

New Hampshire WRRC Information Transfer

Basic Information

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Principal Investigators:	Michelle Daley

Publications

1. 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.
2. 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.
3. Hope, A.J., W.H. McDowell, W.M. Wollheim, Submitted, Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream, Biogeochemistry.
4. 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.
5. 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.
6. Hope, A.J., W.H. McDowell, W.M. Wollheim. 2013. Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream. Biogeochemistry. September 2013. DOI 10.1007/s10533-013-9900-y
7. Liptzin, D., M.L. Daley, and W.H. McDowell. 2013. A comparison of wet deposition collectors at a coastal rural site. Water, Air, & Soil Pollution. 224(5):1558. 2013.
8. Heffernan, J.B., P.A. Soranno, M.J. Angilletta, L.B. Buckley, D.S. Gruner, T.H. Keitt, J.R. Kellner, J.S. Kominoski, A.V. Rocha, J. Xiao, T.K. Harms, S.J. Goring, L.E. Koenig, W.H. McDowell, H. Powell, A.D. Richardson, C.A. Stow, R. Vargas, K.C. Weathers. 2014. Macrosystems ecology: understanding ecological patterns and processes at continental scales. *Frontiers in Ecology and the Environment* 12: 5-14.
9. Kaushal, S.S., W.H. McDowell, and W.M. Wollheim. 2014. Tracking evolution of urban biogeochemical cycles: past, present, and future. *Biogeochemistry* 121:1-21.
10. Koenig, L.E., A.J. Baumann, and W.H. McDowell. 2014. Improving automated phosphorus measurements in freshwater: an analytical approach to eliminating silica interference. *Limnology and Oceanography: Methods*. *Limnology and Oceanography: Methods*. 12:223–231. DOI: 10.4319/lom.2014.12.223. March 2014.
11. McDowell, W.H. 2014. NEON and STREON: opportunities and challenges for the aquatic sciences. *Freshwater Science* 34:386-391.

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12. Meyer, A. 2014. Response of ammonium uptake to carbon availability in an agriculturally influenced first order stream. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 50 pages.
13. Shonka, N. 2014. Water quality sensors provide insight into the suspended solids dynamics of high flow storm events in the Lamprey River. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 93 pages.
14. Sullivan, M. 2014. Groundwater nitrogen attenuation in suburban and urban riparian zones. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 94 pages.
15. Appling, A. Leon, M. and McDowell, W.H. 2014. Reducing bias and quantifying uncertainty in watershed flux estimates: The R package loadflex. Submitted December 2014 to Ecosphere.

Information Transfer

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

This project provided salary for the Center's Associate Director to meet with state representatives, local town officials, watershed groups, school groups, the general public and scientists to discuss WRRC findings that relate to population growth and land use change. The NH WRRC website (<http://www.wrrc.unh.edu/>) is also used to disseminate information on water resources, and is updated and maintained by salary provided by this project. The time of the Director and Associate Director is increasingly spent discussing current and future research in the Lamprey River Hydrologic Observatory, which is partially funded by the longstanding 104B project "Water Quality and the Landscape: Long-term monitoring of a rapidly developing suburban watershed" and on nitrogen dynamics in New Hampshire's Great Bay watershed. On January 9, 2015 the NH WRRC totally funded and organized the **Eighth Annual Lamprey River Symposium** (see also below). Presentations focused on water quality, hydrology, stormwater, climate and landuse change, aquatic species and habitat, watershed planning and nitrogen cycling in coastal New Hampshire. The symposium attracted approximately 90 attendees, including scientists, regional leaders, town officials, members of state agencies, and federal agencies. The agenda can be found on the NH WRRC Lamprey River Hydrologic Observatory Symposium [website](#). This annual symposium and other discussions in which the Center's Director and Associate Director participate further the research and information transfer goals of the NH WRRC.

2014 Information Transfer Activities Supported by Section 104b Funding and Matching Funds

Data sharing with Lamprey River watershed local advisory committee

The Lamprey River Advisory Committee (LRAC) is undergoing a long-term analysis of Lamprey River water quality data collected by both the Lamprey River Watershed Association's (LRWA) volunteer monitoring program and the NH WRRC 104B project "Water Quality and the Landscape: Long-term monitoring of a rapidly developing suburban watershed". The NH WRRC associate director serves on the LRAC and is a member of the water quality sub-committee which is advising a LRAC funded intern who is conducting the long-term water quality analysis. Preliminary temporal and spatial trends in dissolved oxygen and pH have been examined thus far and further analysis is underway.

Nitrogen Data in New Hampshire's Great Bay watershed

Over the six years, there has been significant focus on nitrogen loading to New

Hampshire's largest estuary, the Great Bay estuary, and the impairment to aquatic life it has caused. In August 2009, Great Bay, Little Bay and the tidal rivers were added to the New Hampshire 2008 303d list of impaired waters rendering them in violation of the federal Clean Water Act. Based on the most recent "State of Our Estuaries Report" prepared by the Piscataqua Region Estuaries Partnership (PREP 2013), 32% of the nitrogen entering Great Bay and Little Bay is from point sources; the majority (68%) enters via non-point sources of pollution. The Lamprey River is the largest tributary to Great Bay, and thus the long-term data provided by the NH WRRC from the LRHO are of considerable value for watershed management. The NH WRRC provides the best dataset in NH for assessing the spatial and temporal variability in N concentrations and export in response to suburbanization and changes in land use. These 14+ years of data will be instrumental in assessing the success of current and future efforts to reduce non-point sources of nitrogen pollution reaching Great Bay. There is much interest in LRHO datasets from NH Department of Environmental Services (DES), PREP, the Environmental Protection Agency (EPA) and other municipal, regional, state and federal agents. Many of the presentations and meetings listed below focused on transferring information on nitrogen cycling to stakeholders throughout NH's coastal watershed and beyond. The NH WRRC has received several phone calls and meeting requests to discuss the Great Bay nitrogen issue. The NH WRRC has been specifically asked to present coastal NH nitrogen data to the following groups: the NH Shoreland Advisory Committee, the Water Integration for Squamscott-Exeter (WISE) and Green Infrastructure (GI) NERRS Science Collaborative projects and the Southeast Watershed Alliance.

Water quality monitoring advice for wood restoration projects in NH streams

The Natural Resources Conservation Service (NRCS) and Trout Unlimited (TU) have selected 23 Wetlands Reserve Program (WRP) properties in NH for possible wood loading restoration work. The project plan is to add wood into small segments of 1st and 2nd order stream channels (averaging about 1,000 feet) on 15 properties in the summer of 2015 with the goal of recreating and increasing fish spawning and rearing habitat. A supplemental goal of this work is to study the changes in water quality and nutrient uptake which may be enhanced by adding carbon (in the form of wood) to streams. The NH WRRC Director, Associate Director and the WQAL manager have been advising the NRCS and TU on how to best understand changes in water quality and nutrient dynamics with existing financial resources.

Symposia, Conferences and Seminars Organized and Funded

The NH WRRC funded and organized the "**Eight Annual Lamprey River Symposium**" held January 9, 2015 in Durham, NH. The symposium is dedicated to exchanging the results of recent research on the water quality, hydrology, water resources issues, and management of the Lamprey River basin. The Symposium is a vehicle for researchers to share data and insights with other researchers, as well as those in the management and policy arena who would benefit from exposure to the latest research on the watershed. The symposium drew approximately 90 attendees, including researchers, legislators, water system operators, town officials, regional leaders and government officials. The symposium contained 14 presentations split up over three sessions. There was a poster session during and after lunch where 7 posters and displays were exhibited. The day ended with an open discussion on research priorities in the Lamprey

watershed and southeast NH. This event was funded and organized by the NH WRRC. Staff from UNH cooperative extension and Great Bay National Estuarine Research Reserve helped moderate the open discussions and NH EPSCoR assisted with registration and printing. Survey results indicate that most of the attendees found the topics covered to be either helpful or very helpful.

The NH WRRC sponsored the “**NH Water and Watershed Conference**” in Plymouth, NH on March 21, 2015. This event was designed to meet the information and networking needs of lake, river, and watershed groups; environmental organizations; volunteer monitors; municipal board and staff members; elected officials; local and regional planners; policy makers; scientists; educators; consultants and students. The focus for the 2014 conference was on the sustainability of New Hampshire’s water resources. The NH WRRC co-sponsored this conference along with Plymouth State University and the Center for the Environment, NH EPSCoR, NH DES, US Geological Survey New England Water Science Center and a few others. The conference contained 5 concurrent sessions including the sustainability of New Hampshire’s water resources, integrating science with decision making for water resources, climate change and water resources, emerging issues in water and public health and integrated land use planning for water resources. The conference drew approximately 250 people, including researchers, legislators, water system operators, land use planners, and government officials.

Publications

Heffernan, J.B., P.A. Soranno, M.J. Angilletta, L.B. Buckley, D.S. Gruner, T.H. Keitt, J.R. Kellner, J.S. Kominoski, A.V. Rocha, J. Xiao, T.K. Harms, S.J. Goring, L.E. Koenig, W.H. McDowell, H. Powell, A.D. Richardson, C.A. Stow, R. Vargas, K.C. Weathers. 2014. Macrosystems ecology: understanding ecological patterns and processes at continental scales. *Frontiers in Ecology and the Environment* 12: 5-14.

Flint, S.F. and W.H. McDowell. 2015. Effects of headwater wetlands on dissolved nitrogen and dissolved organic carbon concentrations in a suburban New Hampshire watershed. *Freshwater Science* 34:456-471.

Kaushal, S.S., W.H. McDowell, and W.M. Wollheim. 2014. Tracking evolution of urban biogeochemical cycles: past, present, and future. *Biogeochemistry* 121:1-21.

Koenig, L.E., A.J. Baumann, and W.H. McDowell. 2014. Improving automated phosphorus measurements in freshwater: an analytical approach to eliminating silica interference. *Limnology and Oceanography: Methods*. *Limnology and Oceanography: Methods*. 12:223–231. DOI: 10.4319/lom.2014.12.223. March 2014.

McDowell, W.H. 2014. NEON and STREON: opportunities and challenges for the aquatic sciences. *Freshwater Science* 34:386-391.

Meyer, A. 2014. Response of ammonium uptake to carbon availability in an agriculturally influenced first order stream. M.S. Dissertation, Department of Natural Resources & the

Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 50 pages.

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Sullivan, M. 2014. Groundwater nitrogen attenuation in suburban and urban riparian zones. M.S. Dissertation, Department of Natural Resources & the Environment, College of Life Science and Agriculture, University of New Hampshire, Durham, NH, 94 pages.

Appling, A. Leon, M. and McDowell, W.H. 2014. Reducing bias and quantifying uncertainty in watershed flux estimates: The R package loadflex. Submitted December 2014 to Ecosphere.

Conference Proceedings & Abstracts:

Appling, A.P. McDowell, W. H., Potter, J. D., Nelson, S. J., Kahl, J. S. 2014. From the frying pan into the fire? Lake greenhouse gas responses to acid rain recovery. Joint Aquatic Sciences Meeting. Portland, OR. May 2014.

Bucci, J. P., I. Sidor, A. Walant, M. Daley, J. Potter, W. McDowell. 2014. Detection of a Mitochondrial DNA Biomarker in Surface Water within Suburban Streams Impacted by Animal Fecal Waste: Does Flow Matter. American Society for Microbiology 2014 General Meeting. Boston, MA. May 2014.

Daley, M.L., J.D. Potter, A. Kobylinski, C. French, S. Miller, C. Keely, J. Bucci, W.H. McDowell. 2014. Collaborative science to identify non-point nitrogen sources in a coastal New England watershed and reduce nitrogen delivery to an impaired estuary. Joint Aquatic Sciences Meeting. Portland, OR. May 2014.

Diemer, L. A., McDowell, W. H., Prokushkin, A. S. 2014. Nutrient uptake decreases along a gradient of DOC:NO₃ in arctic streams of central Siberia. Aquatic Sciences Meeting. Portland, OR. May 2014.

Koenig L.E., A. Ramirez and W.H. McDowell. 2014. Quantifying carbon losses from tropical watersheds: The effects of urbanization on organic and inorganic carbon flux. Joint Aquatic Sciences Meeting. Portland, OR. May 2014.

McDowell, W.H., Potter, J. D., Daley, M. L., Snyder, L., Mulukutla, G. 2014. Using sensors and sensor networks to quantify ecosystem services in developed and rural watersheds. Joint Aquatic Sciences Meeting. Portland, OR. May 2014.

- McDowell, W.H. Freshwater Science: Lessons Learned and Looking Ahead. Plenary Address, First Annual Symposium on Aquatic Science, University of Maine, Orono, Maine. January 29, 2015. (CZO, LTER, EPSCoR, and NH AES)
- Potter, J.D. Snyder, L., Mulukutla, G., McDowell, W. H. 2014. Addressing anthropogenic effects on aquatic biogeochemistry using a distributed sensor network in New Hampshire. Joint Aquatic Sciences Meeting. Portland, OR. May 2014.
- Rodriguez-Cardona, B. and McDowell, W.H. 2014. Nitrate uptake kinetics in suburban streams of New Hampshire. NH Water and Watershed Conference. Plymouth, NH. March 21, 2014.
- Rodriguez-Cardona, B., McDowell, W. H. 2014. Nitrate uptake kinetics in suburban streams of New Hampshire. Joint Aquatic Sciences Meeting. Portland, OR. May 2014.
- Shonka, N. 2014. Water quality sensors provide insight into the suspended solids dynamics during high flow events in the Lamprey River, NH. NH Water and Watershed Conference. Plymouth, NH. March 21, 2014.
- Shonka, N. and McDowell, W.H. 2014. Using In-situ water quality sensors to provide insight into the suspended solids dynamics of high flow storm events in the Lamprey River, New Hampshire. Joint Aquatic Sciences Meeting. Portland, OR. May 2014.
- Shonka, N., Potter, J., Daley, M., McDowell, W., Snyder, L. and Mulukutla, G. 2014. New Hampshire EPSCoR Intensive Aquatic Sensor Network: The Data are Flowing Fast. Climate change poster session with William Hohenstein, USDA Climate Change Program Director, and David Hollinger, Hub Leader, Northeast Regional Hub for Risk Adaptation and Mitigation to Climate Change. University of New Hampshire. Durham, NH. May 13, 2014.
- Shonka, N. 2014. Sensing Suspended Solids: Using in-situ water quality sensors to provide insight into the suspended solids dynamics of high flow storm events in the Lamprey River. Climate change poster session with William Hohenstein, USDA Climate Change Program Director, and David Hollinger, Hub Leader, Northeast Regional Hub for Risk Adaptation and Mitigation to Climate Change. University of New Hampshire. Durham, NH. May 13, 2014.
- Wymore, A. S., Mineau, M. M., Potter, J. D., Marks, J. C., McDowell, W. H. 2014. Leaf litter leachate controls bacterial communities and ecosystem processing rates. Joint Aquatic Sciences Meeting. Portland, OR. May 2014.
- Wymore, A.S. et al. 2014. Identifying the Sources of Dissolved Organic Matter in Streams Using Elemental Analysis Isotopic Ratio Mass Spectroscopy (EA-IRMS) Across a Land Use Gradient. American Geophysical Union Fall Meeting. San Francisco, CA. December 2014.

Presentations/Information Transfer

- Appling, A. 2015. Patterns and drivers of diel solute cycles in headwater streams. Annual Lamprey River Science Symposium. University of New Hampshire, Durham, NH. January 9, 2015.
- Daley, M.L. 2014. Shared preliminary Great Bay N Sources and Transport NERRS Science Collaborative project results with Brian Giles and Mitch Kalter who are representatives of the Piscataqua Region Estuaries Partnership serving as ad hoc science advisory committee members of the NH Shoreland Advisory Committee. The purpose was to see how the latest science from the project can be used to evaluate the current shoreland standards embodied in RSA 483-B, Shoreland Water Quality and Protection Act. April 16, 2014.
- Daley, M.L. 2014. Presentation and field trip on “What it’s like to be a scientist and how I became a water quality scientist” with 20 3rd graders from the Maple Street Magnet School Rochester NH. Students learned how to measure pH, temperature, dissolved oxygen and conductivity in the Cocheco River using field meters and they gained an understanding of how to interoperate these water quality values. June 18, 2014.
- Daley, M.L. 2014. Research on nitrogen in the Great Bay watershed: Learn how diffuse sources of nitrogen pollution travel from our communities to the Great Bay. Scheduled for Contemporary Coastal Issues sail on the Gundalow in Portsmouth, NH on July 23, 2014 but sail was cancelled last minute due to thunderstorms. Will reschedule.
- Daley, M.L. 2014. Advised Bauneg Beg Lake Association on lake sampling for dissolved oxygen and phosphorus. August 4, 2014.
- Daley, M.L. 2014. Led field trip for undergraduate and graduate students to sites in the Lamprey River Hydrologic Observatory. September 16, 2014.
- Daley, M.L. 2014. Water Quality Research in the Lamprey River Hydrologic Observatory. Presentation to University of New Hampshire undergraduate class: Studio Soils. October 25, 2014.
- Daley, M.L. 2014. Presented Great Bay N Sources and Transport project results to members of the Water Integration for Squamscott-Exeter (WISE) and Green Infrastructure (GI) NERRS Science Collaborative projects to facilitate collaboration on water resource issues. October 30, 2014.
- Daley, M.L. 2014. Great Bay watershed management. Presentation to University of New Hampshire class: Watershed Water Quality Management. December 2, 2014.
- Daley, M.L. 2014. Presented Great Bay N Sources and Transport project results to the PREP management committee. Kittery, ME. December 9, 2014.

Daley, M.L. 2015. Non-point nitrogen sources and transport in the Great Bay watershed. Annual Lamprey River Science Symposium. University of New Hampshire, Durham, NH. January 9, 2015.

Daley, M.L. 2015. Non-Point Nitrogen Sources and Transport in the Great Bay watershed. Southeast Watershed Alliance Quarterly Meeting. February 4, 2015. Lee, NH.

Daley, M.L. 2015. Forests, Farms, and People: How different sources contribute nitrogen to Great Bay. 2015 NH Farm & Forest Exposition. February 9, 2015. Manchester, NH.

Koenig, Lauren. 2014. Co-lead the NH Envirothon Aquatics portion (training day). Approximately 75 middle to high school students and 5-10 secondary ed. teachers in attendance from across NH. Sanborn Farm, Pittsfield, NH. April 5, 2014.

Koenig, Lauren. 2014. Served as an instructor for the STEM mini-course offered August 25-29th through the CONNECT program at UNH (<http://www.unh.edu/connect/>). The objective of the course is to help incoming freshmen that come from groups with historically low retention in STEM majors (e.g. low-income, multicultural, first-generation college students) build skills that are needed to succeed in their academic programs (e.g., writing of lab/research reports, basic math and statistics for analyzing scientific data). There were 12 students in the class, but the broader CONNECT program serves approximately 100 students.

- Students measured soluble reactive phosphorus (SRP) concentrations across sites with different land uses for their project (WHB, LMP73, Burley Demeritt, College Brook and Pettee Brook). They had to give a general presentation to the entire CONNECT program (including non-STEM majors), so to best communicate their study, they chose to combine a traditional science powerpoint presentation with a music video. Their version of “These boots were made for sampling” - <http://www.youtube.com/watch?v=IQCZ4XEwj7c&feature=share>.

McDowell, William H. July 22, 2014. Interviewed by NHPR for The Exchange talk show with Laura Knoy about the continued recovery of New England’s lakes after several decades of pollution.

McDowell, William H. September 12, 2014. Interviewed live by John Dankosky from Connecticut Public Radio along with Dr. Kaushal on “Understanding the Urban Ecosystem”. <http://sciencefriday.com/segment/09/12/2014/understanding-the-urban-ecosystem.html>.

McDowell W.H. 2014. McIntire Stennis one pager for REE Mission booth at the IUFRO World Congress featured outcomes from the “Water Quality in a Fragmenting Forested Landscape” McIntire Stennis project. September 2014.

McDowell, W.H. 2015. Do sensors matter? Improved precision in flux estimates with continuous data. Annual Lamprey River Science Symposium. University of New Hampshire, Durham, NH. January 9, 2015.

McDowell, W.H. 2015. Served on a panel discussion: “Building a Scholarly Agenda” University of New Hampshire Research and Engagement Academy. January, 23 2015. Durham, NH.

Snyder, L. 2015. Enhanced protocols for managing a network of modern water quality sensors. Poster. Annual Lamprey River Science Symposium. University of New Hampshire, Durham, NH. January 9, 2015.

Wymore, A. 2015. Identifying sources of dissolved organic matter (DOM) in streams using EA-IRMS and Py-GC/MS across a land-use gradient. Annual Lamprey River Science Symposium. University of New Hampshire, Durham, NH. January 9, 2015.

Press Releases

Humphries, C. 2014. The city is an ecosystem, pipes and all. What scientists are finding when they treat the urban landscape as an evolving environment of its own. McDowell, W.H. interviewed for article on October 6, 2014. Published in The Boston Globe on November 7, 2014. <http://www.bostonglobe.com/ideas/2014/11/07/the-city-ecosystem-pipes-and-all/HjLVemBs9nPiuE53PjPSLK/story.html>.

McDowell September 10, 2014. UNH Scientists Find Urban Ecosystems “Evolve,” Require Sustainable Management. University of New Hampshire press release. September 10, 2014. <http://www.unh.edu/news/releases/2014/09/ds10evolve.cfm#ixzz3D10ttLHP>.

McDowell, W.H. 2014. A river runs through it: U.S. cities' waterways show consistent patterns of evolution. NSF press release. September 10, 2014. http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=132583&org=NSF

McDowell, William H. September 23, 2014. Interviewed for the “University of Maryland professor tailors watershed test to urban areas like College Park” press release. The Diamondback. The University of Maryland’s Independent Student Newspaper. http://www.diamondbackonline.com/news/article_5128a2e2-42b5-11e4-b909-001a4bcf6878.html.

Meetings attended

Daley, M.L. 2014. NH Water and Watershed Conference. Plymouth, NH. March 21, 2014.

Daley, M.L. 2014. Models of the Great Bay Symposium. Hosted by SWA. Greenland, NH. April 18, 2014.

Daley, M.L. 2014. Met with NH Fish and Game, NRCS and Trout Unlimited to discuss water quality monitoring of adding wood to streams for stream restoration. May 5, 2014.

Daley, M.L. 2014. Met with Lamprey River Advisory Committee water quality sub-committee to discuss long-term trends in dissolved oxygen levels in the Lamprey. May 4, 2014.

Daley, M.L. 2015. Met with Green Mountain Conservation Group to discuss 10 year water quality report. December 16, 2015.

Daley, M.L. 2015. Met with NH Fish and Game, NRCS and Trout Unlimited to discuss water quality monitoring of adding wood to streams for stream restoration. January 20, 2015.