the Lamprey River, MS Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 66 pages.
	Hope, A.J., W.H. McDowell, W.M. Wollheim, Submitted, Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream, Biogeochemistry.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.

Awards and Achievements

[None reported in IPRS.]

Title	Water Quality Change-Effects of Development in Selected Watersheds
Project Number	2006NH60B
Start Date	3/1/2006
End Date	2/28/2009
Research Category	Water Quality
Focus Categories	Non Point Pollution; Nutrients; Surface Water
Principal Investigators	Jeffrey Schloss

The proposed investigation would allow for the improvement of predictive models used for watershed planning and management for both inland lake watersheds (where phosphorus is the concern) as well as costal and river watersheds (where nitrogen is a concern). The benefits of this are wide ranging from assisting watershed stewardship education efforts throughout the state and region to providing existing watershed based programs like the EPA Basins Model Initiative, the statewide 303d listing process (under the federal Clean Water Action Program) as well as regional and state initiatives (US EPA Region 1 and NE states) to develop total daily maximum loading criteria (TMDLs) and nutrient criteria for lakes, rivers and streams. In addition we expect the data to also be useful in attempts to use the regionally developed USGS SPARROW model with greater resolution in terms of scale. The project will also complement current efforts underway to predict receiving water response to nutrient loading for source water protection planning. In addition the work will provide additional data to include in our submissions to EPA s new STORET and for use in our ongoing collaborative web based water quality data distribution project between UNH and the NH Department of Environmental Services. The study is also consistent with ongoing studies undertaken by the UNH WRRC program to document land use change impacts on nutrients in surface water and groundwater.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2008	$5,000	$15,556

Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	7	
Masters	1	
Ph.D.	1	
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Craycraft, R. and J.A.Schloss, 2009. New Hampshire Lakes Lay Monitoring Program Yearly Report 2008. 28 individual lake reports 18 to 160 pages each. University of New Hampshire Center for Freshwater Biology. Durham, NH.
	Craycraft, R. and J.A.Schloss, 2009. Newfound Watershed Assessment Project 2007 and 2008. Special report in fulfillment for the NH DES 319 Watershed Assistance Grant. University of New Hampshire Center for Freshwater Biology. Durham, NH. 170 pages (report 83pp, appendices 87pp).
	Wilderman, Susan E. 2009. Contributions of Groundwater Seepage to the Water and Nutrient Budget of Mendums Pond Barrington, New Hampshire. MS Thesis.

	University of New Hampshire. Durham, NH. May 2009.
	Craycraft, R. and J.A.Schloss, 2010, New Hampshire Lakes Lay Monitoring Program Yearly Report 2009, 27 individual lake reports 18 to 160 pages each, UNH Center for Freshwater Biology, University of NH, Durham, NH.
	Harvey, Rebecca, 2010, Pharmaceuticals and Personal Care Products in the Environment, Masers Thesis, Plymouth State University, Plymouth NH, 93pp.
	Harvey, R, 2010, Pharmaceuticals and Personal Care Products in the Environment, Fact Sheet, Squam Lakes Association, Holderness, NH, 4pp.

Awards and Achievements

[None reported in IPRS.]

Title	Grant--Determining the Effectiveness of the Clean Air Act and Amendments for the Recovery of Surface Waters in the Northeastern U.S.
Project Number	2006NH86S
Start Date	3/6/2007
End Date	3/5/2011
Research Category	Not Applicable
Focus Categories	
Principal Investigators	Steve Kahl; William McDowell

This proposed research is part of the EPA program to collect long-term data on the trends and patterns of response in surface waters sensitive to acidic deposition. The goals and methods are hierarchical from intensive site-specific to regional statistical populations. The objectives are to: 1) document the changes and patterns in aquatic chemistry for defined sub-populations and sites that are known to be susceptible to acidification or recovery; 2) evaluate linkages in changes in surface waters, if any, to changes in deposition that are related to regulatory goals; 3) characterize the effectiveness of the Clean Air Act Amendments in meeting goals of reducing acidification of surface waters and improving biologically-relevant chemistry in the northeastern US; and 4) provide information for assessment of the need for future reductions in atmospheric deposition based on the rate of recovery (or not) of the systems under study. In 2008-09, we are also evaluating changes in biological condition using zooplankton collected in 2004 under separate funding from 145 ELS-II lakes in the northeast, as part of our 20th anniversary re-analysis of the Eastern Lake Survey (see Rosfjord et al., 2007).

Funding	
Funding Period	**Total 'Pass-through' Grant**
FY2008	$0

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate	1	
Masters	1	
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Hunt, K., J.S. Kahl, J. Rubin, and D. Mageean, 2007. Assessing the science-based needs of stakeholders; a case study on acid rain research and policy. Journal of Contemporary Water Research and Education, 136: 68-79.
	Rosfjord, C., K. Webster, J.S. Kahl, S.A. Norton, I. Fernandez, and A. Herlihy, 2007. Anthropogenically-driven changes in chloride complicate interpretation of base cation trends in lakes recovering from acidic deposition. Environ Sci Technol, 41:7688 -7693.
	Baumann, A.J. and J.S. Kahl, 2007. Chemical trends in Maine High Elevation Lakes. LakeLine 27:30-34.

	Rosfjord, C., J.S. Kahl, K. Webster, S. Nelson, I. Fernandez, L. Rustad, and R. Stemberger, 2006. Acidic deposition-relevant changes in lake chemistry in the EPA Eastern Lake Survey, 1984-2004. Final report to USDA NSRC, Durham, NH. 69 p.
	Hunt, K., J.S. Kahl, J. Rubin, and D. Mageean, 2007. Assessing the science-based needs of stakeholders; a case study on acid rain research and policy. Journal of Contemporary Water Research and Education, 136: 68-79.
	Rosfjord, C., K. Webster, J.S. Kahl, S.A. Norton, I. Fernandez, and A. Herlihy, 2007. Anthropogenically-driven changes in chloride complicate interpretation of base cation trends in lakes recovering from acidic deposition. Environ Sci Technol, 41:7688 -7693.
	Baumann, A.J. and J.S. Kahl, 2007. Chemical trends in Maine High Elevation Lakes. LakeLine 27:30-34.
	Rosfjord, C., J.S. Kahl, K. Webster, S. Nelson, I. Fernandez, L. Rustad, and R. Stemberger, 2006. Acidic deposition-relevant changes in lake chemistry in the EPA Eastern Lake Survey, 1984-2004. Final report to USDA NSRC, Durham, NH. 69 p.
	Nelson, S.J., W.H. Halteman, J.S. Kahl, N.C. Kamman, D.P. Krabbenhoft, 2010. Predicting mercury concentrations in northeast lakes using hydrogeomorphic features, landscape setting, and chemical co-variates. Environmental Science and Technology, in review.
	Nelson, S.J., W.H. Halteman, J.S. Kahl, N.C. Kamman, D.P. Krabbenhoft, 2011, Predicting mercury concentrations in northeast lakes using hydrogeomorphic features, landscape setting, and chemical co-variates, Intended for: Environmental Science and Technology, In final prep, May 2011.
	Navrátil, T., S.A. Norton, I.J. Fernandez, S.J. Nelson, 2010, Twenty-year inter-annual trends and seasonal variations in precipitation and stream water chemistry at the Bear Brook Watershed in Maine, USA, Environ. Monit. Assess, 171:3-21.
	S.J. Nelson, P. Vaux, M.J. James-Pirri, and G. Giese, 2010, Assessment of natural resource conditions in and adjacent to Cape Cod National Seashore, Massachusetts, Natural Resource [Technical] Report NPS/XXXX/ NRXX-20XX/XXX. National Park Service, Fort Collins, Colorado, in final prep.
	James-Pirri, M.J., S.J. Nelson, and P.D. Vaux, July 2010, Natural Resource Assessment for Saugus Iron Works National Historic Site, Natural Resources Report NPS/NER/NRR-2010/XXX, National Park Service, Boston, MA, in press.
	Fernandez, Ivan; Stephen, Norton, 2010, The Bear Brook Watershed in Maine: The Second Decade: Preface. Environmental Monitoring and Assessment, 171(1-4): 1-2(2)
	Norton, S.; I. Fernandez; J. Kahl; L., Rustad; Tomas, Navratil; H., Almquist, 2010, The evolution of the science of Bear Brook Watershed in Maine, USA. Environmental Monitoring and Assessment, 171(1-4): 3-21.
	Kim, Jong-Suk; Shaleen, Jain; Stephen, Norton, 2010, Streamflow variability and hydroclimatic change at the Bear Brook Watershed in Maine (BBWM), USA, Environmental Monitoring and Assessment, 171(1-4): 47-58.
	Laudon, Hjalmar; Stephen, Norton, 2010, Drivers and evolution of episodic acidification at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 59-69.
	Porcal, Petr; Aria, Amirbahman; Jiri, Kopacek; Stephen, Norton, 2010. Experimental photochemical release of organically bound aluminum and iron in three streams in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 71-81.
	Simon, Kevin; Michael, Chadwick; Alexander, Hury; H.,Valett, 2010, Stream ecosystem response to chronic deposition of N and acid at the Bear Brook Watershed, Maine,

	Environmental Monitoring and Assessment, 171(1-4): 83-92.
	Amirbahman, Aria; Brett, Holmes; Ivan, Fernandez; Stephen, Norton, 2010, Mobilization of metals and phosphorus from intact forest soil cores by dissolved inorganic carbon, Environmental Monitoring and Assessment, 171(1-4): 93-110.
	SanClements, Michael; Ivan, Fernandez; Stephen, Norton, 2010, Soil chemical and physical properties at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 111-128.
	Elvir, Jose; G. Wiersma; Suzanne, Bethers; Peter, Kenlan, 2010, Effects of chronic ammonium sulfate treatment on the forest at the Bear Brook Watershed in Maine, Environmental Monitoring and Assessment, 171(1-4): 129-147.
	Fernandez, Ivan; Mary, Adams; Michael, SanClements; Stephen, Norton, 2010, Comparing decadal responses of whole-watershed manipulations at the Bear Brook and Fernow experiments, Environmental Monitoring and Assessment, 171(1-4): 149-161.
	Nelson, S.J., W.H. Halteman, J.S. Kahl, N.C. Kamman, D.P. Krabbenhoft, 2011, Predicting mercury concentrations in northeast lakes using hydrogeomorphic features, landscape setting, and chemical co-variates, Intended for: Environmental Science and Technology, In final prep, May 2011.
	Navrátil, T., S.A. Norton, I.J. Fernandez, S.J. Nelson, 2010, Twenty-year inter-annual trends and seasonal variations in precipitation and stream water chemistry at the Bear Brook Watershed in Maine, USA, Environ. Monit. Assess, 171:3-21.
	S.J. Nelson, P. Vaux, M.J. James-Pirri, and G. Giese, 2010, Assessment of natural resource conditions in and adjacent to Cape Cod National Seashore, Massachusetts, Natural Resource [Technical] Report NPS/XXXX/ NRXX-20XX/XXX. National Park Service, Fort Collins, Colorado, in final prep.
	James-Pirri, M.J., S.J. Nelson, and P.D. Vaux, July 2010, Natural Resource Assessment for Saugus Iron Works National Historic Site, Natural Resources Report NPS/NER/NRR-2010/XXX, National Park Service, Boston, MA, in press.
	Fernandez, Ivan; Stephen, Norton, 2010, The Bear Brook Watershed in Maine: The Second Decade: Preface. Environmental Monitoring and Assessment, 171(1-4): 1-2(2)
	Norton, S.; I. Fernandez; J. Kahl; L., Rustad; Tomas, Navratil; H., Almquist, 2010, The evolution of the science of Bear Brook Watershed in Maine, USA. Environmental Monitoring and Assessment, 171(1-4): 3-21.
	Kim, Jong-Suk; Shaleen, Jain; Stephen, Norton, 2010, Streamflow variability and hydroclimatic change at the Bear Brook Watershed in Maine (BBWM), USA, Environmental Monitoring and Assessment, 171(1-4): 47-58.
	Laudon, Hjalmar; Stephen, Norton, 2010, Drivers and evolution of episodic acidification at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 59-69.
	Porcal, Petr; Aria, Amirbahman; Jiri, Kopacek; Stephen, Norton, 2010. Experimental photochemical release of organically bound aluminum and iron in three streams in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 71-81.
	Simon, Kevin; Michael, Chadwick; Alexander, Hury; H.,Valett, 2010, Stream ecosystem response to chronic deposition of N and acid at the Bear Brook Watershed, Maine, Environmental Monitoring and Assessment, 171(1-4): 83-92.
	Amirbahman, Aria; Brett, Holmes; Ivan, Fernandez; Stephen, Norton, 2010, Mobilization of metals and phosphorus from intact forest soil cores by dissolved inorganic carbon, Environmental Monitoring and Assessment, 171(1-4): 93-110.

	SanClements, Michael; Ivan, Fernandez; Stephen, Norton, 2010, Soil chemical and physical properties at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 111-128.
	Elvir, Jose; G. Wiersma; Suzanne, Bethers; Peter, Kenlan, 2010, Effects of chronic ammonium sulfate treatment on the forest at the Bear Brook Watershed in Maine, Environmental Monitoring and Assessment, 171(1-4): 129-147.
	Fernandez, Ivan; Mary, Adams; Michael, SanClements; Stephen, Norton, 2010, Comparing decadal responses of whole-watershed manipulations at the Bear Brook and Fernow experiments, Environmental Monitoring and Assessment, 171(1-4): 149-161.

Awards and Achievements

[None reported in IPRS.]

Title	Grant--Watershed Assessment of New Boston Air Force Base
Project Number	2007NH102S
Start Date	8/23/2007
End Date	8/22/2009
Research Category	Climate and Hydrologic Processes
Focus Categories	Water Quantity; Water Quality; Hydrology
Principal Investigators	William McDowell

['S' projects don't yet have Abstracts]

Funding	
Funding Period	**Total 'Pass-through' Grant**
FY2008	$0

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate		
Masters	1	
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**

Awards and Achievements

[None reported in IPRS.]

Title	Urbanization Impacts on NH Streamwater Thermal Loading
Project Number	2008NH87B
Start Date	3/1/2008
End Date	2/28/2010
Research Category	Water Quality
Focus Categories	Surface Water; Non Point Pollution; Water Quality
Principal Investigators	Jennifer Jacobs; Thomas Ballestero; Robert Roseen

The goal of the proposed research is to quantify the impact of urbanization on NH stream water temperature. We propose to 1) augment existing datasets from the UNH Stormwater Center s (UNHSC) stream temperature and conductivity monitoring locations. The methodology s target domain is headwater (primarily first order) streams in New England Coastal streams. For this project, there are four existing sites that are currently being monitored and an additional six sites will be identified and instrumented. 2) We will compare the magnitude and timing of heat input upstream and downstream of road crossings and impervious areas. 3) We will characterize the thermal loadings and concentrations longitudinally downstream of the source using a One-Dimensional Solute Transport with Inflow and Storage (OTIS) model. The model will be calibrated using continuous temperature measurements and fiber optic distributed temperature sensing (FO-DTS). The research results will determine if and when road crossings and impervious areas elevate background levels of temperature and the longitudinal extent of the impact. Recognizing that stormwater is managed using a variety of strategies and systems, the proposed research will characterize the thermal input to such stormwater facilities.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2009	$15,487	$34,188

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate	3	
Masters	7	1
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Jacobs, J.M., T. Richard, and R. Abele. 2010. Summer Water Temperatures in NH and MA Coldwater Streams. New England Association of Environmental Biologists Conference. March 17-19. Newport, Rhode Island.

Awards and Achievements

[None reported in IPRS.]

Title	New Hampshire WRRC Information Transfer
Project Number	2008NH97B
Start Date	3/1/2008
End Date	2/28/2011
Research Category	Water Quality
Focus Categories	Nitrate Contamination; Non Point Pollution; Water Quality
Principal Investigators	William McDowell

This project will provide salary for the Center's Director and Associate Director as they meet with state representatives, local town officials, watershed groups, scientists and the general public to discuss the research findings from the Lamprey River Watershed Hydrologic Observatory and other issues related to water quality in New Hampshire and the region. Salary for website maintenance is also included.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2009	$23,941	$16,155

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate		
Masters		
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Baillio, J. 2012. 2012. Controls on variability of dissolved greenhouse gas concentration and emissions from small streams in southeastern New Hampshire. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 111 pages.
	Daley, M.L. and W.H. McDowell, In Preparation, Human impacts on stream nitrogen chemistry and watershed N retention across a wide range of rural to urban catchments, Ecological Applications.
	Hope, A.J., W.H. McDowell, W.M. Wollheim, Submitted, Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream, Biogeochemistry.
	Liptzin, D., M.L. Daley, and W.H. McDowell. Accepted. A comparison of wet deposition collectors at a coastal rural site. Submitted to Water, Air, & Soil Pollution. April 2013.
	Parham, L. 2012. Spatial and temporal variation in degradation of dissolved organic carbon on the main stem of the Lamprey River. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 66 pages.

Awards and Achievements

[None reported in IPRS.]

Title	Water Quality and the Landscape: Long-term monitoring of rapidly developing suburban watersheds
Project Number	2003NH21B
Start Date	3/1/2003
End Date	2/28/2011
Research Category	Water Quality
Focus Categories	Non Point Pollution; Surface Water; Nutrients
Principal Investigators	William McDowell

The proposed work will continue documentation of long-term changes to water quality in response to changing land use and management practices as a result of population growth. There are several components to this project, drawing from the efforts of local watershed monitoring groups, as well as on-going research projects by UNH staff and students, all leading to long-term datasets of water quality in New Hampshire. These datasets can be used to assess the impacts of human development, land use changes and management practices in rapidly growing areas of the state and New England. Further, these data could be used to test and refine water quality models and aid in the development of best management practices and restoration efforts across the state and region.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2009	$5,874	$51,946

Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	4	
Masters	4	1
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	Daley, M.L., J.D. Potter and W.H. McDowell. 2009. Salinization of urbanizing New Hampshire streams and groundwater: impacts of road salt and hydrologic variability. Journal of the North American Benthological Society 28(4):929-940.
	DiFranco, E. 2009. Spatial and temporal trends of dissolved nitrous oxide in the Lamprey River watershed and controls on the end-products of denitrification. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 108 pages.
	Daley, M.L. and W.H. McDowell. In Preparation. Nitrogen saturation in highly retentive coastal urbanizing watersheds. Ecosystems.

	Daley, M.L. 2009. Nitrogen Sources and Retention within the Lamprey River Watershed and Implications for Management. State of the Estuaries Conference. Somersworth, NH. October 2009.
	Daley, M.L. 2009. Water Quality of Private Wells in Suburban NH and Impacts of Land Use. Northeast Private Well Symposium. Portland, ME. November, 2009.
	Daley, M.L. 2009. Spatial and Temporal variability in nitrogen concentrations, export and retention in the Lamprey River watershed. Joint NH Water and Watershed Conference. Concord, NH. November, 2009.
	Daley, M.L. and W.H. McDowell. 2009. Nitrogen Saturation in Highly Retentive Watersheds? American Geophysical Union Fall Conference, San Francisco, CA. December, 2009.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	Daley, M.L., J.D. Potter and W.H. McDowell, 2010, Nitrogen Assessment for the Lamprey River Watershed, Report prepared for the New Hampshire Department of Environmental Services. http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/unh_nitrogenassessment.pdf
	Dunlap, K, 2010, Seasonal Nitrate Dynamics in an Agriculturally Influenced NH Headwater Stream, M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 102 pages.
	Galvin, M, 2010, Hydrologic and nutrient dynamics in an agriculturally influenced New England floodplain, M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 94 pages.
	Daley, M.L., W.H. McDowell, B. Sive, and R. Talbot, In Preparation, Factors controlling atmospheric deposition at a coastal suburban site, Journal of Geophysical Research (Atmospheres).
	Daley, M.L. and W.H. McDowell, 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.
	Davis, J.M., W.H. McDowell, J.E. Campbell and A.N. Hristov, 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. 2010. Ecosystem Processes in a Piped Stream. Plum Island Ecosystems Long Term Ecological Research All Scientists Meeting, Woods Hole, MA. April 8, 2010.
	Hope, A.J. and W.H. McDowell, 2010, Ecosystem Processes in a Piped Stream, Aquatic Sciences: Global Changes from Center to Edge, ASLO & NABS Joint Summer Meeting, Santa Fe, NM, June 2010.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	McDowell, W.H., M.L. Daley and J.D. Potter, 2011, Dissolved organic matter dynamics in a suburban basin: wetlands and people drive quantity and quality, North American Benthological Society Meeting, Providence, RI, May 2011.
	McDowell, W.H. and M.L. Daley, 2011, Net Manageable Nitrogen: Definition and Rationale for a new approach to nitrogen management in moderately impacted watersheds, American Geophysical Union Fall Conference, San Francisco, CA, December, 2011.
	McDowell, W.H. and M.L. Daley, 2011, Net Manageable Nitrogen: Definition and Rationale for a new approach to nitrogen management in moderately impacted watersheds, National Academy

	Keck Futures Initiative Ecosystem Services Conference, Irvine, CA, November, 2011.
	Daley, M.L. and W.H. McDowell, In Preparation, Nitrogen saturation in highly retentive coastal urbanizing watersheds, Ecological Applications.
	Baillio, J., 2012, Controls on variability of dissolved greenhouse gas concentration and emissions from small streams in southeastern New Hampshire, MS Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 111 pages.
	Daley, M.L. and W.H. McDowell, In Preparation, Human impacts on stream nitrogen chemistry and watershed N retention across a wide range of rural to urban catchments, Ecological Applications.
	Liptzin, D., M.L. Daley, and W.H. McDowell. Accepted. A comparison of wet deposition collectors at a coastal rural site. Submitted to Water, Air, & Soil Pollution. April 2013.
	Parham, L., 2012, Spatial and temporal variation in degradation of dissolved organic carbon on the main stem of the Lamprey River, MS Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 66 pages.
	Hope, A.J., W.H. McDowell, W.M. Wollheim, Submitted, Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream, Biogeochemistry.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.

Awards and Achievements

[None reported in IPRS.]

Title	Water Quality Change-Effects of Development in Selected Watersheds
Project Number	2006NH60B
Start Date	3/1/2006
End Date	2/28/2011
Research Category	Water Quality
Focus Categories	Non Point Pollution; Nutrients; Surface Water
Principal Investigators	Jeffrey Schloss

The proposed investigation would allow for the improvement of predictive models used for watershed planning and management for both inland lake watersheds (where phosphorus is the concern) as well as costal and river watersheds (where nitrogen is a concern). The benefits of this are wide ranging from assisting watershed stewardship education efforts throughout the state and region to providing existing watershed based programs like the EPA Basins Model Initiative, the statewide 303d listing process (under the federal Clean Water Action Program) as well as regional and state initiatives (US EPA Region 1 and NE states) to develop total daily maximum loading criteria (TMDLs) and nutrient criteria for lakes, rivers and streams. In addition we expect the data to also be useful in attempts to use the regionally developed USGS SPARROW model with greater resolution in terms of scale. The project will also complement current efforts underway to predict receiving water response to nutrient loading for source water protection planning. In addition the work will provide additional data to include in our submissions to EPA's new STORET and for use in our ongoing collaborative web based water quality data distribution project between UNH and the NH Department of Environmental Services. The study is also consistent with ongoing studies undertaken by the UNH WRRC program to document land use change impacts on nutrients in surface water and groundwater.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2009	$5,000	$18,584

Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	6	
Masters	1	1
Ph.D.	1	
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Craycraft, R. and J.A.Schloss, 2009. New Hampshire Lakes Lay Monitoring Program Yearly Report 2008. 28 individual lake reports 18 to 160 pages each. University of New Hampshire Center for Freshwater Biology. Durham, NH.
	Craycraft, R. and J.A.Schloss, 2009. Newfound Watershed Assessment Project 2007 and 2008. Special report in fulfillment for the NH DES 319 Watershed Assistance Grant. University of New Hampshire Center for Freshwater Biology. Durham, NH. 170 pages (report 83pp, appendices 87pp).
	Wilderman, Susan E. 2009. Contributions of Groundwater Seepage to the Water and Nutrient Budget of Mendums Pond Barrington, New Hampshire. MS Thesis.

	University of New Hampshire. Durham, NH. May 2009.
	Craycraft, R. and J.A.Schloss, 2010, New Hampshire Lakes Lay Monitoring Program Yearly Report 2009, 27 individual lake reports 18 to 160 pages each, UNH Center for Freshwater Biology, University of NH, Durham, NH.
	Harvey, Rebecca, 2010, Pharmaceuticals and Personal Care Products in the Environment, Masers Thesis, Plymouth State University, Plymouth NH, 93pp.
	Harvey, R, 2010, Pharmaceuticals and Personal Care Products in the Environment, Fact Sheet, Squam Lakes Association, Holderness, NH, 4pp.

Awards and Achievements

[None reported in IPRS.]

Title	A pilot study of septic impacts on water quality using Boron concentrations and isotopes as a source tracer
Project Number	2009NH117B
Start Date	3/1/2009
End Date	2/28/2010
Research Category	Water Quality
Focus Categories	Groundwater; Non Point Pollution; Methods
Principal Investigators	Jeffrey Schloss

The contamination of surface water by septic systems has become a growing environmental and economic concern during the shoreland development boom of the past decade. However, it is complicated to quantify the magnitude of the impact and to attribute precise sources, making it difficult for regulars to address the issue. Tracers have been used to assess the influence septic effluent has on surface waters. Boron has proved to be a particularly useful tracer in some regions for measuring the transport and rate of septic contamination and can be used to describe effluent s role in surface water quality. This study will use boron concentrations in groundwater and surface water to estimate the influence of septic systems on groundwater and surface water. We will use the Squam Lake Watershed as the test location for this pilot study because of the excellent background water quality data and land use information available from a variety of sources. Our goals are to evaluate this method for application in the northeast, and based on the pilot results, provide preliminary recommendations for water quality protection to the five towns in the Squam Watershed.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2009	$29,949	$54,770

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate		
Masters	1	
Ph.D.	1	
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**

Awards and Achievements

[None reported in IPRS.]

Title	Grant--Determining the Effectiveness of the Clean Air Act and Amendments for the Recovery of Surface Waters in the Northeastern U.S.
Project Number	2006NH86S
Start Date	3/6/2006
End Date	2/28/2011
Research Category	Not Applicable
Focus Categories	
Principal Investigators	Steve Kahl; William McDowell

['S' projects don't yet have Abstracts]

Funding	
Funding Period	**Total 'Pass-through' Grant**
FY2009	$0

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate	1	
Masters	1	
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Hunt, K., J.S. Kahl, J. Rubin, and D. Mageean, 2007. Assessing the science-based needs of stakeholders; a case study on acid rain research and policy. Journal of Contemporary Water Research and Education, 136: 68-79.
	Rosfjord, C., K. Webster, J.S. Kahl, S.A. Norton, I. Fernandez, and A. Herlihy, 2007. Anthropogenically-driven changes in chloride complicate interpretation of base cation trends in lakes recovering from acidic deposition. Environ Sci Technol, 41:7688 -7693.
	Baumann, A.J. and J.S. Kahl, 2007. Chemical trends in Maine High Elevation Lakes. LakeLine 27:30-34.
	Rosfjord, C., J.S. Kahl, K. Webster, S. Nelson, I. Fernandez, L. Rustad, and R. Stemberger, 2006. Acidic deposition-relevant changes in lake chemistry in the EPA Eastern Lake Survey, 1984-2004. Final report to USDA NSRC, Durham, NH. 69 p.
	Nelson, S.J., W.H. Halteman, J.S. Kahl, N.C. Kamman, D.P. Krabbenhoft, 2010. Predicting mercury concentrations in northeast lakes using hydrogeomorphic features, landscape setting, and chemical co-variates. Environmental Science and Technology, in review.
	Nelson, S.J., W.H. Halteman, J.S. Kahl, N.C. Kamman, D.P. Krabbenhoft, 2011, Predicting mercury concentrations in northeast lakes using hydrogeomorphic features, landscape setting, and chemical co-variates, Intended for: Environmental Science and Technology, In final prep, May 2011.
	Navrátil, T., S.A. Norton, I.J. Fernandez, S.J. Nelson, 2010, Twenty-year inter-annual trends

	and seasonal variations in precipitation and stream water chemistry at the Bear Brook Watershed in Maine, USA, Environ. Monit. Assess, 171:3-21.
	S.J. Nelson, P. Vaux, M.J. James-Pirri, and G. Giese, 2010, Assessment of natural resource conditions in and adjacent to Cape Cod National Seashore, Massachusetts, Natural Resource [Technical] Report NPS/XXXX/ NRXX-20XX/XXX. National Park Service, Fort Collins, Colorado, in final prep.
	James-Pirri, M.J., S.J. Nelson, and P.D. Vaux, July 2010, Natural Resource Assessment for Saugus Iron Works National Historic Site, Natural Resources Report NPS/NER/NRR-2010/XXX, National Park Service, Boston, MA, in press.
	Fernandez, Ivan; Stephen, Norton, 2010, The Bear Brook Watershed in Maine: The Second Decade: Preface. Environmental Monitoring and Assessment, 171(1-4): 1-2(2)
	Norton, S.; I. Fernandez; J. Kahl; L., Rustad; Tomas, Navratil; H., Almquist, 2010, The evolution of the science of Bear Brook Watershed in Maine, USA. Environmental Monitoring and Assessment, 171(1-4): 3-21.
	Kim, Jong-Suk; Shaleen, Jain; Stephen, Norton, 2010, Streamflow variability and hydroclimatic change at the Bear Brook Watershed in Maine (BBWM), USA, Environmental Monitoring and Assessment, 171(1-4): 47-58.
	Laudon, Hjalmar; Stephen, Norton, 2010, Drivers and evolution of episodic acidification at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 59-69.
	Porcal, Petr; Aria, Amirbahman; Jiri, Kopacek; Stephen, Norton, 2010. Experimental photochemical release of organically bound aluminum and iron in three streams in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 71-81.
	Simon, Kevin; Michael, Chadwick; Alexander, Hury; H.,Valett, 2010, Stream ecosystem response to chronic deposition of N and acid at the Bear Brook Watershed, Maine, Environmental Monitoring and Assessment, 171(1-4): 83-92.
	Amirbahman, Aria; Brett, Holmes; Ivan, Fernandez; Stephen, Norton, 2010, Mobilization of metals and phosphorus from intact forest soil cores by dissolved inorganic carbon, Environmental Monitoring and Assessment, 171(1-4): 93-110.
	SanClements, Michael; Ivan, Fernandez; Stephen, Norton, 2010, Soil chemical and physical properties at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 111-128.
	Elvir, Jose; G. Wiersma; Suzanne, Bethers; Peter, Kenlan, 2010, Effects of chronic ammonium sulfate treatment on the forest at the Bear Brook Watershed in Maine, Environmental Monitoring and Assessment, 171(1-4): 129-147.
	Fernandez, Ivan; Mary, Adams; Michael, SanClements; Stephen, Norton, 2010, Comparing decadal responses of whole-watershed manipulations at the Bear Brook and Fernow experiments, Environmental Monitoring and Assessment, 171(1-4): 149-161.
	Nelson, S.J., W.H. Halteman, J.S. Kahl, N.C. Kamman, D.P. Krabbenhoft, 2011, Predicting mercury concentrations in northeast lakes using hydrogeomorphic features, landscape setting, and chemical co-variates, Intended for: Environmental Science and Technology, In final prep, May 2011.
	Navrátil, T., S.A. Norton, I.J. Fernandez, S.J. Nelson, 2010, Twenty-year inter-annual trends and seasonal variations in precipitation and stream water chemistry at the Bear Brook Watershed in Maine, USA, Environ. Monit. Assess, 171:3-21.
	S.J. Nelson, P. Vaux, M.J. James-Pirri, and G. Giese, 2010, Assessment of natural resource conditions in and adjacent to Cape Cod National Seashore, Massachusetts, Natural Resource

	[Technical] Report NPS/XXXX/ NRXX-20XX/XXX. National Park Service, Fort Collins, Colorado, in final prep.
	James-Pirri, M.J., S.J. Nelson, and P.D. Vaux, July 2010, Natural Resource Assessment for Saugus Iron Works National Historic Site, Natural Resources Report NPS/NER/NRR-2010/XXX, National Park Service, Boston, MA, in press.
	Fernandez, Ivan; Stephen, Norton, 2010, The Bear Brook Watershed in Maine: The Second Decade: Preface. Environmental Monitoring and Assessment, 171(1-4): 1-2(2)
	Norton, S.; I. Fernandez; J. Kahl; L., Rustad; Tomas, Navratil; H., Almquist, 2010, The evolution of the science of Bear Brook Watershed in Maine, USA. Environmental Monitoring and Assessment, 171(1-4): 3-21.
	Kim, Jong-Suk; Shaleen, Jain; Stephen, Norton, 2010, Streamflow variability and hydroclimatic change at the Bear Brook Watershed in Maine (BBWM), USA, Environmental Monitoring and Assessment, 171(1-4): 47-58.
	Laudon, Hjalmar; Stephen, Norton, 2010, Drivers and evolution of episodic acidification at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 59-69.
	Porcal, Petr; Aria, Amirbahman; Jiri, Kopacek; Stephen, Norton, 2010. Experimental photochemical release of organically bound aluminum and iron in three streams in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 71-81.
	Simon, Kevin; Michael, Chadwick; Alexander, Hury; H.,Valett, 2010, Stream ecosystem response to chronic deposition of N and acid at the Bear Brook Watershed, Maine, Environmental Monitoring and Assessment, 171(1-4): 83-92.
	Amirbahman, Aria; Brett, Holmes; Ivan, Fernandez; Stephen, Norton, 2010, Mobilization of metals and phosphorus from intact forest soil cores by dissolved inorganic carbon, Environmental Monitoring and Assessment, 171(1-4): 93-110.
	SanClements, Michael; Ivan, Fernandez; Stephen, Norton, 2010, Soil chemical and physical properties at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 111-128.
	Elvir, Jose; G. Wiersma; Suzanne, Bethers; Peter, Kenlan, 2010, Effects of chronic ammonium sulfate treatment on the forest at the Bear Brook Watershed in Maine, Environmental Monitoring and Assessment, 171(1-4): 129-147.
	Fernandez, Ivan; Mary, Adams; Michael, SanClements; Stephen, Norton, 2010, Comparing decadal responses of whole-watershed manipulations at the Bear Brook and Fernow experiments, Environmental Monitoring and Assessment, 171(1-4): 149-161.

Awards and Achievements

[None reported in IPRS.]

Title	Grant--Watershed Assessment of New Boston Air Force Base
Project Number	2007NH102S
Start Date	8/23/2007
End Date	8/22/2009
Research Category	Climate and Hydrologic Processes
Focus Categories	Water Quantity; Water Quality; Hydrology
Principal Investigators	William McDowell

['S' projects don't yet have Abstracts]

Funding	
Funding Period	**Total 'Pass-through' Grant**
FY2009	$0

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate		
Masters	1	1
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**

Awards and Achievements

[None reported in IPRS.]

Title	New Hampshire WRRC Information Transfer
Project Number	2008NH97B
Start Date	3/1/2010
End Date	2/28/2011
Research Category	Water Quality
Focus Categories	Nitrate Contamination; Non Point Pollution; Water Quality
Principal Investigators	William McDowell

This project will provide salary for the Center's Director and Associate Director as they meet with state representatives, local town officials, watershed groups, scientists and the general public to discuss the research findings from the Lamprey River Watershed Hydrologic Observatory and other issues related to water quality in New Hampshire and the region. Salary for website maintenance is also included.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2010	$23,925	$16,144

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate		
Masters		
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Baillio, J. 2012. 2012. Controls on variability of dissolved greenhouse gas concentration and emissions from small streams in southeastern New Hampshire. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 111 pages.
	Daley, M.L. and W.H. McDowell, In Preparation, Human impacts on stream nitrogen chemistry and watershed N retention across a wide range of rural to urban catchments, Ecological Applications.
	Hope, A.J., W.H. McDowell, W.M. Wollheim, Submitted, Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream, Biogeochemistry.
	Liptzin, D., M.L. Daley, and W.H. McDowell. Accepted. A comparison of wet deposition collectors at a coastal rural site. Submitted to Water, Air, & Soil Pollution. April 2013.
	Parham, L. 2012. Spatial and temporal variation in degradation of dissolved organic carbon on the main stem of the Lamprey River. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 66 pages.

Awards and Achievements

[None reported in IPRS.]

Title	Water Quality and the Landscape: Long-term monitoring of rapidly developing suburban watersheds
Project Number	2003NH21B
Start Date	3/1/2010
End Date	2/28/2011
Research Category	Water Quality
Focus Categories	Non Point Pollution; Surface Water; Nutrients
Principal Investigators	William McDowell

The proposed work will continue documentation of long-term changes to water quality in response to changing land use and management practices as a result of population growth. There are several components to this project, drawing from the efforts of local watershed monitoring groups, as well as on-going research projects by UNH staff and students, all leading to long-term datasets of water quality in New Hampshire. These datasets can be used to assess the impacts of human development, land use changes and management practices in rapidly growing areas of the state and New England. Further, these data could be used to test and refine water quality models and aid in the development of best management practices and restoration efforts across the state and region.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2010	$11,460	$63,630

Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	4	
Masters	5	2
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	Daley, M.L., J.D. Potter and W.H. McDowell, 2010, Nitrogen Assessment for the Lamprey River Watershed, Report prepared for the New Hampshire Department of Environmental Services. http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/unh_nitrogenassessment.pdf
	Dunlap, K, 2010, Seasonal Nitrate Dynamics in an Agriculturally Influenced NH Headwater Stream, M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 102 pages.
	Galvin, M, 2010, Hydrologic and nutrient dynamics in an agriculturally influenced New England floodplain, M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 94 pages.

	Daley, M.L., W.H. McDowell, B. Sive, and R. Talbot, In Preparation, Factors controlling atmospheric deposition at a coastal suburban site, Journal of Geophysical Research (Atmospheres).
	Daley, M.L. and W.H. McDowell, 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.
	Davis, J.M., W.H. McDowell, J.E. Campbell and A.N. Hristov, 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. 2010. Ecosystem Processes in a Piped Stream. Plum Island Ecosystems Long Term Ecological Research All Scientists Meeting, Woods Hole, MA. April 8, 2010.
	Hope, A.J. and W.H. McDowell, 2010, Ecosystem Processes in a Piped Stream, Aquatic Sciences: Global Changes from Center to Edge, ASLO & NABS Joint Summer Meeting, Santa Fe, NM, June 2010.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.
	McDowell, W.H., M.L. Daley and J.D. Potter, 2011, Dissolved organic matter dynamics in a suburban basin: wetlands and people drive quantity and quality, North American Benthological Society Meeting, Providence, RI, May 2011.
	McDowell, W.H. and M.L. Daley, 2011, Net Manageable Nitrogen: Definition and Rationale for a new approach to nitrogen management in moderately impacted watersheds, American Geophysical Union Fall Conference, San Francisco, CA, December, 2011.
	McDowell, W.H. and M.L. Daley, 2011, Net Manageable Nitrogen: Definition and Rationale for a new approach to nitrogen management in moderately impacted watersheds, National Academy Keck Futures Initiative Ecosystem Services Conference, Irvine, CA, November, 2011.
	Daley, M.L. and W.H. McDowell, In Preparation, Nitrogen saturation in highly retentive coastal urbanizing watersheds, Ecological Applications.
	Baillio, J., 2012, Controls on variability of dissolved greenhouse gas concentration and emissions from small streams in southeastern New Hampshire, MS Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 111 pages.
	Daley, M.L. and W.H. McDowell, In Preparation, Human impacts on stream nitrogen chemistry and watershed N retention across a wide range of rural to urban catchments, Ecological Applications.
	Liptzin, D., M.L. Daley, and W.H. McDowell. Accepted. A comparison of wet deposition collectors at a coastal rural site. Submitted to Water, Air, & Soil Pollution. April 2013.
	Parham, L., 2012, Spatial and temporal variation in degradation of dissolved organic carbon on the main stem of the Lamprey River, MS Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 66 pages.
	Hope, A.J., W.H. McDowell, W.M. Wollheim, Submitted, Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream, Biogeochemistry.
	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.

	Buyofsky, Lauren A., 2006, Relationships between groundwater quality and landscape characteristics in the Lamprey River watershed, "MS Dissertation", Department of Natural Resources, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 176 pages.

Awards and Achievements

[None reported in IPRS.]

Title	Water Quality Change-Effects of Development in Selected Watersheds
Project Number	2006NH60B
Start Date	3/1/2010
End Date	2/28/2011
Research Category	Water Quality
Focus Categories	Non Point Pollution; Nutrients; Surface Water
Principal Investigators	Jeffrey Schloss

The proposed investigation would allow for the improvement of predictive models used for watershed planning and management for both inland lake watersheds (where phosphorus is the concern) as well as costal and river watersheds (where nitrogen is a concern). The benefits of this are wide ranging from assisting watershed stewardship education efforts throughout the state and region to providing existing watershed based programs like the EPA Basins Model Initiative, the statewide 303d listing process (under the federal Clean Water Action Program) as well as regional and state initiatives (US EPA Region 1 and NE states) to develop total daily maximum loading criteria (TMDLs) and nutrient criteria for lakes, rivers and streams. In addition we expect the data to also be useful in attempts to use the regionally developed USGS SPARROW model with greater resolution in terms of scale. The project will also complement current efforts underway to predict receiving water response to nutrient loading for source water protection planning. In addition the work will provide additional data to include in our submissions to EPA's new STORET and for use in our ongoing collaborative web based water quality data distribution project between UNH and the NH Department of Environmental Services. The study is also consistent with ongoing studies undertaken by the NH WRRC program to document land use change impacts on nutrients in surface water and groundwater.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2010	$5,001	$14,202

Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	7	
Masters	1	1
Ph.D.	1	
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Craycraft, R. and J.A.Schloss, 2010, New Hampshire Lakes Lay Monitoring Program Yearly Report 2009, 27 individual lake reports 18 to 160 pages each, UNH Center for Freshwater Biology, University of NH, Durham, NH.
	Harvey, Rebecca, 2010, Pharmaceuticals and Personal Care Products in the Environment, Masers Thesis, Plymouth State University, Plymouth NH, 93pp.
	Harvey, R, 2010, Pharmaceuticals and Personal Care Products in the Environment, Fact Sheet, Squam Lakes Association, Holderness, NH, 4pp.

Awards and Achievements

[None reported in IPRS.]

Title	Hydrologic and Isotopic Investigation of Base Flow Generation in the Headwaters Lamprey River Watershed
Project Number	2010NH128B
Start Date	3/1/2010
End Date	2/28/2011
Research Category	Climate and Hydrologic Processes
Focus Categories	Wetlands; Surface Water; Geochemical Processes
Principal Investigators	John Davis

Many watersheds throughout New England are experiencing population growth resulting in increasing demands for water withdrawals and increased loading of anthropogenic by-products. When combined with climate change forecasts calling for less snowpack and warmer summers, the hydrologic fluxes and stores are likely to be stressed to unprecedented levels in the coming decades. Because of the relatively limited storage capacity of watersheds in northern New England, understanding the sources of base flow their sizes and relative contributions is particularly important in the forecasting of seasonal low flow conditions. The proposed research focuses on the use of natural environmental tracers combined with hydrometric measurements to characterize hydrologic residence times, pathways, and processes. Results to date suggest that water isotopes in the Lamprey River result from a mixture of at least two sources -- groundwater and some other source that has undergone evaporative fractionation. The 1-year research project proposed here will expand the suite of tracers and focus on the role that wetlands play in sustaining base flow in the Headwaters Lamprey River Watershed. The similarities observed between the water isotopes in the HLRW and other river basins across coastal New England suggests that the hydrologic processes affecting base flow are similar among the basins and the results of research focused on the HLR Watershed can be generalized to other watersheds in the region. Understanding of the sources of base flow will greatly improve our ability to manage the watershed and insure sustained water supply and water quality in the face of ongoing environmental change.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2010	$24,624	$49,825

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate	3	
Masters	2	1
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Zuidema, S., 2011, Identifying groundwater contributions to baseflow in a temperate headwater catchment, Thesis, M.S., University of New Hampshire, Durham, NH.

Awards and Achievements

[None reported in IPRS.]

Title	Public information digests in support of the UNH Stormwater Center and the NH Stormwater Commission
Project Number	2010NH131B
Start Date	3/1/2010
End Date	2/28/2011
Research Category	Water Quality
Focus Categories	Non Point Pollution; Surface Water; Management and Planning
Principal Investigators	Robert Roseen; Thomas Ballestero

We propose to develop and publish two Information Digests for a lay audience on the topic of stormwater. The information used will be synthesis and distillation of important existing technical research products with particular emphasis on the target audience of municipal decision makers. The intent of this outreach product is to transform existing technical research information into a format that is readily usable and to get it in the hands of those involved in everyday decision-making. The Digests will be available in hard copy and electronically on the UNHSC, NH Lakes, and DES websites. While we will strive to minimize hard copy printing, some distribution of hard copy to municipal and public works officials will be required to assure adequate information transfer. Stormwater is a rapidly emerging environmental issue. The NH legislature established the Stormwater Commission in 2008 (PI Roseen and Kahl are members) for the purposes of identifying the issues and finding solutions to reduce impact from stormwater runoff. This commission quickly learned that issues ranging from widespread lack of understanding of environmental impact to uncertain municipal authority to address stormwater are just two examples of the need for public education on this topic. Therefore, to address the need for information for the general public, municipal officials, and policy makers, we propose to develop and make available in hard copy and electronically two digests: 1) a general document in support of the work of the Stormwater Commission on imperviousness, runoff, and solutions, and 2) a more targeted document on issues and solutions for road salt runoff. The Information Digests will be timely in its support of the Commission, and will highlight recent research and solutions from the UNH Stormwater Center. The latter Digest is timely because of the ongoing debate over Cl TMDLs in southern NH, where some streams are in violation of EPA regulations for Cl year around. The road salt Digest will be serve as the outreach document for recent research done by Kahl in support of the TMDL for the widening of I-93, and PI Roseen on the Reduction of Deicing Materials using Porous Pavements.

Funding		
Funding Period	**Federal §104 Funds**	**Required §104 Matching Funds**
FY2010	$15,251	$31,850

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate		
Masters		
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	UNH Stormwater Center, 2011, Stormwater Commission Summary, Fact Sheet.

	UNH Stormwater Center, 2011, Winter Maintenance, Fact Sheet
	UNH Stormwater Center, 2011, Thermal Impacts of Stormwater BMPs, Fact Sheet.
	UNH Stormwater Center, 2011, Greenland Meadows LID Case Study: Economics, Fact Sheet.
	UNH Stormwater Center, 2011, Greenland Meadows LID Case Study: Water Quality, Fact Sheet.
	UNH Stormwater Center, 2011, Boulder Hills LID Case Study: Economics, Fact Sheet.

Awards and Achievements

[None reported in IPRS.]

Title	Grant--Determining the Effectiveness of the Clean Air Act and Amendments for the Recovery of Surface Waters in the Northeastern U.S.
Project Number	2006NH86S
Start Date	3/6/2006
End Date	3/5/2011
Research Category	Not Applicable
Focus Categories	
Principal Investigators	Steve Kahl; William McDowell

['S' projects don't yet have Abstracts]

Funding	
Funding Period	**Total 'Pass-through' Grant**
FY2010	$0

Degree Level	Number of Students	Number of Dissertations/Theses
Undergraduate	1	
Masters	1	
Ph.D.		
Post-Doctoral		

Publications	
Publication Type	**Publication Citation**
	Nelson, S.J., W.H. Halteman, J.S. Kahl, N.C. Kamman, D.P. Krabbenhoft, 2011, Predicting mercury concentrations in northeast lakes using hydrogeomorphic features, landscape setting, and chemical co-variates, Intended for: Environmental Science and Technology, In final prep, May 2011.
	Navrátil, T., S.A. Norton, I.J. Fernandez, S.J. Nelson, 2010, Twenty-year inter-annual trends and seasonal variations in precipitation and stream water chemistry at the Bear Brook Watershed in Maine, USA, Environ. Monit. Assess, 171:3-21.
	S.J. Nelson, P. Vaux, M.J. James-Pirri, and G. Giese, 2010, Assessment of natural resource conditions in and adjacent to Cape Cod National Seashore, Massachusetts, Natural Resource [Technical] Report NPS/XXXX/ NRXX-20XX/XXX. National Park Service, Fort Collins, Colorado, in final prep.
	James-Pirri, M.J., S.J. Nelson, and P.D. Vaux, July 2010, Natural Resource Assessment for Saugus Iron Works National Historic Site, Natural Resources Report NPS/NER/NRR-2010/XXX, National Park Service, Boston, MA, in press.
	Fernandez, Ivan; Stephen, Norton, 2010, The Bear Brook Watershed in Maine: The Second Decade: Preface. Environmental Monitoring and Assessment, 171(1-4): 1-2(2)
	Norton, S.; I. Fernandez; J. Kahl; L., Rustad; Tomas, Navratil; H., Almquist, 2010, The evolution of the science of Bear Brook Watershed in Maine, USA. Environmental Monitoring and Assessment, 171(1-4): 3-21.

	Kim, Jong-Suk; Shaleen, Jain; Stephen, Norton, 2010, Streamflow variability and hydroclimatic change at the Bear Brook Watershed in Maine (BBWM), USA, Environmental Monitoring and Assessment, 171(1-4): 47-58.
	Laudon, Hjalmar; Stephen, Norton, 2010, Drivers and evolution of episodic acidification at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 59-69.
	Porcal, Petr; Aria, Amirbahman; Jiri, Kopacek; Stephen, Norton, 2010. Experimental photochemical release of organically bound aluminum and iron in three streams in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 71-81.
	Simon, Kevin; Michael, Chadwick; Alexander, Hury; H.,Valett, 2010, Stream ecosystem response to chronic deposition of N and acid at the Bear Brook Watershed, Maine, Environmental Monitoring and Assessment, 171(1-4): 83-92.
	Amirbahman, Aria; Brett, Holmes; Ivan, Fernandez; Stephen, Norton, 2010, Mobilization of metals and phosphorus from intact forest soil cores by dissolved inorganic carbon, Environmental Monitoring and Assessment, 171(1-4): 93-110.
	SanClements, Michael; Ivan, Fernandez; Stephen, Norton, 2010, Soil chemical and physical properties at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 111-128.
	Elvir, Jose; G. Wiersma; Suzanne, Bethers; Peter, Kenlan, 2010, Effects of chronic ammonium sulfate treatment on the forest at the Bear Brook Watershed in Maine, Environmental Monitoring and Assessment, 171(1-4): 129-147.
	Fernandez, Ivan; Mary, Adams; Michael, SanClements; Stephen, Norton, 2010, Comparing decadal responses of whole-watershed manipulations at the Bear Brook and Fernow experiments, Environmental Monitoring and Assessment, 171(1-4): 149-161.
	Nelson, S.J., W.H. Halteman, J.S. Kahl, N.C. Kamman, D.P. Krabbenhoft, 2011, Predicting mercury concentrations in northeast lakes using hydrogeomorphic features, landscape setting, and chemical co-variates, Intended for: Environmental Science and Technology, In final prep, May 2011.
	Navrátil, T., S.A. Norton, I.J. Fernandez, S.J. Nelson, 2010, Twenty-year inter-annual trends and seasonal variations in precipitation and stream water chemistry at the Bear Brook Watershed in Maine, USA, Environ. Monit. Assess, 171:3-21.
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	James-Pirri, M.J., S.J. Nelson, and P.D. Vaux, July 2010, Natural Resource Assessment for Saugus Iron Works National Historic Site, Natural Resources Report NPS/NER/NRR-2010/XXX, National Park Service, Boston, MA, in press.
	Fernandez, Ivan; Stephen, Norton, 2010, The Bear Brook Watershed in Maine: The Second Decade: Preface. Environmental Monitoring and Assessment, 171(1-4): 1-2(2)
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	Laudon, Hjalmar; Stephen, Norton, 2010, Drivers and evolution of episodic acidification at the Bear Brook Watershed in Maine, USA, Environmental Monitoring and Assessment, 171(1-4): 59-69.
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	Simon, Kevin; Michael, Chadwick; Alexander, Hury; H.,Valett, 2010, Stream ecosystem response to chronic deposition of N and acid at the Bear Brook Watershed, Maine, Environmental Monitoring and Assessment, 171(1-4): 83-92.
	Amirbahman, Aria; Brett, Holmes; Ivan, Fernandez; Stephen, Norton, 2010, Mobilization of metals and phosphorus from intact forest soil cores by dissolved inorganic carbon, Environmental Monitoring and Assessment, 171(1-4): 93-110.
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	Fernandez, Ivan; Mary, Adams; Michael, SanClements; Stephen, Norton, 2010, Comparing decadal responses of whole-watershed manipulations at the Bear Brook and Fernow experiments, Environmental Monitoring and Assessment, 171(1-4): 149-161.

Awards and Achievements

[None reported in IPRS.]