



Watershed Based Plan for the High Quality Waters of the AWWA Region

A Final Report to

The New Hampshire Department of Environmental Services

Submitted by

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Jane B Cook 1983 Charitable Trust
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Town of Acton, Maine
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Great East Lake Improvement Association
Lovell Lake Association
Wilson Lake Association
Local businesses
Generous individual donors

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Executive Summary

The *Salmon Falls Headwater Lakes Watershed Management Plan* is a reflection of the interests and ideas put forth by a dedicated group of individuals to protect and restore the water quality of the lakes that form the headwaters of the Salmon Falls River on the border of New Hampshire and Maine. The Acton Wakefield Watersheds Alliance (AWWA) coordinated this project as a catalyst for strengthening the efforts to protect the region's waters for **environmental health** and economic stability.

AWWA developed the pro-active watershed-based management plan for the high quality lake watersheds that flow into the Salmon Falls River including Great East Lake, Lake Ivanhoe, Horn Pond, Wilson Lake and Lovell Lake. The plan evaluated available data to determine realistic long-term water quality goals; conducted watershed surveys to identify sources of pollution; reviewed local land use regulations; mitigated identified erosion issues with its existing Youth Conservation Corps; and conducted an outreach campaign designed to raise stakeholder stewardship.

The Steering Committee, including community decision-makers and interested citizens, met throughout the project period and developed a community-driven Action Plan that identified five key action categories. Implementation of the watershed based plan will result in stable or improved water quality and will be verified through continued water quality monitoring and other measurable results including calculations of reductions of phosphorus inputs to the waterbodies.

The project began on January 21, 2008 and concluded in March of 2010 excepting the completion of this report. The total project cost was \$318,363 which included the \$108,266 grant award and \$210,097 non-federal match. Match was contributed as follows:

Alden N. Young Trust	\$50,000	Town of Acton ME	\$ 8,875
Jane B Cook 1983 Charitable Trust	\$20,000	Lake associations	\$ 3,050
Adelard & Valeda Roy Foundation	\$ 5,000	Individual donations	\$ 5,771
NH Charitable Foundation	\$20,000	In-kind and volunteer time	\$73,401
Town of Wakefield NH	\$24,000		

In addition to the excellent support from the NH Department of Environmental Services Watershed Assistance Section and particularly Project Manager Sally Soule, AWWA's project partners included:

FB Environmental Associates	Round Pond/Lake Ivanhoe Association
Great East Lake Improvement Association	Three Rivers Land Trust
Horn Pond Association	Town of Acton
Lovell Lake Association	Town of Wakefield
Maine Congress of Lake Associations	UNH Cooperative Extension
Maine Department of Environmental Protection	UNH Lakes Lay Monitoring Program
Moose Mountains Regional Greenways	Wilson Lake Association

All nine objectives of the Salmon Falls Headwater Lakes Management Plan project were met over the course of the project period.

- The AWWA staff and Board of Directors worked diligently to identify capacity needs and provide all necessary ability to successfully manage the project.
- Through a community forum, meetings with community groups and review of local ordinances the needs and priorities for the plan were determined.
- Over 2000 watershed landowners were notified about the whys and hows of watershed surveys and over 100 volunteers were trained to survey the watershed properties, 36 people attended Septic Socials and eight presentations were given 300 members of lake association and community groups. Signage highlighting the YCC projects is becoming a well recognized site along the lakeshores.
- Exhaustive collaboration between the water quality experts in both New Hampshire and Maine resulted in the setting of phosphorus water quality goals for all five project lakes.
- Current and future pollution sources were identified and quantified by on-the-ground volunteer watershed surveys and complex computer modeling performed by FB Environmental. FBE then determined the phosphorus reductions needed to achieve the goal.
- In January 2009, 32 stakeholders gathered to provide valuable input for the plan. The ideas were refined into an Action Plan by the Steering Committee in March and May of 2009. With the assistance of FBE these actions were further defined, and time-frames and associated costs were set.
- The UNH Lakes Lay Monitoring program coordinated the volunteer water quality monitor training and analyzed all the collected data over the course of the project period.
- The AWWA Youth Conservation Corps (YCC) completed 23 projects, by installing 76 BMPs to fix erosion or runoff problems at both private and public sites. The Technical Director offered technical assistance to an additional 50 landowners interested in learning solutions to their erosion issues.
- The Salmon Falls Headwater Lakes Watershed Plan was presented on January 23, 2010 to 40 enthusiastic community members. The feedback from the presentation was incorporated and the final edition was published in March. It was distributed widely to stakeholder groups throughout the watersheds and a steering committee has been established to oversee implementation of the plan recommendations.

Introduction

The Acton Wakefield Watersheds Alliance (AWWA) is a non-profit volunteer organization formed in 2004 to protect and improve water quality in the lakes and streams in the Acton, ME, Wakefield, NH border region and ultimately in the rivers, estuaries and bays into which they flow. The Alliance is registered with the State of New Hampshire and holds 501(c)3 status. AWWA has nine active directors and officers who bring a wide range of expertise and affiliations to the group. The mission of the Acton Wakefield Watersheds Alliance is to protect the watersheds and preserve or restore the water quality of lakes and streams located primarily in, but not limited to, Wakefield, NH and Acton, ME. AWWA focuses its efforts on prevention of pollution from and education about the effects of non-point source pollution, primarily as it is delivered through stormwater.

In 2006, AWWA received a 319 grant from the NH DES to initiate a Youth Conservation Corps program. In its first year the YCC; which is comprised of a Technical Director, Crew Leader and four - six high school age crew members; completed 10 projects on four lakes resulting in the prevention of 15+ tons of sediment from reaching the receiving waterbodies. The YCC Technical Director designed an additional 35 technical assistance plans for properties on eight lakes and ponds. Homeowners pledged to complete at least one of the recommended designs. Project sites were chosen from all the requests based on a set of seven criteria with the most important being the amount of potential pollution prevention.

In 2007 increased municipal support and additional grant monies enabled the AWWA YCC to expand its summer season with the crew working on weekends in June and September to install projects on municipal sites along local rivers and streams. Over the course of the full season the YCC completed a total of 20 projects resulting in an additional estimated sediment load reduction of over 15 tons. The Technical Director provided an additional 25 technical assistance visits.

Prior to this grant project period AWWA board members had been actively promoting water resource awareness in the communities. They presented a shorefront landscaping workshop, taught in the local schools, worked with the town boards, presented at local lake association meetings and staffed informational displays and activities at community events. AWWA encouraged regular press coverage for its activities and was featured in the local newspapers on several occasions.

The project area encompasses the headwaters of the Salmon Falls River which includes the watersheds of Lake Ivanhoe, Great East Lake, Wilson Lake, Horn Pond, and Lovell Lake. These watersheds cover approximately 26 mi² along the border of New Hampshire and Maine. The Salmon Falls River forms the state border to its confluence with the Cocheco River in Dover, NH where it becomes the Piscataqua River and flows into the Gulf of Maine. Lake Ivanhoe and Lovell Lake are entirely in NH, Wilson Lake is in ME and Great East Lake and Horn Pond are bisected by the border.

Both communities are primarily rural and forested with very little industrial or commercial development. While much of the land is undeveloped very little is permanently protected through conservation easements. The Hydrologic Unit Codes are 010600030403 and 010600030401.

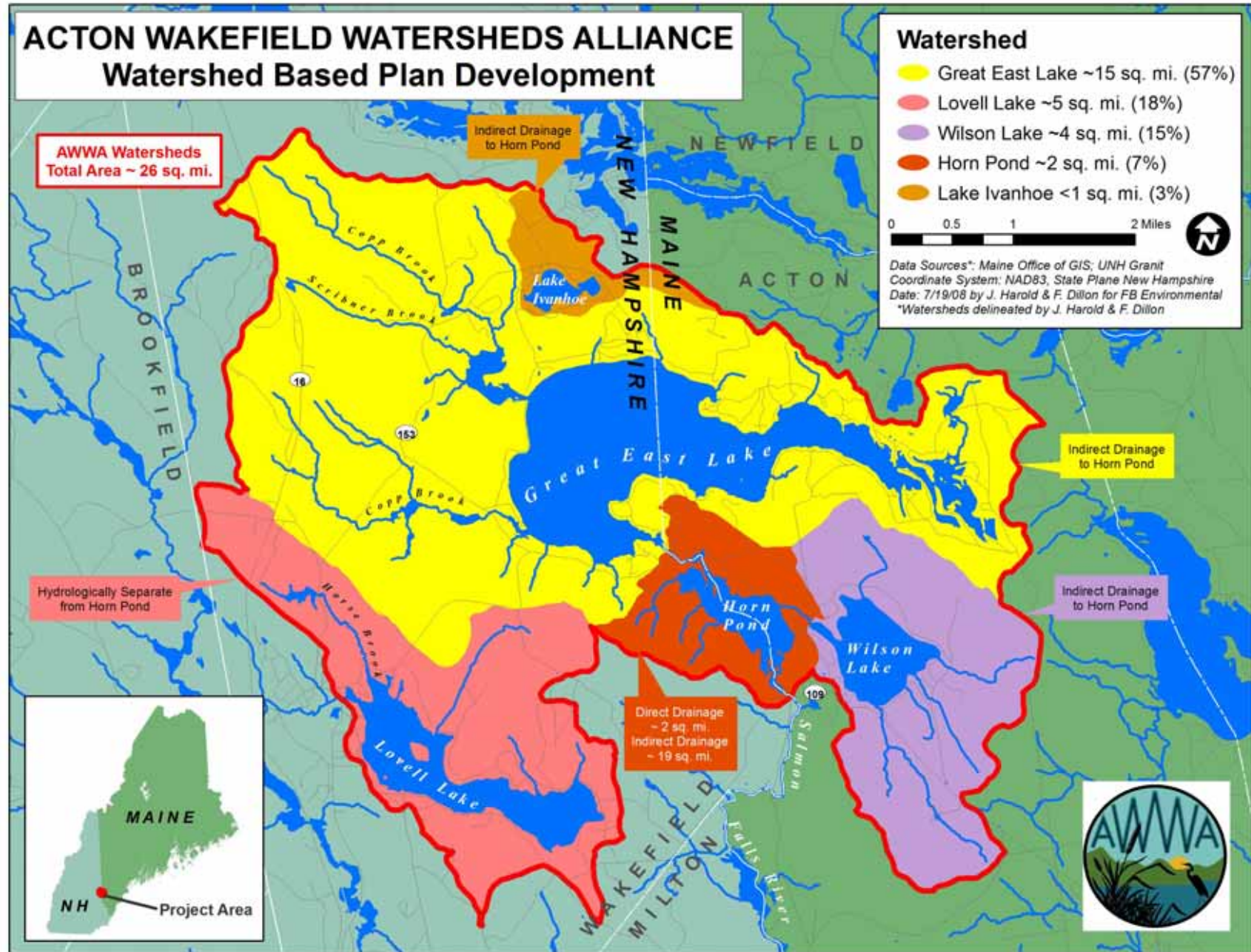
After two years of focusing on the YCC program AWWA directors recognized the need for a more comprehensive understanding of the watershed characteristics, potential problems and threats and current water quality of the lakes. AWWA chose to focus on the Salmon Falls headwater lakes based on available data for analysis and the stakeholder support from the communities and lake associations.

The lakes are a valuable resource in these communities providing recreation, relaxation, drinking water and a large percentage of the town revenues in the form of property taxes. Lakes and their surrounding lands also provide habitat for plants, wildlife and aquatic life. While clean water is essential for all life, pollution and irresponsible water use plague the waterbodies, making proactive protection of water resources essential. The Acton-Wakefield region in Western Maine and Eastern New Hampshire has an economy that depends greatly on the local waterbodies, including those that form the Salmon Falls Headwaters.

It is estimated in Maine that the State's lakes generate 13 million annual recreation user days and New Hampshire's lakes generate nearly 15 million recreation user days per year. This generates more than 1.1 billion dollars in total sales (for boating, fishing, and swimming) in each state. Additionally, lakefront property owners in these states contribute nearly \$600 million per year in property taxes. The value of lakes (including property values) declines when water quality declines. Therefore it is essential to find the balance between environmental quality and economic growth that benefits these valuable waterbodies.

The desired outcome of this project was to maintain and protect the water quality of the high quality waters of the AWWA region including Great East Lake, Horn Pond, Lake Ivanhoe, Lovell Lake and Wilson Lake, through the development of a watershed management plan and establishment of water quality goals. Not only was the plan well received but the stakeholder involvement has engaged numerous individuals and groups in the discussion about the importance of healthy waters and empowered them to become active stewards through a variety of recommended action items.

Watershed Map



Project Performance Targets and Milestones

Objective 1: Organizational capacity is sufficient to carry out the requirements of the project.

How will you measure success? The AWWA Board has completed a visioning process to identify staffing, volunteer and partner needs. Necessary staff has been hired, partners identified, and volunteers recruited. Reports have been submitted in a timely manner, funding has been applied for and insurance has been purchased. (Yes or No)

- **Deliverable 1A:** The AWWA Board has completed a list of tasks and identified roles and responsibilities.
 - Task 1: Complete two visioning sessions to identify goals and tasks and present results to the Board.
 - Task 2: The Board accepts the job descriptions and agrees to hire staff.
- **Deliverable 1B:** AWWA staff has been hired and contracts have been signed.
 - Task 3: Hire staff and complete all necessary contracts.
- **Deliverable 1C:** Agreement with consultant has been completed.
 - Task 4: Distribute Requests for Qualifications (RFQ) to at least three firms.
 - Task 5: Review RFQ's and select qualified firm.
 - Task 6: Prepare and sign contract.
- **Deliverable 1D:** All required reports are submitted, funding options are investigated, insurance policy is contracted and administrative duties are complete.
 - Task 7: Document all project costs, match and revenues.
 - Task 8: Submit all required reports in a timely manner.
 - Task 9: Research and apply for funding.
 - Task 10: Purchase necessary liability insurance.

Objective 2: Community needs and priorities for watershed-based management plan have been determined.

How will you measure success? A community forum has been held, partnerships with local land conservation groups have been established and municipal Master Plans and ordinances have been reviewed. (Yes or No)

- **Deliverable 2A:** Community forum has been held.
 - Task 11: Plan and hold at least one community forum to establish stakeholder concerns and develop a vehicle for implementation of the plan.
- **Deliverable 2B:** Partnerships with local land conservation groups have been established.
 - Task 12: Meet with each local land conservation group to introduce the plan project.
- **Deliverable 2C:** Municipal Master Plans and ordinances have been reviewed.
 - Task 14: Review Municipal Master Plans and ordinances to determine opportunities to align them with the watershed-based management plan.
 - Task 15: Develop specific recommendations to align ordinances and Municipal Master Plans with the water quality goals of the watershed-based management plan.

Objective 3: Outreach activities will be conducted to increase stakeholder participation in the watershed-based management plan and encourage land-use practices that maintain or improve

water quality.

How will you measure success? At least 15 community residents attended the community forum, watershed survey outreach campaigns on each target waterbody have been conducted, at least one septic social has been held on each waterbody, presentations have been delivered to at least four community groups, and signage highlighting AWWA YCC projects is installed on at least 10 YCC BMP installation sites. (Yes or No)

- **Deliverable 3A:** Outreach campaigns for watershed surveys have been conducted.
 - Task 16: Prepare and send an explanation letter to each watershed landowner.
 - Task 17: Train survey volunteers
 - Task 18: Create and distribute brochures and press releases
 - Task 19: Plan, publicize and hold a public meeting to present the details of the watershed survey.
- **Deliverable 3B:** At least one “Septic Social”, coordinated with assistance from the York County Soil and Water Conservation District, is held on each target water body to educate landowners and change behaviors regarding septic system maintenance.
 - Task 20: Publicize each Septic Social to appropriate stakeholders
 - Task 21: Coordinate and deliver Septic Socials
 - Task 22: Document participation
- **Deliverable 3C:** Presentations about AWWA’s efforts and NPS pollution have been delivered to at least four lake associations, community organizations or other interested groups.
 - Task 23: Prepare presentations about AWWA’s efforts and NPS pollution
 - Task 24: Coordinate with AWWA Board and community organizations to deliver presentations.
- **Deliverable 3D:** Signage is installed at a minimum of 10 YCC BMP installation sites to increase AWWA visibility and encourage dialogue about NPS pollution solutions.
 - Task 25: Design and purchase signs.
 - Task 26: Install signs at a minimum of 10 YCC BMP installation sites.

Objective 4: Water quality goals that maintain the Tier 2 high quality water status as defined in the DES Antidegradation Provision are established for Great East Lake, Horn Pond, Lake Ivanhoe, Lovell Lake and Wilson Lake.

How will you measure success? Phosphorous water quality goals are set for each lake.

- **Deliverable 4A:** The Site Specific Project Plan (SSPP) has been developed using the Generic Watershed Management Plan (QAPP) to address assimilative capacity, watershed load modeling and BMP/ NPS load reduction management measures.
 - Task 27: Prepare draft SSPP and send it to DES for review
 - Task 28: Revise SSPP based upon DES review and comments
 - Task 29: Finalize SSPP
- **Deliverable 4B:** The high quality waters of the AWWA region have been demonstrated to meet the Tier 2 High Quality Water criteria for phosphorous.
 - Task 30: Gather existing water quality data and determine acceptability for use in analysis of assimilative capacity.

- Task 31: Analyze data to determine current median water quality for phosphorous identified in the watershed-based management plan.
- Task 32: Calculate the total assimilative capacity, reserve assimilative capacity, and remaining assimilative capacity for each water quality parameter being addressed in the watershed-based management plan.
- Task 33: Analyze data to verify that the current median water quality value determined in task 31 is greater than the reserve assimilative capacity.
- **Deliverable 4C:** The process for developing and establishing the water quality goal for phosphorous has been completed. At a minimum, the water quality goal must be greater than the 10 percent reserve assimilative capacity.
 - Task 34: Outline the process for determining the water quality goal.
 - Task 35: Carry out the process for determining the water quality goal.
 - Task 36: Formally document the water quality goal. This goal will be used to guide the development of watershed-based management plan.

Objective 5: Identify current and future pollution sources (EPA element a) and estimate pollutant reductions needed to maintain the water quality goal (EPA element b).

How will you measure success? Current and future pollutant source loads are identified and quantified and the phosphorous reductions needed to achieve the goal have been determined.

- **Deliverable 5A:** Identification of the current and future pollution source loads by land use type and source group by subwatershed for each parameter has been completed. Refining pollution source loads for each subwatershed based upon site specific knowledge may be necessary.
 - Task 37: Determine annual pollution source loads for each subwatershed using one or several models that may include STEPL.
 - Task 38: Develop a QAPP for watershed surveys.
 - Task 39: Complete watershed surveys for: Horn Pond, Lake Ivanhoe, Lovell Lake, and Great East Lake as described in the QAPP.
- **Deliverable 5B:** Pollution reductions needed to maintain the water quality goal and future watershed conditions have been estimated.
 - Task 40: Using trophic status models including at a minimum, Dillon-Rigler and Vollenweider, to determine in-lake phosphorus concentration, model the increased phosphorus source loading under future watershed conditions.
- Task 41: Analyze phosphorus concentration model outputs to determine phosphorus reductions needed to achieve the in-lake phosphorus water quality goal.

Objective 6: Determine actions needed to reduce the pollutant source loads in order to maintain the water quality goal (EPA element c).

How will you measure success? Specific actions, structural and non-structural, are identified for each lake.

- **Deliverable 6A:** A description of the NPS management measures that will need to be implemented to achieve the load reduction estimated under EPA element “b” above, and

an identification of the critical areas in which those measures will be needed to implement this plan.

- Task 42: Estimate the load reductions expected for the management measures described under EPA element c (recognizing the natural variability of the difficulty in precisely predicting the performance of management measures over time).
- Task 43: Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan (EPA element d).
- Task 44: Develop a schedule for implementing the NPS management measures. (EPA element f).
- **Deliverable 6B:** A method to measure the effectiveness of NPS management measures, once implemented, to achieve the load reductions necessary to meet the established water quality goals.
 - Task 45: Develop and describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented (EPA element g).
 - Task 46: Develop criteria to determine if substantial progress is being made towards attaining the water quality goals of the watershed-based plan. Develop a method for determining if the watershed-based management plan needs to be revised if the criteria indicate that water quality goals are not being met. (EPA element h).

Objective 7: Develop a monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under EPA element h (EPA element i).

How will you measure success? Monitoring program is developed and implemented. (Yes or No)

- **Deliverable 7A:** QAPP for UNH Lakes Lay Monitoring Program is approved.
 - Task 47: Prepare draft QAPP and send it to DES & EPA for review and comments
 - Task 48: Revise and finalize QAPP based on DES and EPA review and comments
- **Deliverable 7B:** Volunteer monitors are recruited and trained for each target waterbody.
 - Task 49: Work with lake associations to partner with or recruit volunteer monitors on each target lake.
 - Task 50: Partner with UNH LLMP to train or update each volunteer monitor.
- **Deliverable 7C:** Recommend future monitoring efforts to evaluate the effectiveness of the implementation efforts over time.
 - Task 51: Long term monitoring plan is developed and incorporated into the watershed-based management plan.

Objective 8: Best Management Practices (BMPs) have been implemented to correct identified NPS pollution problems.

How will you measure success? The AWWA Youth Conservation Corps (YCC) installed BMPs to fix erosion or runoff problems at a minimum of 15 private or public sites. (Yes or No)

- **Deliverable 8A:** BMPs are installed to fix erosion or runoff problems on a minimum of 15 private or public sites.

- Task 52: Meet with landowners to assess sites for possible projects determining most compromised properties and develop preliminary design.
- Task 53: Select project sites based on problem severity and geographical distribution.
- Task 54: Enter into Letters of Agreement with chosen site landowners.
- Task 55: Complete site-specific BMP designs, acquire necessary local and state permits and coordinate procurement of materials.
- Task 56: Implement completed designs on project sites using recommended BMPs.
- Task 57: Perform before and after photographic documentation and sediment load estimations.

Objective 9: Develop a watershed-based management plan for the AWWA high quality waters region and present the plans to the communities and lake associations.

How will you measure success? A plan is developed and presented to communities and lake associations.

- **Deliverable 9A:** A watershed-based management plan for the AWWA high quality waters region is developed.
 - Task 58: All data and information gathered during the previous project phases is gathered and reviewed for inclusion in the plan. (Including: water quality goals, pollutant loading, pollution reduction actions, outreach, regulatory review, monitoring, etc.)
 - Task 59: Recommendations identified in previous phases of the project are reviewed. Additional recommendations are prepared if appropriate.
 - Task 60: Plan is prepared (written and x copies are printed).
- **Deliverable 9B:** The watershed-based management plan is presented and distributed to communities and lake associations.
 - Task 61: Presentations are made to communities and lake associations.
 - Task 62: The plan is distributed to local stakeholders.
 - Task 63: AWWA meets to review the project and to discuss next steps.

Project Performance Target Verification

The AWWA staff and volunteers spent many hours ensuring that organizational capacity remains sufficient to successfully execute the projects as well as ensure that the organization will continue to thrive as a valuable resource for the communities in the campaign to protect water quality. They attended a number of capacity building programs offered by the NH Center for Nonprofits and the Maine Association of Nonprofits. The Executive Director continued to expand partnership opportunities to bring expertise to enhance the project performance. The ED was able to secure additional grants and local support to provide the necessary funding to complete the project.

The community forum held on January 16, 2009 brought community decision-makers from both Acton and Wakefield together for an interactive discussion that formed the basis for the stakeholder driven action plan. The Three Rivers Land Trust and the Moose Mountains Regional Greenways land trust groups became active partners and shared presentation times and outreach activities. FBE conducted a comprehensive review of both Towns' ordinances and master plans outlined in the "Municipal Ordinance Review" included in the Plan. This review inspired both Planning Boards to resolve to work together across town and state boundaries to strengthen their stormwater management ordinances.

3091 landowners received brochures explaining why and how the watershed surveys would be conducted on Great East Lake, Horn Pond, Lake Ivanhoe, Lovell Lake and Wilson Lake. Over 100 volunteers were trained to conduct the surveys and press releases announced the survey dates. Each survey began with a presentation open to the public about the benefits and protocols for conducting a watershed survey. The full watershed survey reports and summary sheets are included in Appendix B.

Joe Anderson of York County Soil and Water Conservation District led four Septic Socials to 36 interested stakeholders. AWWA staff developed and delivered presentations about NPS pollution, water quality and value of healthy waterbodies to the Great East Lake Improvement Association, the Lovell Lake Association, the Wilson Lake Association, the Horn Pond Association, the AWWA Annual Meeting, a NH DES Comprehensive Shoreland Protection Act forum and the YCC Season tours. Colorful signage is displayed at each of the YCC project sites and is becoming a recognizable announcement of a clean water partner.

Establishing the water quality goals for the target lakes proved challenging due to the cross-border nature of the project and the variations in the States' approach to setting water quality standards. A series of meetings and conferences took place between the Water Quality experts in the two states resulting in a tenuous consensus and the acknowledgement that continued investigation should occur in both states to further address the issue. Existing water quality data was exhaustively analyzed and assimilative capacities were determined. Continued discussion between the states would be helpful as other cross boundary lakes will likely face the same challenges.

Current and future pollution sources were identified with computer modeling and on-the-ground watershed surveys. Several models were utilized to help stakeholders understand the

state of the current water quality in the lakes, and to assist with quantifying necessary efforts to improve and protect them in the future. In order to estimate pollution flowing off of the land during storm events the project team analyzed current land uses and phosphorus inputs to the watershed. A separate model and ordinance review were used to estimate future water quality levels based on new development. In order to measure current inputs, the AWWA conducted watershed surveys with the help of over 100 local citizens to identify sites contributing excess phosphorus, the main pollutant of concern, to the project lakes and tributaries. Refer to the individual watershed survey reports in Appendix B for lake specific details.

The Plan

The *Salmon Falls Headwater Lakes Watershed Management Plan* was distributed to the Wakefield and Acton planning boards and conservation commissions, the local land trusts, lake associations, regional planning commissions and interested citizens. The full plan can be found in Appendix A.

Monitoring

The UNH Lakes Lay Monitoring Program (LLMP) coordinated the volunteer monitoring for Great East Lake, Horn Pond, Lake Ivanhoe and Lovell Lake. Volunteers with the Maine Volunteer Lakes Monitoring Program coordinated those on Wilson Lake. Copies of the reports are included in Appendix C.

YCC

The AWWA Youth Conservation Corps completed 23 erosion control projects exceeding its goal of 15 within the Salmon Falls Headwater Lakes watersheds. These projects included installation of 75 erosion control Best Management Practices (BMPs). Season reports are included in Appendix D.

Project Outcomes & Measurable Results

The outcome of this project was the development of a watershed-based plan. The Salmon Falls Headwater Lakes was published in March 2010 and distributed to local decision-makers.

The Plan incorporates all required elements of a High Quality Waters Plan as described in the DES guidance as follows:

- **Develop a Site Specific Project Plan (SSPP):**
The SSPP was developed by FB Environmental Associates and was submitted on December 29, 2008.
- **Collect and Verify Existing Water Quality Data (EPA key elements a & b):**
Trained water quality monitors had been collecting data for many years which was submitted to the UNH Lakes Lay Monitoring Program for verification and analysis.
- **Conduct Assimilative Capacity Analysis (EPA key element b):**
All water quality data was analyzed in depth by FB Environmental and assimilative capacity was determined for each individual lake.
- **Establish Water Quality Goal(s) (EPA key element h):**
A subcommittee of technical advisors from the NH Department of Environmental Services, Maine Department of Environmental Protection and UNH Center for Freshwater Biology worked with FBE and AWWA to establish the water quality goals for each lake.
- **Identify Current and Potential Future Pollution Sources (EPA key element a):**
Computer modeling, shoreline surveys and on-the-ground watershed surveys were conducted to identify existing and potential sources of phosphorus loading.
- **Estimate Pollution Limits or Reductions Needed (EPA key element b):**
FBE utilized all available data and information to estimate pollution limits and necessary reductions.
- **Develop Watershed Management Plan (EPA key elements c, d, f, g, h & i):**
FBE, AWWA and NH DES developed the plan, presented it to local stakeholders and published the final version in March 2010.
- **Develop Plan Verification System:**
FBE developed and included the “Methods for Measuring Success in Chapter 6 of the Plan.
- **Outreach and Education (EPA key element e):**
Many aspects of the project offered outreach opportunities including the volunteer watershed surveys, Youth Conservation Corps program, septic surveys, the stakeholder stakeholder forum, and the final Plan presentation.

A description of the monitoring activities is included in Appendix C. The reports describe related QA/QC activities conducted for the monitoring effort.

Conclusions and Recommendations

The publication and distribution of the *Salmon Falls Headwater Lakes Watershed Management Plan* marked a 100% successful project outcome. The presentation of the published plan and the interest it continues to generate are the foundation for future protection of these high quality waters. All facets of the watershed communities including local decision-makers, seasonal lake residents and upland landowners are beginning to exhibit a clear understanding of the importance of taking a pro-active approach to water quality protection.

The most obvious challenges to the project included the very detailed documentation required by the grant administration. The achievement of getting the varied stakeholders to the table was the most meaningful piece of the project as the engagement of the local decision-makers is the key to long-term commitment to water quality protection. Personal contact invitations to meetings and workshops proved to be very effective.

The Watershed Action Strategy included in the Plan detail the recommended action items. AWWA has applied for and received another NH DES Water Assistance Grant for High Quality Waters to begin implementation of some of those actions. In addition, AWWA assisted the Wakefield and Acton Planning Boards in their application to the Piscataqua Region Estuaries Partnership (PREP) Community Technical Assistance Program (CTAP) for assistance with strengthening the Towns' stormwater management regulations. The request was approved and the Stormwater Management Subcommittee will convene in September 2010.

Appendices

A. *Salmon Falls Headwater Lakes Watershed Management Plan*

16

B. Watershed Survey Reports

Great East Lake Watershed Survey Report

Horn Pond Watershed Survey Report

Lake Ivanhoe Watershed Survey Report

Lovell Lake Watershed Survey Report

Wilson Lake Watershed Survey Report

C. Water Quality Reports

Great East Lake

Horn Pond

Lake Ivanhoe

Lovell Lake

Wilson Lake

D. Youth Conservation Corps Season Reports

2007 YCC Season Report

2008 YCC Season Report

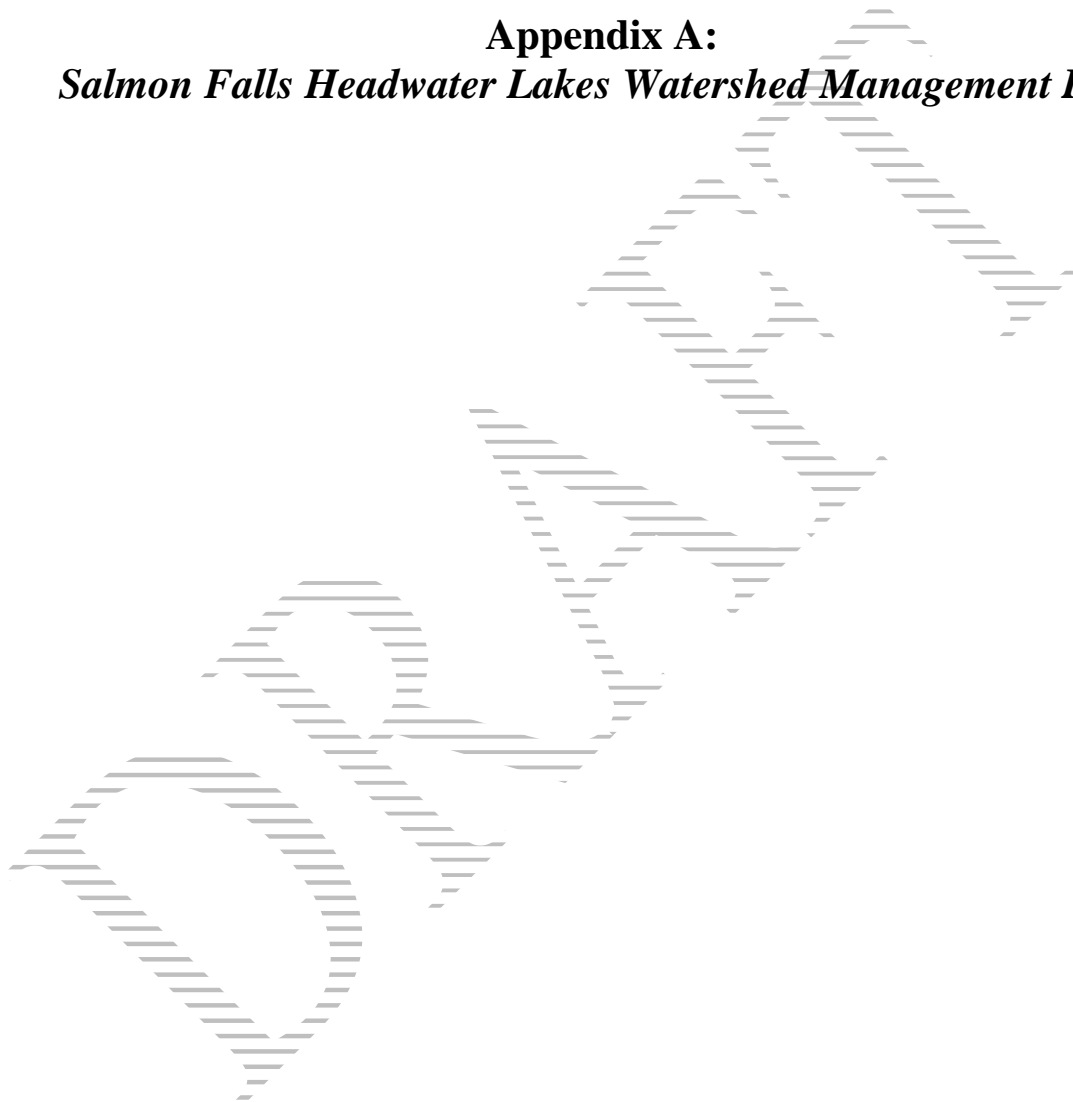
E. AWWA in the News

Salmon Falls Headwater Plan... Rochester News - Feb 2010

Productive Season for Water Protection – Carroll Cty Independent

Busy Season for Youth Corps – Carroll Cty Independent Aug 2009

Appendix A:
Salmon Falls Headwater Lakes Watershed Management Plan



SALMON FALLS HEADWATER LAKES

Watershed Management Plan



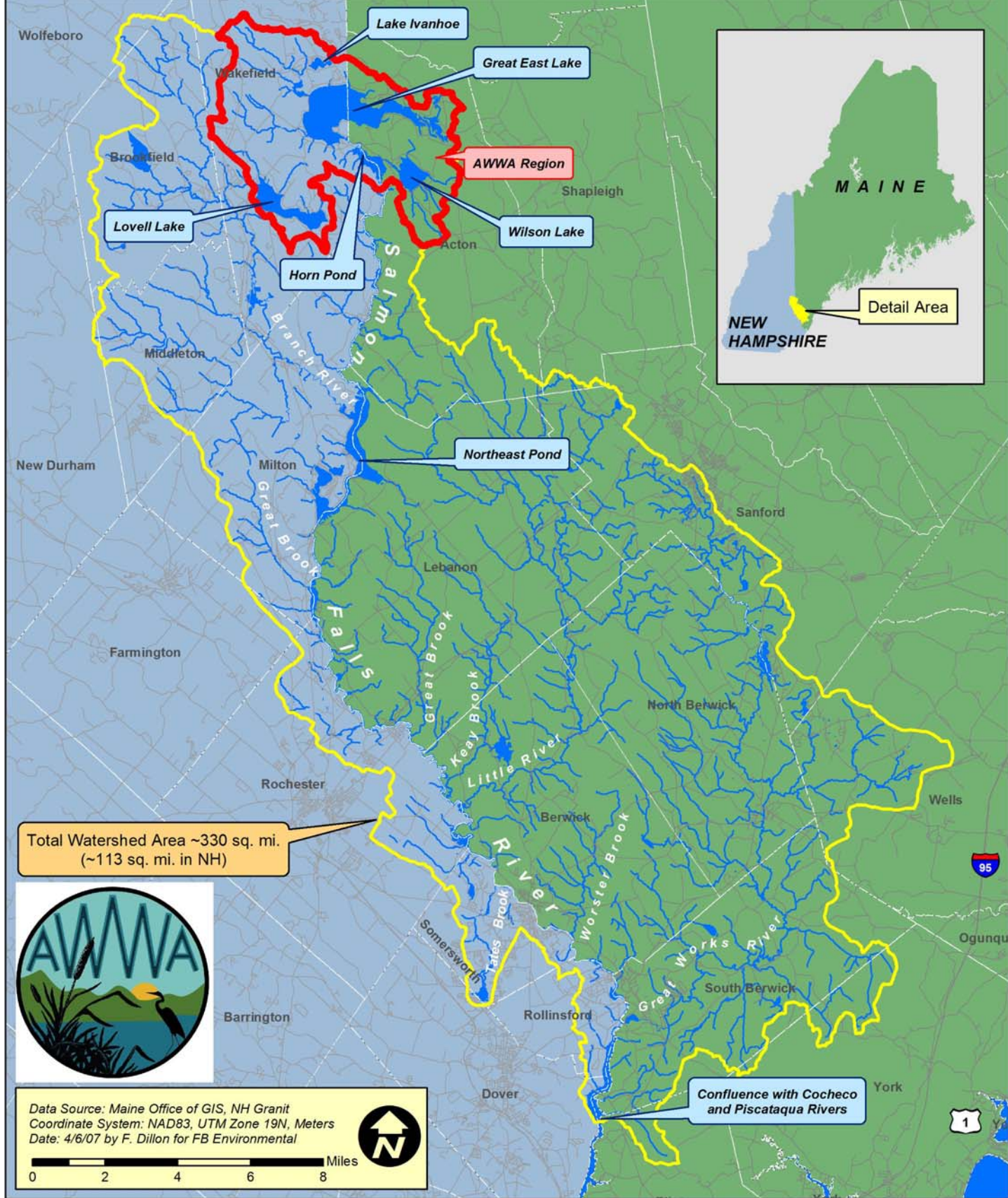
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~ March 2010 ~

AWWA Region & the Salmon Falls River Watershed



SALMON FALLS HEADWATER LAKES

Watershed Management Plan

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*Cover photo: Aerial view of the Salmon Falls headwater lakes, with Great East Lake (top center),
Horn Pond and Wilson Lake (courtesy of John Wilson).*

Acknowledgements

Acton Wakefield Watersheds Alliance Board of Directors

<i>Linda Schier, Executive Director</i>	<i>Donald Chapman, Director</i>
<i>Carol Lafond, President</i>	<i>Chuck Hodsdon, Director</i>
<i>Dick DesRoches, Vice President</i>	<i>Marcia Hodsdon, Director</i>
<i>Pat Theisen, Secretary</i>	<i>Penny Voyles, Director</i>
<i>Jeanne Achille, Treasurer</i>	<i>Glenn Wildes, Director</i>

WMP Steering Committee

<i>Jeanne Achille</i>	<i>Ken Jeffery</i>	<i>Ken Paul</i>
<i>Tom Cashin</i>	<i>Dave Mankus</i>	<i>Bruce Rich</i>
<i>Rod Cools</i>	<i>Paul Mathias</i>	<i>Nancy Ruma</i>
<i>Dick DesRoches</i>	<i>Kathy Menici</i>	<i>Linda Schier</i>
<i>Joe Fleck</i>	<i>Denny Miller</i>	<i>Cheri Schlenker</i>
<i>Nathan Fogg</i>	<i>Don Mills</i>	<i>Peg Stevenson</i>
<i>Robin Frost</i>	<i>Catherine Mills</i>	<i>Pat Theisen</i>
<i>Chuck Hodsdon</i>	<i>Steve Panish</i>	<i>Glenn Wildes</i>

In addition to the Steering Committee, the following people attended the first Community Forum:

<i>Arthur Capello</i>	<i>Dick Neal</i>
<i>John Ciardi</i>	<i>Denise Roy Palmer</i>
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Salmon Falls Headwater Lakes Watershed Management Plan

EXECUTIVE SUMMARY

Project Overview

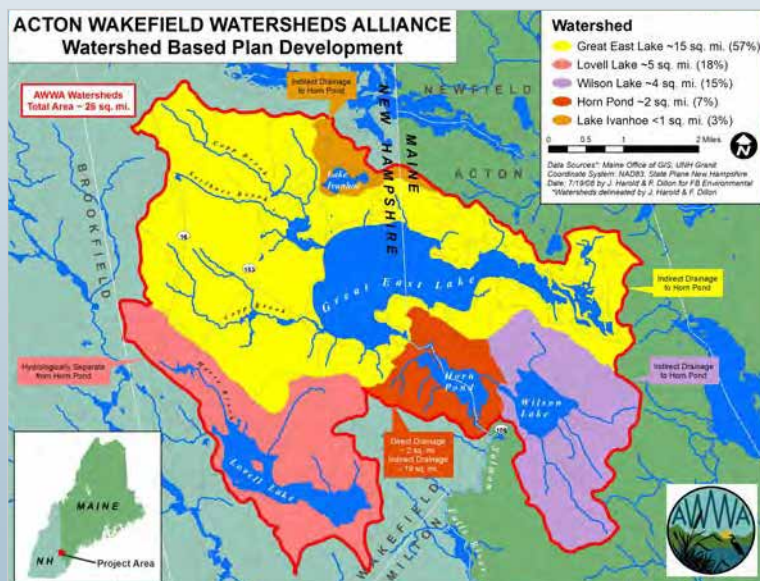
The Salmon Falls Headwater Lakes Watershed Management Plan (WMP) is a reflection of the interests and ideas put forth by a dedicated group of individuals to protect and restore the water quality of the lakes that form the headwaters of the Salmon Falls River including Great East Lake, Horn Pond, Lake Ivanhoe, Lovell Lake and Wilson Lake. This group of local landowners, community decision-makers, municipal officials, lake associations, and natural resource professionals agree that these waterbodies are of significant value to the communities of Acton, Maine and Wakefield, New Hampshire, and that action is needed to preserve their high quality status. The Acton Wakefield Watersheds Alliance (AWWA) obtained a grant from the US Environmental Protection Agency (EPA) and the New Hampshire Department of Environmental Services (NHDES) to develop this community-based plan in cooperation with the towns, lake associations and other local stakeholders.

A Watershed Steering Committee, led by AWWA, came together as part of this plan representing a number of stakeholders including the Wakefield and Acton planning boards, town officials, representatives of the lake associations, local land trusts and interested community members.

The Salmon Falls Headwater Lakes Watersheds

This WMP focuses on five of the Salmon Falls headwater lake watersheds: Great East Lake, Horn Pond, Lake Ivanhoe, and Wilson Lake, which form the headwaters of the Salmon Falls River; and Lovell Lake, which feeds the Branch River. Branch River flows into Milton Three Ponds, where it joins the Salmon Falls River. The Salmon Falls River defines the border between Maine and New Hampshire from Great East Lake to its confluence with the Cocheco River. When the Salmon Falls River joins the Cocheco River they form the Piscataqua River, defining the state border to the Gulf of Maine. These five watersheds cover approximately 26 square miles within Acton, ME and Wakefield, NH.

Development in the Acton-Wakefield region is considered rural with nearly 89% of land area undeveloped. The approximately 11% developed land is largely residential, primarily occurring along major roadways and lake shores. The lakes and their associated wetlands are home to a diverse community of fish, birds, mammals and plants that are dependent on clean water for survival.



The Problem

Phosphorus, known as a limiting nutrient in lakes, is so minute that it is measured in parts per billion (ppb). Phosphorus is present in soils, both naturally, and as a result of human activity such as improperly functioning septic systems, fertilizers and construction activity. Small increases in phosphorus can have devastating effects on water quality leading to decreased clarity and frequent algal blooms. Rain and snowmelt result in stormwater runoff which carries pollutants, including phosphorus, from the land into the waterbodies.

A series of analyses were used to determine current in-lake phosphorus levels for all five lakes, and to determine the phosphorus threshold, (the amount of phosphorus that each lake can accept before the water quality will decline). These detailed analyses of the water quality data for the SF headwater lakes indicate that Lake Ivanhoe, Lovell Lake and Horn Pond may not meet the NHDES criteria for High Quality Waters (HQW) and that all five need phosphorus control measures to maintain or achieve HQW status.

With increased development, phosphorus runoff generally increases if development is not properly managed. The build-out analysis conducted for the project estimated that (given current growth rates) 4,239 new buildings and 9,000 new people may become part of this watershed within the next 44 years. This could result in several hundred more pounds of phosphorus entering the lakes each year which would have a devastating effect on the lake water quality if proper controls are not put in place.

Why Develop a Management Plan?

Lakes are arguably one of our most valuable natural resources. We use them for recreation, relaxation, drinking water, and to build our homes near. Lakes and their surrounding lands also provide habitat for plants, wildlife and aquatic life. While clean water is essential for all life, pollution and irresponsible water use plague our waterbodies, making proactive protection of water resources essential. The Acton-Wakefield region in Western Maine and Eastern New Hampshire has an economy that depends greatly on the local waterbodies, including those that form the Salmon Falls Headwaters.



Photo credit—Jim Theisen

It is estimated in Maine that the State's lakes generate 13 million annual recreation user days and New Hampshire's lakes generate nearly 15 million recreation user days per year. This generates more than 1.1 billion dollars in total sales (for boating, fishing, and swimming) in each state. Additionally, lakefront property owners in these states contribute nearly \$600 million per year in property taxes. The value of lakes (including property values) declines when water quality declines. Therefore it is essential to find the balance between environmental quality and economic growth that benefits these valuable waterbodies.

This WMP provides a roadmap for protecting and improving the water quality of the five headwater lakes and provides a mechanism and rationale for acquiring grant and other funding to help pay for the efforts needed to address the recommended actions. In addition, it sets the stage for ongoing dialogue among key stakeholders in many facets of the communities, and promotes coordinated municipal land use ordinance changes to address stormwater runoff. For this plan to succeed, it will need a concerted effort of volunteers, and a strong and diverse steering committee that will meet at least annually to review progress made, and to make adjustments to the plan as needed.

What the Plan Includes

Over the two year project period AWWA, NHDES and FB Environmental Associates (FBE) partnered to assess the five lakes' watersheds. Several models were utilized to help stakeholders understand the state of the current water quality in the lakes, and to assist with quantifying necessary efforts to improve and protect them in the future. In order to estimate pollution flowing off of the land during storm events the project team analyzed current land uses and phosphorus inputs to the watershed. A separate model and ordinance review were used to estimate future water quality levels based on new development. In order to measure current inputs, the AWWA conducted watershed surveys with the help of over 100 local citizens to identify sites contributing excess phosphorus, the main pollutant of concern, to the project lakes and tributaries. Finally, the project team worked together with Maine and New Hampshire environmental agencies to organize, summarize, and analyze all of the lake water quality data gathered by volunteers and professionals for more than three decades for the project lakes. These data enabled the project scientists to determine the current in-lake status and set phosphorus goals for each of the five lakes. This plan describes the challenges of overcoming the differences in water quality standards in Maine and New Hampshire, and outlines recommendations that aim to harmonize these standards so they can be used on a regional, watershed-wide basis (*see below*).

In January 2009, 32 stakeholders gathered to provide valuable input for this plan. The ideas were refined into an Action Plan by the Steering Committee in March and May of 2009. With the assistance of FBE these actions were further defined, and time-frames and associated costs were set.

MAJOR GOALS FOR 2010-2020: MAINTAIN OR IMPROVE EXISTING WATER QUALITY

Maintain existing water quality at current phosphorus levels.

- ◆ Great East Lake at 6.4 ppb
- ◆ Wilson Lake at 6.5 ppb
- ◆ Horn Pond at 8.0 ppb

Improve existing water quality. Reduce in-lake phosphorus to 7.2 ppb.

- ◆ Lake Ivanhoe—reduce by 0.8 ppb
- ◆ Lovell Lake—reduce by 0.3 ppb

5 KEY ACTION CATEGORIES FOR THE SALMON FALLS HEADWATER LAKES

- ⇒ **Private and Public Roadway Best Management Practices (BMP)** - Reducing sediment loads to the lakes and tributary streams is a priority and can be accomplished through the stabilization and reinforcement of road crossings and roadsides to trap pollutants before entering the watercourses.
- ⇒ **Community Planning & Development** - local ordinances must be strengthened to protect water quality and both local and state regulations must be routinely and fairly enforced.
- ⇒ **Residential BMPs - Riparian Buffers, Low Impact Development and Septic Systems** – coordinate with local landowners to encourage vegetated buffers at the shoreline and low impact development techniques, and implement a septic system inspection and pumping recommendation program.
- ⇒ **Education and Outreach** – work with seasonal and full-time residents to enhance the understanding of land use/water quality connections through school programs, lake associations, and community groups.
- ⇒ **Land Conservation** – coordinate among municipalities, land trusts, regional planning commissions, and lake associations to protect upland areas of the SF headwater lakes' watersheds to ensure that some land remains in an undisturbed state which will help reduce total phosphorus runoff.

Funding the Plan

Reducing phosphorus inputs from existing development and preventing phosphorus inputs from future development in the SF headwater lakes watersheds will require significant financial and technical resources on the order of at least \$600,000 per year including the financial support of private, town, state and federal partners. Section 5.4 lists the costs associated with successfully implementing the 10-year plan, including both structural and non-structural measures. Success requires that a sustainable funding plan be developed to ensure that the major planning objectives can be achieved over the long-term. This funding strategy will outline the financial responsibilities at all levels of the community (landowners, towns, community groups, and state and federal government). The funding plan should be incorporated into this WMP within the first year, and revisited on an annual basis.

Administering the Plan

AWWA will work with the municipalities and stakeholder groups to administer the Salmon Falls Headwater Lakes Watershed Management Plan. AWWA will work toward implementing the Action Plan which outlines responsible parties, potential funding sources, approximate costs, and an implementation schedule for each task within the five categories.

AWWA will convene the Steering Committee at least annually to provide periodic updates to the plan, track and record any progress made, maintain and sustain the action items, and make the plan relevant on an ongoing basis by adding new tasks as they develop. The Steering Committee will use established indicators within the WMP to determine the effectiveness of the Plan. All achievements, such as press coverage, outreach activities, number of sites repaired, number of volunteers, amount of funding received, and number of sites documented, will be tracked by AWWA.

Next Steps

The success of this WMP will weigh heavily on the cooperation of the local municipalities and key stakeholders to support the plan, and the Steering Committee to engage enthusiastic support, to develop a sustainable funding plan and acquire the necessary funds to implement it. AWWA has been approved for a NHDES Watershed Assistance grant for 2010-2011 to begin implementing some of the action items recommended in the Plan. The goal is to engage all facets of the communities in the protection of the region's most valuable assets – **our lakes**.



Photo credit—Jeanne Achille

KEY CHAPTERS IN THE PLAN

Chapter 1 of the Plan introduces the plan, describing the problem, defining the goals and objectives, the community-based planning process, and outlines the federal requirements of the Plan. Chapter 1 also provides background information of the AWWA's activities related to the plan development and watershed protection.

Chapter 2 describes the watershed, providing detailed information about climate, population, land use and growth trends, physical features and the threat of invasive plants. Chapter 2 also explains the process of estimating the pollutant load sources using the STEPL model.

Chapter 3 provides an overview of the water quality standards, the methodology used to assess the water quality, and the recommendations for managing these lakes to prevent water quality decline in the future. Further, this Chapter will describe why several of the Salmon Falls (SF) headwater lakes may not be considered High Quality Waters and the evidence that shows that they are experiencing a decline in water quality. Chapter 3 also includes the results of the Master Plan and Ordinance Review, the Build Out Analysis and the Shoreline Survey Assessment.

Chapter 4 offers the Management Plan rationale and approach and details the goals and techniques that may be used to achieve them. This Chapter explains non-structural and structural restoration approaches to phosphorus reduction and describes the current and projected pollution sources. An explanation of how to use an adaptive management approach is also included here.

Chapter 5 gets to the core of the Plan, outlining necessary management strategies to reduce phosphorus to the SF headwater lakes. The Action Strategy is included detailing the action items, schedule and estimated costs.

Chapter 6 provides recommendations for how the action items in the plan will be tracked in order to ensure that necessary steps are being taken to protect or improve the water quality of the SF headwater lakes over the next 10 years. Specific water quality monitoring recommendations are made for each lake.

Chapter 7 describes who will be carrying out the plan and suggests methods for securing sustainable funding.

1. INTRODUCTION

1.1 Purpose and Background

Lakes are arguably one of our most valuable natural resources. We use them for recreation, relaxation, drinking water, and to build our homes near. Lakes and their surrounding lands also provide habitat for plants, wildlife and aquatic life. While clean water is essential for all life, pollution and irresponsible water use plague our waterbodies, making proactive protection of water resources essential. The Acton-Wakefield region in Western Maine and Eastern New Hampshire has an economy that depends greatly on the local waterbodies, including those that form the Salmon Falls Headwaters. The Salmon Falls watershed headwaters region (see map, inside cover) includes Great East Lake, Horn Pond, Lake Ivanhoe (also known as Round Pond, and Little Round Pond), Lovell Lake, Wilson Lake and their associated tributaries. These lakes are considered high quality waters as defined by the NH Department of Environmental Services (NHDES) Watershed Assistance Section. These waters eventually flow to the Piscataqua River after flowing to the Salmon Falls River, which forms the southern border between Maine and New Hampshire.



The Salmon Falls headwater lakes region includes Great East Lake, Horn Pond, and Wilson Lake (shown in photo) as well as Lake Ivanhoe and Lovell Lake.

The region's lakes are particularly threatened by **phosphorus**. A small increase in phosphorus inputs can have devastating effects on lakes. With increased development, phosphorus runoff generally increases if development is not properly managed. Growth projections in the Acton-Wakefield region indicate strong development pressure in the years to come. The purpose of this Watershed Management Plan (WMP) is to provide recommendations for the local decision-makers as they plan for future development and to offer other stakeholders strategies for minimizing the potential negative effects of our collective impact on water quality. The plan provides the necessary assessments and recommendations for the communities of Acton and Wakefield and its partners including the Acton Wakefield Watersheds Alliance (AWWA) and the individual lake associations to maintain high quality water status in each of the five waterbodies and their associated tributaries over the next ten to fifteen years. These efforts will help protect the tax bases in Wakefield and Acton, including lakefront property values. For reference, conservation efforts in the Mousam Lake watershed provide a strong example of successful efforts to restore and protect a valuable local waterbody. This lake was recently removed from the State of Maine impaired waters (303d) list due to the consistent and outstanding efforts of the local communities, conservation groups, state and federal agencies, and the citizens of the watershed.

Phosphorus -

A nutrient needed for plant growth. It is generally present in small amounts, and limits plant growth in lakes. As the amount of phosphorus increases in the lake, the amount of algae also increases.

1.2 Plan Development and Community Participation Process

This plan was developed using a watershed approach. Using a watershed approach to protect high quality waters is beneficial because it is a holistic process in which local stakeholders are actively involved in selecting management strategies that will be implemented to solve problems in the watershed. The AWWA WMP for the Salmon Falls (SF) headwater lakes worked within this framework by using a series of cooperative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or remediation strategies, and implement selected options. The outcomes of this process are documented within this plan. A community participation process was developed with the assistance of FB Environmental Associates (FBE), a consulting firm hired to help with the Plan. FBE, AWWA, and NHDES representatives lead a series of three well attended workshops to solicit public input and design future efforts for watershed protection.

The first workshop was designed to describe the watershed planning process to local stakeholders. The second workshop served as a public forum in which participants provided input on priority issues and action items for the plan. The third workshop involved the prioritization of action items and helping to set schedules and specific tasks for completing action items. A complete description of these action items appear in Chapter 5 of this plan. The results of these workshops ensure that the Plan is community driven and supported and will allow stakeholders to have a living, working action plan to guide their future efforts. The AWWA is the ideal organization to lead these efforts given their current mission and recent lake protection successes in this region.



Three public workshops were held during the development of this plan.

1.3 Current Efforts of the Acton Wakefield Watersheds Alliance

The Acton Wakefield Watersheds Alliance (AWWA) is a non-profit organization working to protect and restore water quality by affecting land use policies and practices, through education and remediation of **nonpoint source (NPS) pollution** in the border region of Acton, Maine and Wakefield, NH. The Alliance is registered with the State of New Hampshire and holds 501(c)3 status. AWWA has active staff and directors who bring a wide range of expertise and affiliations to the group. The mission of the Acton Wakefield Watersheds Alliance is to protect and restore water quality, by affecting land use policies and practices through education and remediation in the border region of Acton, Maine and Wakefield, NH.

Nonpoint source (NPS) pollution comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into waterbodies.

In 2006, AWWA received a two-year Watershed Assistance grant from the NH Department of Environmental Services to initiate a Youth Conservation Corps (YCC) program. In 2008 the NH State Conservation Committee awarded AWWA a Moose Plate grant to continue its YCC work. In addition to the YCC program, the AWWA board members have been actively promoting water resource awareness in the communities. They have presented shorefront landscaping workshops, taught in the local schools, worked with the town boards, presented at local lake association meetings and staffed informational displays and activities at community events. AWWA encourages regular press coverage for its activities and has been featured in the local newspapers on several occasions. AWWA board members have been invited to share their YCC model with presentations at the NH Lakes Congress, the Green Mountain Conservation Group Watershed Weekend, the Maine Lakes Conservancy Institute Lake Science Academy, 2009 Chicago Lakes Conference, Maine Congress of Lake Associations Conference, and the NH Watersheds Conference.

As the initial YCC project period was completed the AWWA Board recognized the need to focus its efforts to reduce the effects of stormwater runoff and applied for and was awarded a NHDES Watershed Assistance grant to develop this WMP for the headwaters of the Salmon Falls River including Great East Lake, Horn Pond, Lake Ivanhoe, Lovell Lake and Wilson Lake. The WMP will allow AWWA to focus its outreach and remediation efforts on areas with significant problems (adapted from www.awwatersheds.org).

1.3.1 Watershed Surveys

As part of its watershed planning and assessment efforts, more than 75 volunteers completed watershed surveys on Great East Lake, Horn Pond, Lake Ivanhoe and Lovell Lake and assisted with the Wilson Lake watershed survey. The purpose of these surveys was to determine critical areas contributing polluted runoff to these lakes. Volunteers were trained by environmental professionals and spent several days looking at roads, residential areas, commercial areas, and any other land uses that could be contributing polluted runoff to these valuable lakes. In particular, sites with eroding soil were noted. Soil contains phosphorus (P), the pollutant that local stakeholders are most concerned about. The following table (Table 1.1) summarizes the results of these watershed surveys and indicates that sites were found to contribute more than 240 tons of sediment (that's 12 dump trucks full of sediment), and an associated 204 pounds of phosphorus, to the lakes and their tributaries each year.

Table 1.1: Watershed survey results-sediment and phosphorus loads.

Lake	# Sites	Sediment (tons)	Phosphorus (lbs.)
Great East Lake	67 NH, 112 ME	105.21	88.82
Horn Pond	21 NH, 37 ME	10.7	9.2
Lake Ivanhoe	26 NH	42.07	35.95
Lovell Lake	157 NH	57.2	48.8
Wilson Lake	71 ME	24.87	21.14
TOTALS	491	240.05	203.91

Field measurements collected during the watershed surveys were used to estimate the sediment and phosphorus load for each lake. Final estimates were calculated using the US EPA Region 5 model (MDEQ, 1999) which provides a gross estimate of sediment and nutrient load reductions from implementation of various Best Management Practices.

1.3.2 Youth Conservation Corps

The AWWA YCC, following the model of many Maine YCCs, includes a Technical Director, Crew Leader and 4-6 youth crew members. The Technical Director solicits projects, meets with the landowners and creates the site specific design using Maine DEP approved Conservation Practices. From those technical assistance designs, the Technical Director meets with the YCC Committee to select project sites based on the severity of the problems and the suitability for the YCC crew to correct it. The projects require hand tools only and all required permits are secured prior to any work beginning. The Crew Leader oversees the onsite work and the youth crew do the heavy lifting.

Sine AWWA's YCC program was formed in 2005, 61 projects have been completed, including 202 BMP installations. In total, these projects have prevented approximately 62 tons of sediment and over 52 lbs of phosphorus from entering the AWWA lakes and ponds each year. Annually, the crew showcases their projects to the communities with a tour. In 2009, the tour was captured on video and presented by the youth crew at the AWWA annual meeting and is available on the AWWA website: www.AWwatersheds.org.

The YCC Program is an important tool for engaging the community in the quest for healthy waters. Since the AWWA YCC began there has been a noticeable increase in requests for assistance and calls for how-to information on lake protection. The AWWA region towns have consistently given financial support to AWWA and encourage AWWA members to participate in the local decision-making process.

The Acton-Wakefield region has very few employment opportunities for its youth. For most members of the YCC crew this is a first job and an opportunity to learn the basics of successful employment. The AWWA crew members eagerly share their pride in their work and have become knowledgeable spokespeople for water resource protection.

1.3.3 Public Outreach

AWWA's outreach efforts are aimed at local and seasonal residents, school children, summer visitors and community decision-makers. Through presentations, hands-on workshops, interactive classroom sessions, and print and electronic media AWWA's message has been widely broadcast. AWWA's outreach is focused on the concept that a personal connection to one's environment breeds a sense of place and desire to protect it. Much of the recent outreach provided by AWWA has revolved around the completion of and recommendations listed in this Plan. In addition to community workshops, AWWA has sponsored two presentations by FBE to the Planning Boards of the two watershed communities, Acton and Wakefield. These presentations were effective in delivering the message that development will likely increase and that protection of these waters will need local support from the municipalities and their citizens.

1.4 Incorporating EPA's 9 Elements

EPA Guidance lists nine components that are required to be included in Watershed Management Plans to restore waters impaired by nonpoint source pollution. The following describes the nine required elements and where they are found in this plan:

- A. Identify Causes and Sources** or groups of similar sources that need to be controlled to achieve the load reductions estimated in this WMP (and to achieve any other watershed goals identified in the WMP), as discussed in item (B) immediately below: [Section 1.31](#) and [Appendix C](#) describe the results of the watershed surveys conducted for the five lakes included in this project and highlights known sources of NPS pollution in these watersheds.
- B. Estimate Phosphorus Load Reductions Expected from Planned Management Measures** described under (C) below: [Section 4.4](#) describes how reductions in annual phosphorus loading to SF headwater lakes may be realized over a 10-20 year period, and describes the methods used to estimate phosphorus reductions by applying a relational P reduction method developed by Maine DEP to the different land use categories identified. These reductions apply primarily to structural BMPs applied to existing development, (but will not be possible without non-structural BMPs). Examples of structural practices include (but are not limited to) installing vegetated buffers, infiltration practices for roof and driveway runoff, improving and maintaining roads, and fertilizer management.
- C. Description of Management Measures** that will need to be implemented to achieve the estimated phosphorus load reductions and identification of the critical areas in which those measures will be needed to implement this plan: [Section 5.4](#) describes management measures needed to reach reduction targets described in B above. (Management measures to address future development in the watershed are also described in the AWWA watershed surveys.) The Action Plan focuses on five major topic areas to address NPS pollution including: Private and Public Roadway BMPs; Community Planning & Development; Residential BMPs- Riparian Buffers; Low Impact Development and Septic Systems; and Education and Outreach, and Land Conservation. The management options in the action plan focus more on the non-structural BMPs that are integral to making implementation of the structural BMPs possible.
- D. Estimate of Technical and Financial Assistance** needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan: [Sections 5.4 and 7.2](#) describe the cost of successfully implementing this 10-year management plan. The estimated cost to address NPS pollution and reduce phosphorus loading to SF headwater lakes is estimated at \$601,000 per year. Sources of funding need to be diverse, and should include state and federal granting agencies such as the USEPA, NH DES and Maine DEP, local groups such as the towns and lake associations, as well as private donations, and landowner contributions for BMP implementation on private property. AWWA and its core stakeholders shall lead the planning effort while meeting regularly, and efficiently coordinating resources to achieve the goals set forth in this plan.
- E. Information & Education & Outreach** are key components of the plan that will be used to enhance public understanding of the project: [Section 5.3.2](#) describes how the Education & Outreach component of the plan will be implemented. This includes leadership from AWWA to help promote lake/watershed stewardship. BMP demonstration sites, buffer tours, LakeSmart or similar lake stewardship program, and outreach to Road Associations are a few of the actions within the plan, as outlined in [Section 5.4](#).

- F. Schedule for Addressing Phosphorus Reductions:** [Section 5.4](#) provides a list of all the strategies that have been developed to help reduce stormwater runoff and phosphorus runoff to SF headwater lakes. Each strategy, or “Action Item”, has a set schedule that defines when the action should begin. The schedule should be adjusted by the steering committee on an annual basis.
- G. Description of Interim, Measureable Milestones** for determining whether NPS management measures are being implemented: [Section 6.1](#) outlines indicators that should be tracked annually in order to see how successful the plan is at meeting established goals and objectives for the watershed. Using indicators to measure progress of the plan makes the plan relevant, and helps maintain and sustain the action items. This section is broken down into three different types of indicators including: Programmatic, Social and Environmental Indicators. Programmatic indicators are indirect measures of restoration activities in the watershed and include measures of how much funding has been secured or how many BMPs have been installed. Social indicators measure change in social behavior over time. These include indicators such as number of new stakeholders on the steering committee or number of new lake monitoring volunteers. Environmental indicators are a direct measure of environmental conditions, and include indicators such as improvement in water clarity or reduced P concentration in the lake. All told, 27 indicators have been identified for tracking the progress of this plan.
- H. A set of criteria** that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards water quality standards, and if not, the criteria for determining whether this WMP needs to be revised: The indicators identified in G above and in [Section 6.2](#) will be used as the criteria.
- I. A monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria in (H) above: The ultimate objective of this watershed-based management plan is to achieve a stable or decreasing trophic state. This means halting any current trends of declining water clarity, and reducing the probability of any near-future late summer/early fall algal blooms. Success of this plan will not be recognized without ongoing monitoring and assessment. [Section 6.3](#) describes how AWWA and its core stakeholders will take the lead in overseeing the long-term water quality monitoring strategy for the project lakes. Careful tracking of load reductions following successful BMP implementation projects will be essential for tracking how much P has been reduced as a result of this plan.

2. WATERSHEDS CHARACTERIZATION

2.1 Climate

The climate in the Acton-Wakefield region is relatively consistent over the long-term, exhibiting a mean maximum July temperature of 70° F, a mean minimum January temperature of 19.7° F, and an overall average temperature of 45.5° F annually. The average annual precipitation is 37.15 inches including rainfall and snow equivalent. The frost-free season usually ranges from 93 to 108 days. In the winter 2007-2008 Acton accumulated 132.5 inches of snow, while over the past 10 years snowfall has averaged 101.75 inches per winter in Acton. The Acton-Wakefield region is well-known for its high quality lakes and picturesque towns which serve as the backdrop for all-season activities. People are drawn by the moderate climate to participate in activities such as water sports, hiking, ice fishing, snowmobiling, and leaf peeping.

2.2 Population, Land Use and Growth Trends

2.2.1 Population and Growth Trends

Development in the Acton-Wakefield region is considered rural with nearly 89% of land area undeveloped. The approximately 11% developed land is largely residential, primarily occurring along major roadways and lake shores (Figure 2.1). Population and demographics are important factors in watershed planning because large increases in unplanned population growth, and consequently development, could negatively affect lake water quality.

The Acton-Wakefield region has experienced considerable population growth over the last several decades (though increases in dwelling units have been more modest). From 1990-2005, Wakefield experienced the largest average annual and overall population growth rates – 3.4% and 56.5%, respectively – of all the communities in Carroll County (NHOEP, 2008). While Acton's population increase from 1990-2000 was more modest compared to other York County communities (it had the 9th highest growth rate of the 29 towns in the county), its average annual and overall growth rates were 2.2% and 24.2%, respectively (SMRPC, 2004). In 2007, the NH Office of Energy and Planning projected a 36% population growth in Wakefield between 2005 and 2025. A report prepared by the NH Society for the Protection of NH Forests "New Hampshire's Changing Landscape" projected a decrease in over 1,000 acres or 5.4% of forest land.

Given the Acton-Wakefield's region's unique character and desirability as a residential and recreational destination, it is likely significant growth will continue to occur in Wakefield and Acton well into the future. Consequently, both communities should carefully consider the effects of current municipal land use regulations on local water resources. As the region's watersheds are developed, erosion from disturbed areas increases the potential for water quality decline.

Table 2.1: 2000 Population demographics for Acton and Wakefield.

Town	Population	Population Aged 0-17	Population Aged 18-64	Population Aged 65 and Over	Median Household Income
Wakefield, NH	4,252	455	3,160	637	\$42,500
Acton, ME	2,145	209	1,067	335	\$39,036

Median household income among towns in the Acton-Wakefield region ranges from a high of \$46,500 in Wakefield to a low of \$39,036 in Acton (Table 2.1). Most people living in these towns are married and have families. In both Wakefield and Acton 24.4% of residents have received college degrees and higher, and over 80% have received high school diplomas.

A buildout analysis was conducted for the SF headwater lakes watersheds in Wakefield and Acton (Appendix E). The analysis combined projected population estimates, current zoning restrictions, and a host of additional development constraints (conservation lands, steep slopes, wetlands, existing buildings, soils with low development suitability, unbuildable parcels) in order to determine the extent of buildable area in the watershed. Projected development follows closely with population estimates in that Wakefield not only holds the majority of land in the SF headwater lakes watersheds but also has the most buildable area (Table 2.2).

Table 2.2: Buildable land in the Acton-Wakefield region.

Town	Total Area (Acres)	Buildable Area (Acres)	Percent Buildable Area
Acton	5,882	2,407	41%
Wakefield	16,770	5,648	52%

2.2.2 Land Uses

A watershed land use inventory is a useful tool that shows where potential sources of nonpoint source pollution may be stemming from on a larger scale than a watershed survey. A watershed with high levels of development and little remaining undisturbed forests is a likely candidate for high levels of NPS pollution, and consequently, polluted waterbodies. On the other hand, a watershed with carefully managed development, and large areas of undisturbed forests, especially along headwater streams, will be less likely to show the characteristic effects of NPS pollution in the downstream waterbody.

A land use inventory can also provide information about how land uses have changed over time. The SF headwater lakes watershed land use inventory conducted in 2009 determined that the majority of these watersheds consist of non-developed land including mixed forest land (69%), surface water (19%) and wetlands (1%) (Figure 2.1; Map 1, Appendix B). Other managed land uses in the watershed include agricultural land (7%) and beaches and gravel pits (<1%). Agricultural uses in the watershed include cropland, pasture, and hayland.

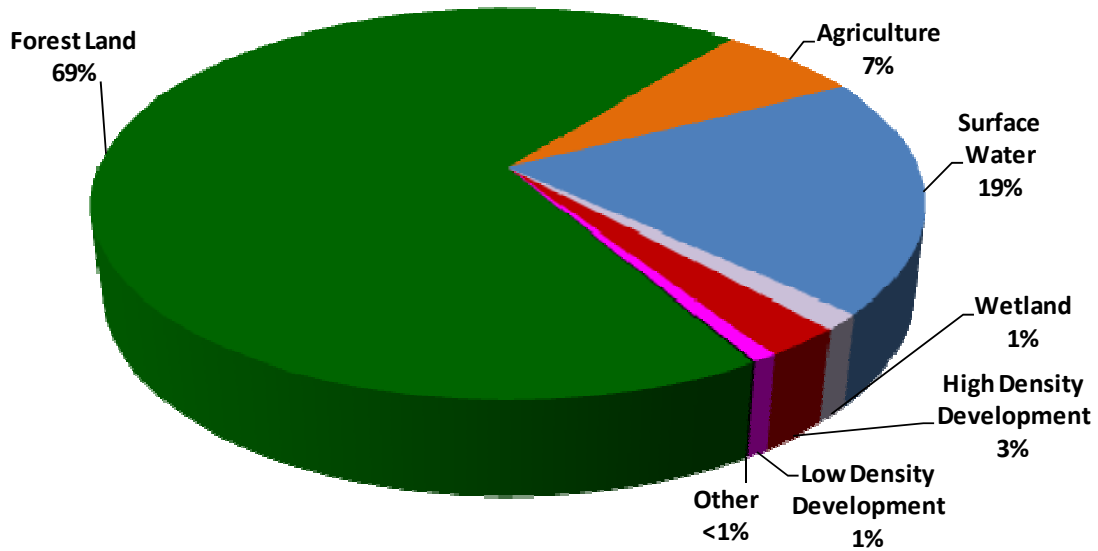


Figure 2.1: Land uses in the Salmon Falls headwater lakes watersheds.

Developed land covers approximately 11% of the SF headwater lakes watershed area. This includes high and low density residential and commercial development and some commercial development encompassing approximately 656 acres (~ 4%) of Impervious Cover (IC), as shown in Figure 2.2 below.

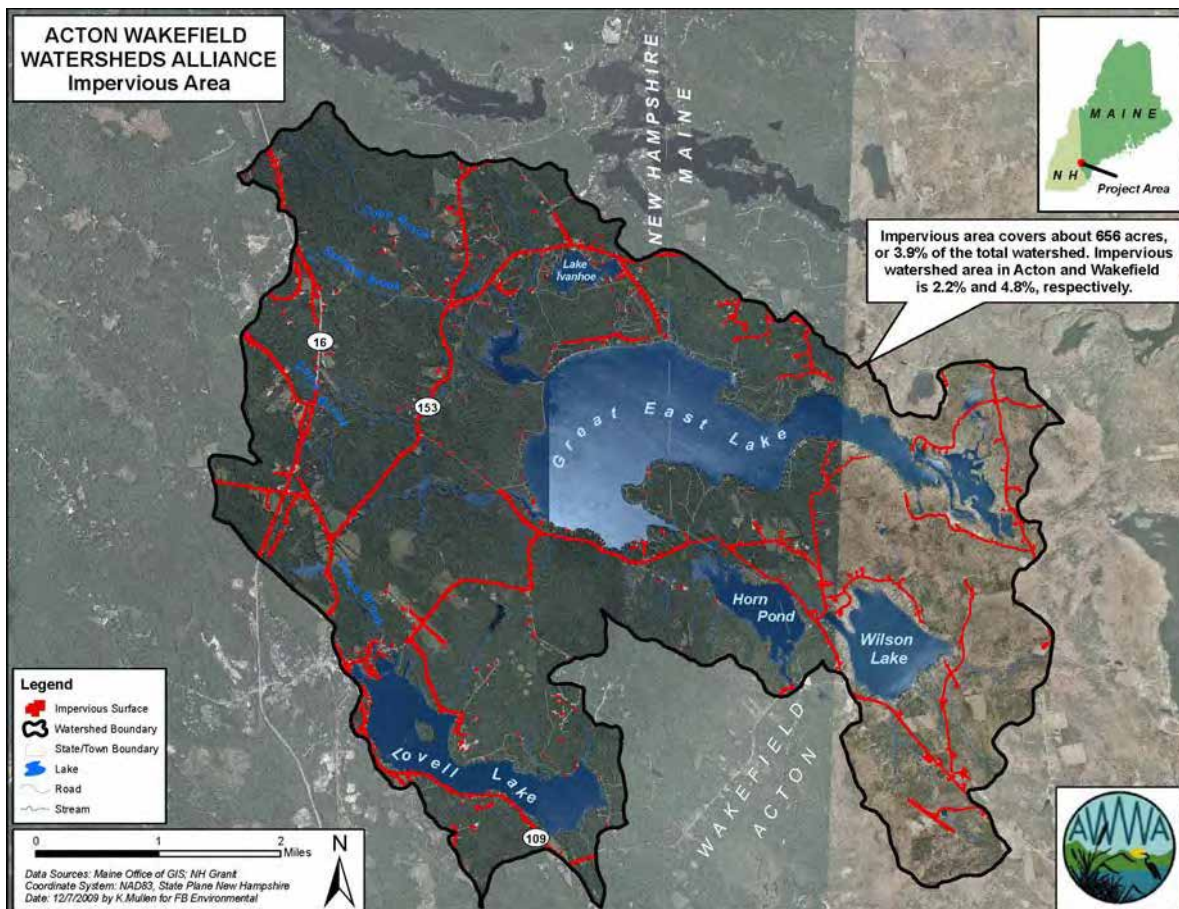


Figure 2.2: Impervious cover (IC) in the AWWA region (see Appendix B for larger map).

IC refers to any man made surface (e.g. asphalt, concrete, and rooftops), along with compacted soil, that water cannot penetrate.

Rain and snow that would otherwise soak into the ground turns into stormwater runoff when it comes into contact with impervious surfaces. Stormwater runoff carries numerous pollutants, such as sediments, nutrients, pathogens, pesticides, hydrocarbons, metals and deicers, into our surface waters. Studies have shown that streams with greater than 10% IC in the watersheds have documented biological impairments in Maine and throughout the country. These impacts are attributed to changes in the aquatic environment due to the increased flow volume associated with stormwater runoff.

Although the SF headwater lakes watersheds have relatively low IC under current conditions, the buildout analysis conducted for the area (Appendix E) along with projected population growth trends indicate that % IC will continue to increase. Consequently, both communities should consider ways to minimize the effects of future development, such as incorporating low impact development (LID) techniques into new development projects. More information on long-term strategies for addressing the effects of public and private roadways, and strategies to implement residential BMPs and low impact development techniques, can be found in the Action Plan in Section 5.4.

2.2.3 Protected Lands

There are many reasons to conserve land in the SF headwater lakes watersheds - protection of water resources, creating and enhancing outdoor recreation opportunities, protecting the region's economic vitality and protecting wildlife habitat among them. These reasons are critical in preserving and enhancing the quality of life in the Acton-Wakefield region.

Currently, based on available data, the amount of conservation lands in the these watersheds is minimal, covering 335 acres, or about 4% of the total watershed area (Figure 2.3; Map 4, Appendix B). Existing conserved lands in the watershed include:

- ***Moose Mountains Regional Greenway:*** (52.16 acres) Located on the western boundary of the watershed near Copp Brook. This land is part of a larger project to protect New Hampshire's natural resources.
- ***Herberich Property:*** (62 acres) Located north of Lovell Lake along Witchtrot Road. This land is owned by the Society for the Protection of New Hampshire Forests. (An adjacent 117-acre Remick property on Witchtrot Road is owned by the Strafford Rivers Conservancy (not shown on Figure 2.3).)
- ***Siemon Property:*** 27.47 acres on the backside of Oak Hill at the eastern end of Lovell Lake, and 7.71 acres on the southern edge of eastern Lovell Lake. The Siemon family donated this land to the Society for the Protection of New Hampshire Forests.

With about 89% of the SF headwater lakes watershed area currently undeveloped, there are numerous opportunities for continued land conservation in the region. Protection of the "upland" areas of the AWWA watersheds would help ensure that some land remains in an undisturbed state, which will help reduce total phosphorus runoff to the SF headwater lakes. Additionally, the New Hampshire wildlife action plan has

identified areas in the Acton-Wakefield region that are of critical importance for maintaining habitats and populations of the state's species of conservation and management concern (Appendix B). These areas, including high priority marshes, conservation focus areas, and supporting natural landscapes, cover nearly 2,690 acres, or 16% of the total watershed area.

Information on strategies to coordinate conservation efforts among the local land trust, AWWA, and the municipalities is included in the Action Plan in Section 5.4.

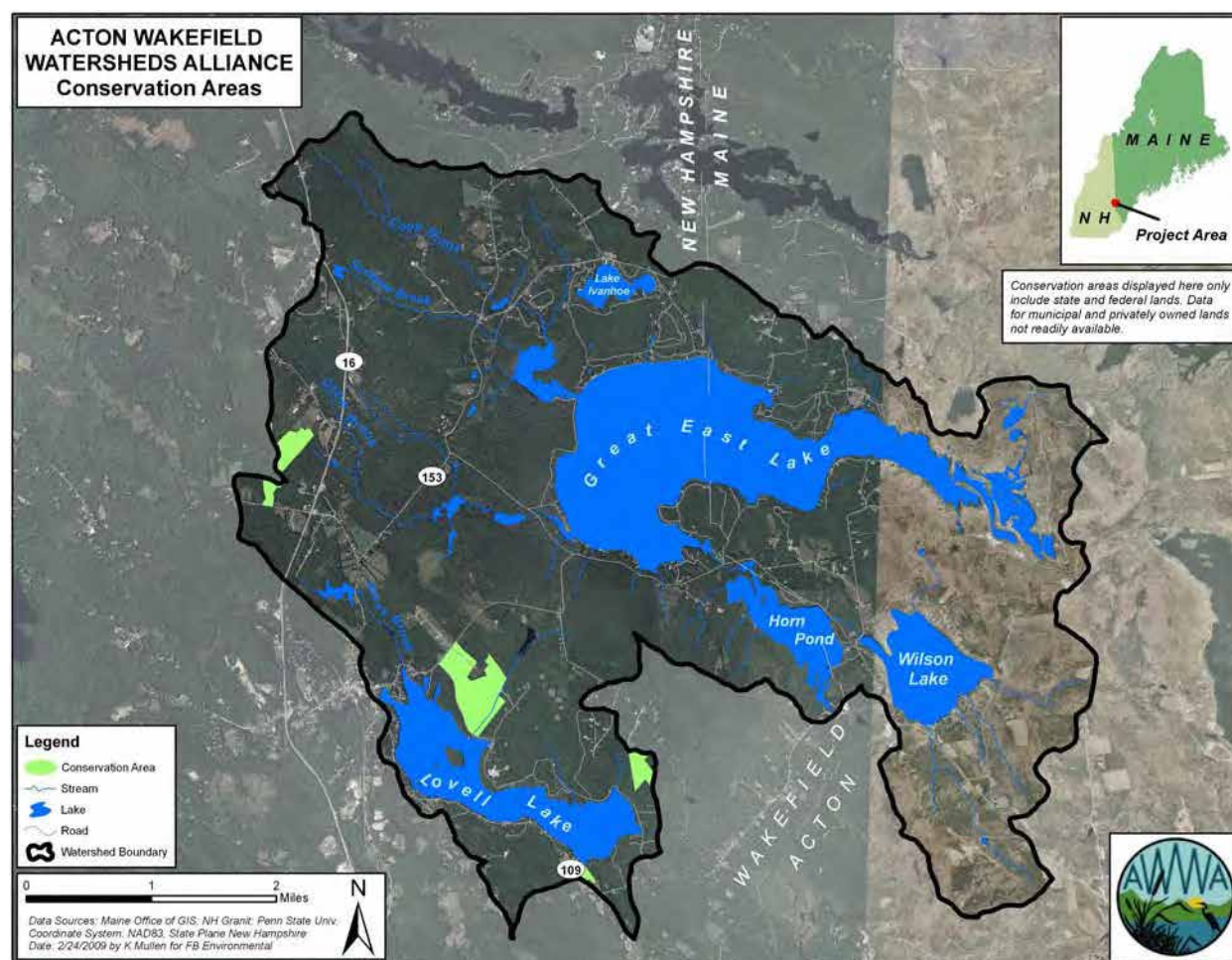


Figure 2.3: Conservation lands in the AWWA region (see Appendix B for larger map).

2.3 Physical Features

2.3.1 Topography

Elevations in the SF headwater lakes watersheds range from a low elevation of 560 to 580 feet at Horn Pond and Great East Lake, to a high elevation of 1,080 feet on Oak Hill and Davis Hill, south of Great East Lake and west of Horn Pond (Map 6, Appendix B). The mean elevation across the SF headwater lakes watersheds is 726 feet. Additional peaks in the region include Cooks Hill and Long Mountain, both 1,060 feet and located along the northwest watershed boundary. Perkins Hill (780 feet) sits along the northern watershed boundary and Gerrish Mountain (940 feet) sits along the southern boundary, south of Wilson Lake.

The steepest slopes in the SF headwater lakes watersheds are found on the northern faces of Oak Hill and Davis Hill, along the northeastern edge of Lovell Lake, and southeast of Wilson Lake.

2.3.2 Soils and Geology

Much like the topography of the region, the different types of soils and their location in the landscape can be attributed to the movement of the glacier that covered Maine and New Hampshire more than 12,500 years ago. Maine and New Hampshire soils are therefore a conglomerate of rock-fragments and soil material called glacial-till, and water-sorted sediment deposited in glacial streams, rivers, and lakes. Fine blue marine sediment known as the Presumpscot Formation was deposited hundreds of miles inland as a result of the mass of ice from the glacier depressing the landscape and then rebounding as the ice melted.

Soil associations are groups of soils with similar characteristics. The SF headwater lakes watersheds within Acton are characterized by the Hermon-Brayton-Dixfield general soil association which consists of sandy, loamy soils formed in glacial till, and the Skerry-Hermon-Monadnock-Colonel general soil association which also consists of loamy and sandy soils formed in glacial till (Ferwerda et al. 1997). Soils on the Wakefield side of the SF headwater lakes watersheds are similar, with the most common soil being Woodstock-Bice fine sandy loam, which is found on hillslopes and formed in glacial till. Paxton fine sandy loam is also common in the Wakefield watershed area. Like the Woodstock-Bice soils, this soil type is found on hillslopes and formed in glacial till. Aside from wetland areas, soils in these watersheds are generally well to excessively well drained.

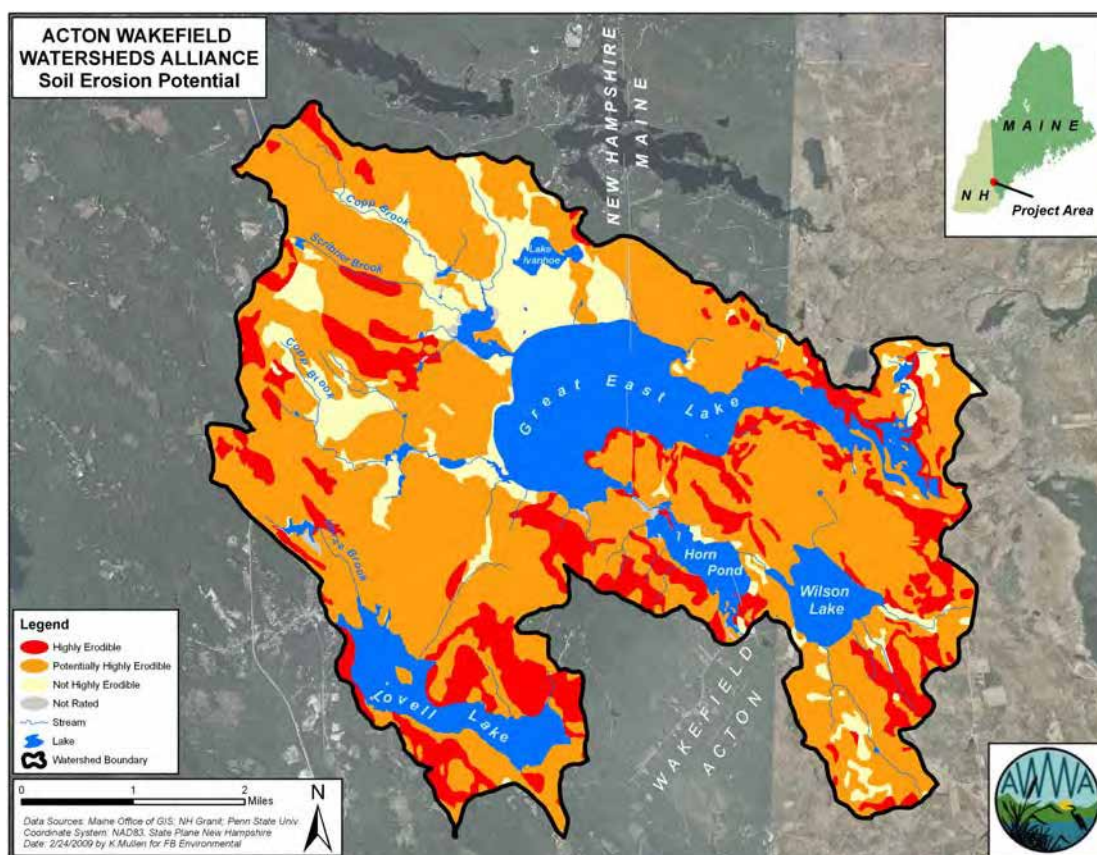


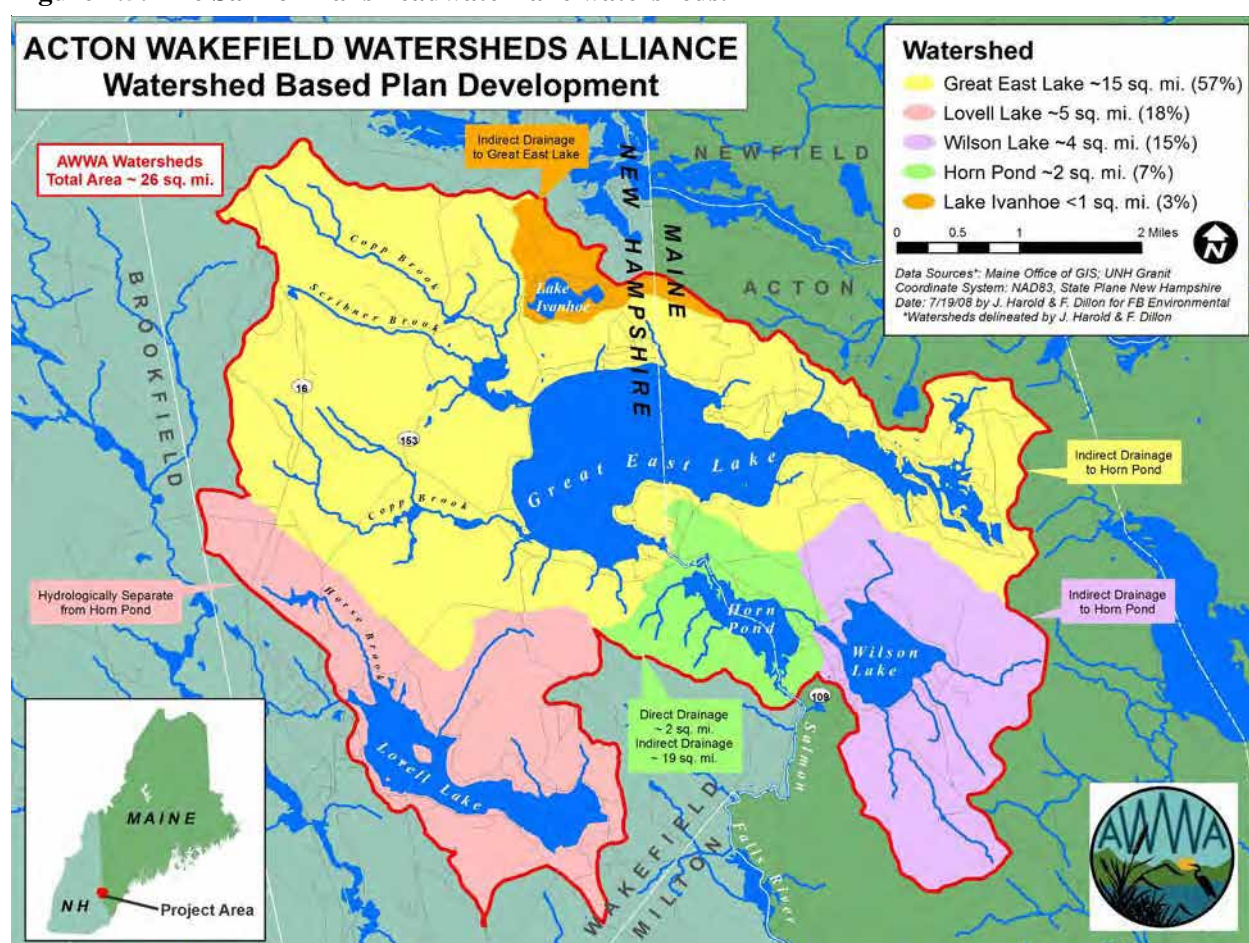
Figure 2.4: Soil erosion potential in the Salmon Falls headwater lakes region (see Appendix B).

Soil erosion potential should be a major factor when determining where development should and should not occur in a watershed. Areas with highly erodible soils should be avoided for future development because they inherently have a potential to erode at a rate far greater than what is considered tolerable soil loss. The potential erodibility of soil is dependent on a combination of factors including land contours, climate conditions, as well as physical and chemical soil properties such as soil texture, composition, permeability, and structure (O'Geen et al. 2006). A highly erodible soil has a higher potential to negatively affect water quality, and therefore requires a greater investment to maintain its stability and function in the landscape.

In these watersheds, 18.4% of the land area is considered highly erodible (Figure 2.4). This land is generally located along the southern shore of Great East Lake, around Lovell Lake and west of Horn Pond, in addition to other areas scattered throughout the watersheds. Potentially erodible land encompasses the majority of the watershed area (68.3%). This means that the soils are at risk of erosion if they are not managed properly. Not highly erodible soils (12.6%) are generally located in low lying wetland areas near abutting streams.

2.3.3 Drainage Areas

Figure 2.5: The Salmon Falls headwater lake watersheds.



The watersheds of Lake Ivanhoe, Great East Lake, and Wilson Lake are all hydrologically connected to the Horn Pond watershed, which flows directly to the Salmon Falls River. Lovell Lake, though not hydrologically connected to Horn Pond, flows to the Salmon Falls River via Branch River and Milton Three Ponds.

The greater Acton-Wakefield region includes the watersheds of Province Lake, Belleau Lake, Balch Lake, Pine River Pond, Sandy Pond, Woodman Lake, Lake Ivanhoe, Great East Lake, Horn Pond, Wilson Lake, Lovell Lake and their tributaries. This WMP focuses on five of the SF headwater lakes watersheds: Great East Lake, Horn Pond, Lake Ivanhoe, and Wilson Lake, which form the headwaters of the Salmon Falls River; and Lovell Lake, which feeds the Branch River. Branch River flows into Milton Three Ponds, where it joins the Salmon Falls River. The Salmon Falls River defines the border between Maine and New Hampshire from Great East Lake to its confluence with the Cocheco River. When the Salmon Falls River joins the Cocheco River they form the Piscataqua River, defining the state border to the Gulf of Maine. These five watersheds cover approximately 26 square miles within Acton, ME and Wakefield, NH (Figure 2.5).

As mentioned earlier, both a land use analysis (Section 2.2.2) and a buildout analysis (Appendix F) were conducted for the AWWA watersheds. Table 2.3 shows the percentage of developed land – including residential, commercial, and agricultural lands – in each watershed, derived from the land use analysis, and the percentage of available buildable area for each watershed, derived from the buildout analysis. Great East Lake, the largest of the watersheds, has the second lowest percentage of developed land, and the second highest percentage of buildable area. Lake Ivanhoe has the smallest watershed, but the highest percentage of both developed land and buildable area. As such, Lake Ivanhoe is likely influenced by this higher level of development, and future development in the watershed should be carefully planned and monitored.

Table 2.3: Percent developed and buildable area in the SF headwater lakes watersheds.

Watershed	Watershed Area (acres)	Percent Developed Area	Percent Buildable Area
Great East Lake	9,620	9%	52%
Horn Pond	1,139	6%	34%
Lake Ivanhoe	455	17%	59%
Lovell Lake	3,075	14%	37%
Wilson Lake	2,480	8%	49%

Table 2.4: Salmon Falls headwater lakes characteristics and morphology.

Watershed	Surface Area (acres)	Volume (m ³)	Mean Depth (feet)	Max. Depth (feet)	Flushing Rate (flushes/yr)
Great East Lake	1,707	75,589,500	35	102	0.3
Horn Pond	227	3,155,000	13	31	8.2
Lake Ivanhoe	68	992,000	12	20	0.9
Lovell Lake	538	8,623,000	13	41	0.7
Wilson Lake	308	6,756,766	17	44	0.85

2.3.4 General Lake Characteristics and Morphology

The morphology (shape) and morphometry (measurement of shape) of lakes have been shown to be good predictors of water clarity and lake ecology, where large, deep lakes are typically clearer than small shallow lakes. Differences in factors such as lake area, number and volume of upstream lakes, and flushing rate affect the way lakes function. This proves somewhat true for the SF headwater waterbodies (Table 2.4). For example,

Great East Lake has the largest surface area, volume, and depth of the five lakes, and is the only lake with “outstanding” water quality. Lake Ivanhoe, on the other hand, has the smallest surface area, volume, and depth of all five lakes, and is the only lake for which current water quality data indicate that the lake may be “impaired” under NH water quality standards.

2.4 Invasive Plants

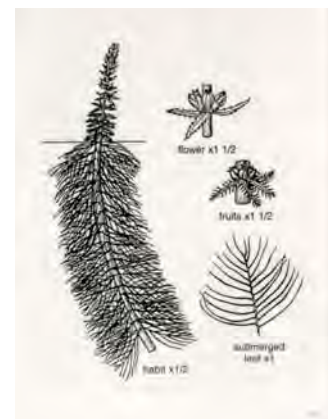
The introduction of non-indigenous invasive aquatic plant species to Maine and New Hampshire’s waterbodies has been increasing. The impacts of the spread of invasive aquatic plants are well known: habitat disruption, loss of native plant and animal communities, reduced property values, impaired fishing and degraded recreational experiences, and enormous and ongoing control costs.

It is crucial that aquatic invasives are detected as early as possible, before they have had an opportunity to cause significant damage or to spread to other waterbodies. Early detection provides the best hope of eradication. Once established, invasive species are difficult and sometimes costly to remove, making early detection of critical importance.

An effective early detection system includes consistent screening by trained monitors. Lakes should be visited and revisited on a frequent and ongoing basis. Invasive species that have been found in lakes throughout Maine and/or New Hampshire include Variable milfoil (ME & NH), Eurasian milfoil (NH), Fanwort (NH), Brazilian elodea (NH) Curly leaf pondweed (ME & NH), Hydrilla (ME), and Brazilian elodes (NH)

While none of the target lakes in the AWWA watersheds have any documented infestations, some nearby lakes have. Additionally, in 2006, a monitor found Variable milfoil growing near the public boat launch on Great East Lake. Although Variable milfoil is an aggressive reproducer that can spread quickly, subsequent monitoring has revealed no sign of regrowth of the original plant or new plants.

Great East Lake has an inspection program that is run by the New Hampshire Lake Host program, and supported with funds from the Courtesy Boat Inspector program in Maine, as the boat launch is located in both states. Lovell Lake participates in the NH Lake Host program as well. Both lakes have staff at the launches on weekends and holidays and occasional other busy days during the summer. The staff is mostly paid but volunteers help to fill in the gaps and extend the inspection hours. Both Great East Lake and Lovell also have weed watcher programs, similar to the Invasive Plant Patrollers program in Maine, in which trained volunteers survey the lakes regularly. Wilson Lake, Horn Pond and Lake Ivanhoe do not yet have inspection or weed watcher programs in place.



Variable milfoil is the aquatic invasive most commonly found in Maine and New Hampshire’s lakes.

2.5 Estimating Watershed Pollutant Sources

Watershed-scale pollutant load modeling is a useful tool for estimating and comparing the potential impacts from various physical processes occurring throughout the landscape. A range of well established approaches exist, varying in level of detail and budget requirements. Most can provide a relative basis for comparison between pollutant loads from various land uses and thereby assist water resource managers in selecting appropriate Best Management Practices (BMPs). Since all models have their strengths and weaknesses, model selection should be based on the project goals and objectives. The primary goals and objectives for estimating pollutant loads in the Acton-Wakefield region are to identify current and future sediment and nutrient sources by land use type and subwatershed. After consulting with NHDES, the modeling method selected for the Salmon Falls Headwater Lakes WMP was EPA's Spreadsheet Tool for Estimating Pollutant Loads (STEPL), which is described in the next section.

2.5.1 STEPL Methodology

STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various BMPs. It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The sediment and pollutant load reductions that result from the implementation of BMPs are calculated using the known BMP efficiencies.

Determining Pollutant Loads from Land Use-Based Sources

STEPL allows users to determine pollutant load sources for single watersheds or for multiple watersheds. Since the Acton-Wakefield region for which this Plan has been developed consists of five watersheds (Great East Lake, Lovell Lake, Wilson Lake, Horn Pond and Lake Ivanhoe), all of these were collectively included as inputs for the STEPL model. Initial data inputs for each watershed were for land use types and areal extents. Land uses originated from a data set developed by the New England Interstate Water Pollution Control Commission (NEIWPCC) for the entire northeast region of the U.S. as part of another nonpoint source pollutant load modeling methodology. This Geographic Information System-based (GIS) land use data, referred to as Northeast AVGWLF, consisted of considerably more categories than the five pre-defined categories included with STEPL, which consist of urban, cropland, pastureland, forest, and user defined. (Feedlots are also included with STEPL, but none were identified by the AVGWLF land use data). Therefore, the Northeast AVGWLF land use categories were combined to fit the pre-defined STEPL land use categories (Table 2.5).

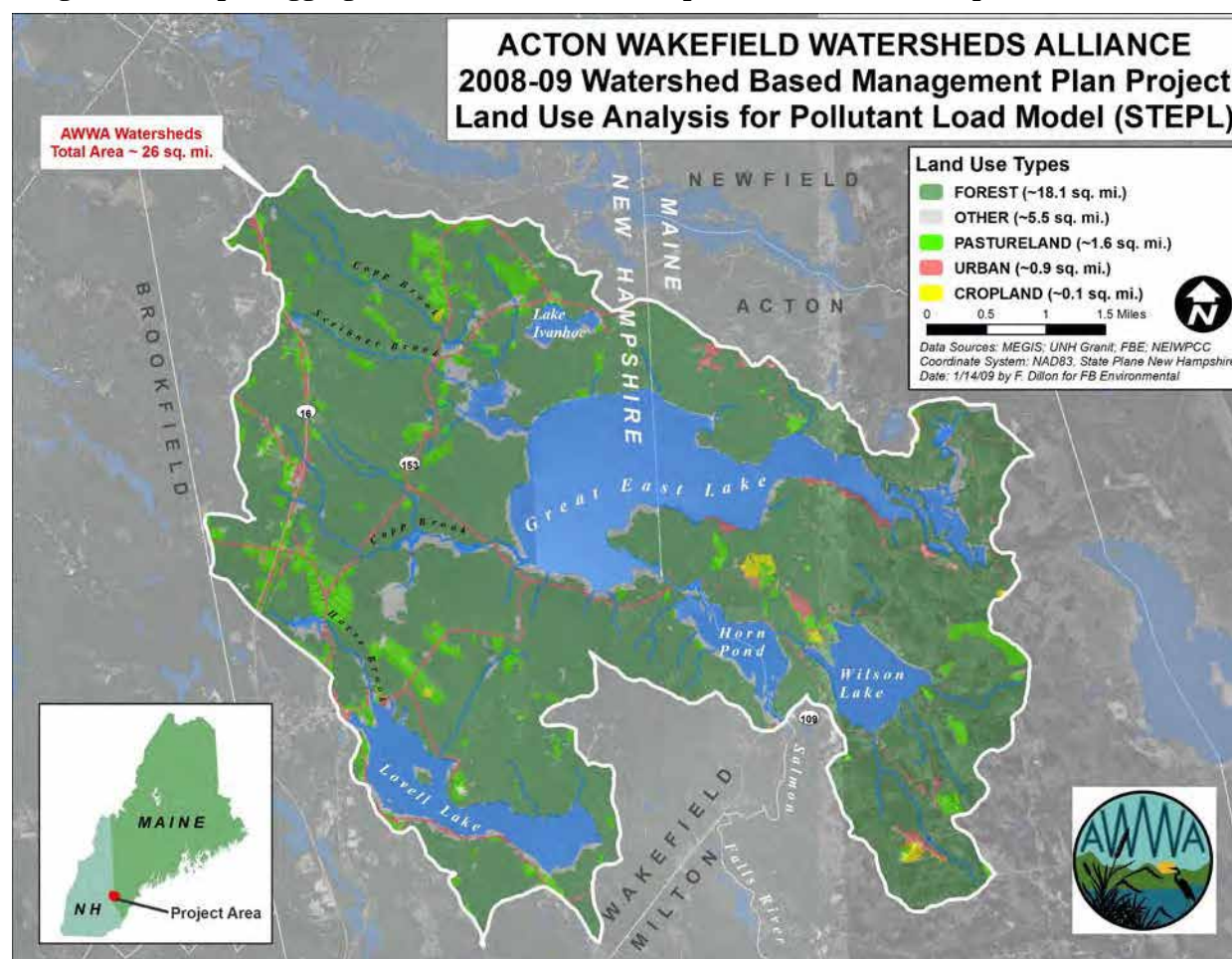
Table 2.5: AVGWLF land use categories combined to fit STEPL land use categories.

Combined AVGWLF and STEPL LU Types	Great East (acres)	Horn (acres)	Ivanhoe (acres)	Lovell (acres)	Wilson (acres)	AWWA Total (Acres)	AWWA % Total
URBAN							
High-density development Total	235.7	21.5	24.7	116.8	39.3	438.0	2.6%
Low-density development Total	86.0	7.4	3.0	7.8	24.2	128.4	0.8%
Subtotals:	321.7	28.9	27.7	124.6	63.5	566.4	3.4%
CROPLAND							
Row crops Total	27.8	6.5	-	3.2	19.0	56.4	0.3%
PASTURELAND							
Hay/pasture Total	538.9	37.1	47.7	316.0	122.1	1061.9	6.3%
FOREST							
Mixed forest Total	3489.8	323.1	88.5	1043.1	1137.7	6082.2	36.3%
Coniferous forest Total	935.2	31.0	83.9	191.6	199.8	1441.5	8.6%
Deciduous forest Total	2131.0	441.5	118.0	733.4	628.2	4052.0	24.2%
Subtotals:	6556.0	795.5	290.4	1968.1	1965.8	11575.6	69.0%
OTHER							
Emergent wetland Total	91.4	2.6	-	22.9	6.4	123.2	0.7%
Woody wetland Total	90.0	-	6.8	3.6	-	100.3	0.6%
Quarries Total	9.7	-	-	4.8	-	14.5	0.1%
Beaches Total	1.9	-	-	-	0.2	2.1	0.0%
Water Total	1983.1	269.2	82.6	632.7	302.7	3270.3	19.5%
Subtotals:	2176.0	271.8	89.4	663.9	309.3	3510.4	20.9%
Overall Total Acres:	9620.3	1139.7	455.2	3075.8	2479.6	16770.6	100%
Overall Total Square Miles:	15.03	1.78	0.71	4.81	3.87	26.20	

STEPL also allows for further distinction of the urban land uses. For the SF headwater lakes region these consist of high density development (primarily roads) and low density residential. Creating custom user defined land use categories was beyond the project scope. As a result, the five remaining general land use types used for the STEPL model inputs were urban, cropland, pastureland, forest and other. This last category is a catchall for land uses that did not fit any of STEPL's other general land use types and was therefore not included in the pollutant load estimation. (Note: other nonpoint source pollutant load models also generally exclude these land uses since they are presumed to contribute negligible amounts of pollutants to nearby surface waters). Overall, the general land use types occupying the SF headwater lakes region from largest to smallest are forest at approximately 11,575 acres (~18 square miles); pastureland at approximately 1,062 acres (~1.7 square miles); urban land at approximately 566 acres; and cropland at approximately 56 acres. The resulting STEPL land use map is shown in Figure 2.6.

STEPL calculated annual pollutant loads for each land use type using researched concentration values for nutrients (phosphorus and nitrogen) and biochemical oxygen demand (a measure of decomposable organic matter) along with runoff volume based on rainfall data from a weather station nearby (Durham, NH). STEPL also adjusts pollutant load values based on the use of various BMPs, which is discussed in more detail in the following pages.

Figure 2.6: Map of aggregated land uses for STEPL pollutant load model input.



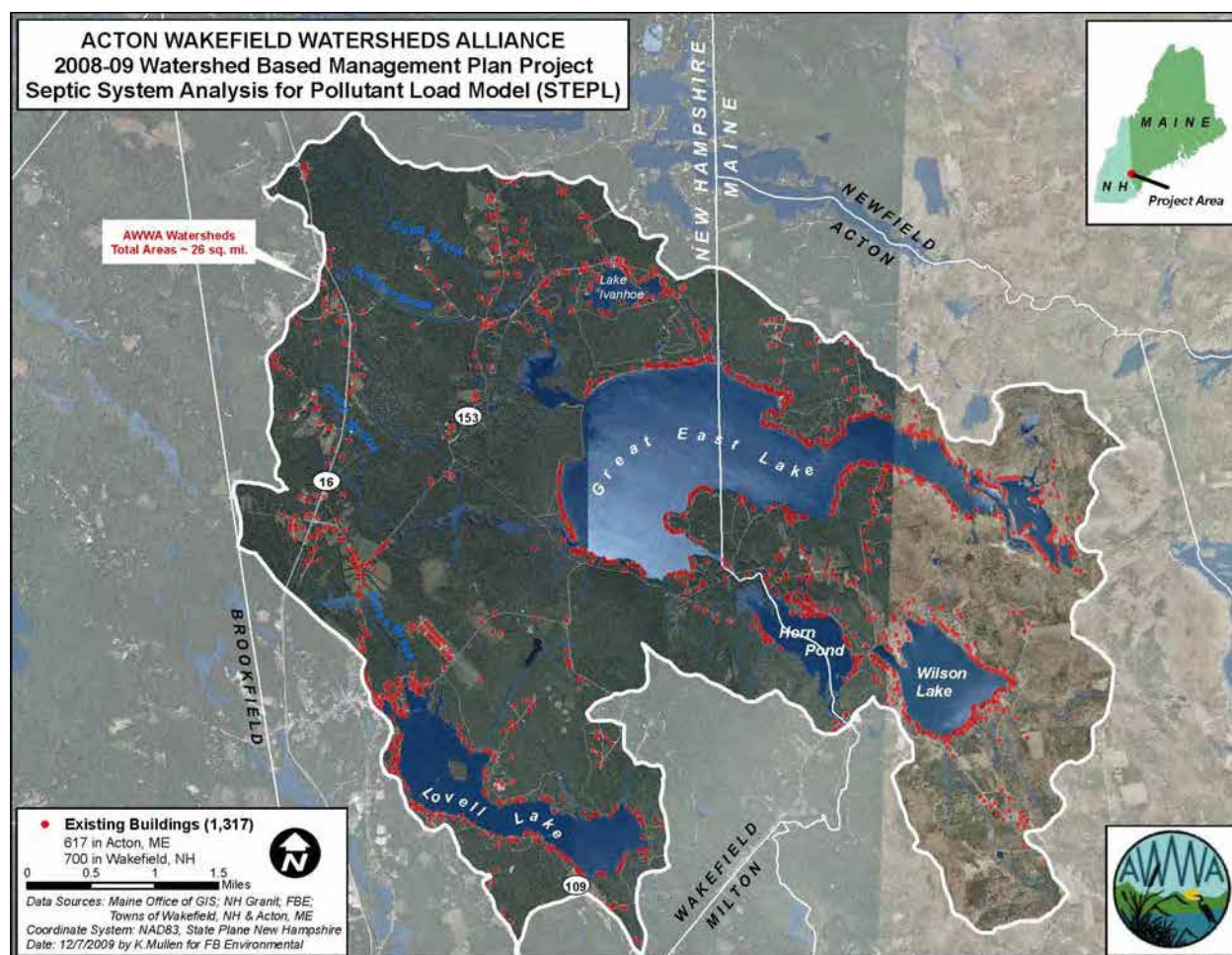
Determining Pollutant Loads from Other Sources

STEPL also allows pollutant load inputs for livestock and septic systems. No definitive animal husbandry information exists for the SF headwater lakes region and so no data could be entered into STEPL for these potential sources. However, anecdotal information suggests there are very few domesticated animals in the watershed, and those that do exist likely play very little role in pollutant load contributions to nearby surface waters. In contrast, septic systems may be contributing fairly significant pollutant loads in the watershed, particularly when poorly functioning systems are situated in close proximity to nearby surface waters.

STEPL requires inputs for the numbers of septic systems in each watershed and calculates theoretical loadings based on researched estimates of nutrient and organic concentrations. The number of septic systems was first determined separately for Acton and Wakefield based on the available data types. Acton's cadastral database contained a field denoting whether a particular parcel also had a building. Parcels with buildings were assumed to have septic systems. Wakefield's cadastral database did not identify parcels with buildings. Therefore, digital aerial photographs were used to identify the locations of buildings, which in turn were assumed to have accompanying septic systems. In both cases, the use of a GIS was instrumental in conducting the analyses,

which determined that Acton has approximately 617 septic systems and Wakefield has approximately 700 septic systems. Many septic systems are located in close proximity to surface waters (Figure 2.7).

Figure 2.7: Map of residential septic system data used for STEPL pollutant load model.



Septic system numbers were then determined for each watershed, also using GIS. The Great East Lake watershed has approximately 665 septic systems; the Lovell Lake watershed has approximately 301 septic systems; the Wilson Lake watershed has approximately 184 septic systems; the Horn Pond watershed has approximately 110 septic systems; and the Lake Ivanhoe watershed has approximately 57 septic systems (Table 2.6). All of these values were entered directly into the STEPL model to estimate pollutant loads from septic systems in the watershed.

In addition to estimating sediment loads for each watershed based on the Universal Soil Loss Equation (USLE), STEPL also allows for an estimation of sediment loads based on the dimensions of various erosional features throughout the landscape (e.g., streambanks and gullies). This data was not available at the time the STEPL model was run and additional sediment loads were not determined. However, AWWA has since completed estimates of soil erosion so this data can be added to STEPL at some point in the future to calculate the sediment load from erosional features.

2.5.2 STEPL Results

For the SF headwater lakes watersheds, we used the STEPL model to evaluate total phosphorus loading only, because it is considered the limiting nutrient in freshwater lake environments. Under current conditions, it is estimated that phosphorus loading from existing land uses in the SF headwater lakes watersheds totals ~2,721 lbs P/year.

Subwatershed modeling using STEPL indicated that the Great East Lake subwatershed contributes the highest load of phosphorus (1,377 lbs P/year) of the five subwatersheds, while the Lake Ivanhoe subwatershed contributes the smallest load (114 lbs P/year; Table 2.7, Figure 2.8). Because Great East Lake has the largest land area of the SF headwater lakes subwatersheds, it is reasonable for this subwatershed to contribute the largest amount of phosphorus from surrounding land uses. However, on a per acre basis, the Great East Lake subwatershed also contributes the greatest amount of phosphorus of the five subwatersheds (Table 2.8).

Table 2.6: Number of septic systems in the SF headwater lakes region by subwatershed.

Watershed	Acton	Wakefield	Totals
Great East Lake	338	327	665
Horn Pond	93	17	110
Lake Ivanhoe	2	55	57
Lovell Lake	-	301	301
Wilson Lake	184	-	184
Totals:	617	700	1317

Table 2.7: SF headwater lakes subwatershed annual phosphorus loads.

STEPL Phosphorus Load by Subwatershed (lb/year)	
Watershed	P Load
Great East Lake	1377
Horn Pond	198
Lake Ivanhoe	114
Lovell Lake	619
Wilson Lake	413
Total	2721

Table 2.8: SF headwater lakes subwatershed per acre phosphorus loads.

STEPL Phosphorus Load by Subwatershed (lb/acre/year)	
Watershed	P Load
Great East Lake	8
Horn Pond	7
Lake Ivanhoe	6
Lovell Lake	6
Wilson Lake	4
Average	7

Phosphorus loads are heavily dependent on land uses within the subwatersheds. Table 2.9 illustrates the subwatershed loads by land use and other sources. Some sources, such as atmospheric deposition, are natural sources of phosphorus loading while others are human sources. Overall, forested land in the AWWA subwatersheds covers the most land area, and also contributes the highest annual phosphorus loads (793 lbs P/year). Pastureland, including hay land, contributes the second-highest phosphorus load at 727 lbs P/year, followed by urban (residential and commercial) land uses at 374 lbs P/year. Septic systems, atmospheric deposition, and cropland provide 321, 321, and 185 kg P/year, respectively. Table 2.9 and Figures 2.9 through 2.13, illustrate the respective phosphorus loads by source for each subwatershed. Forest and pastureland represent the highest loading sources for each of the individual subwatersheds.

STEPL Phosphorus Load by Subwatershed

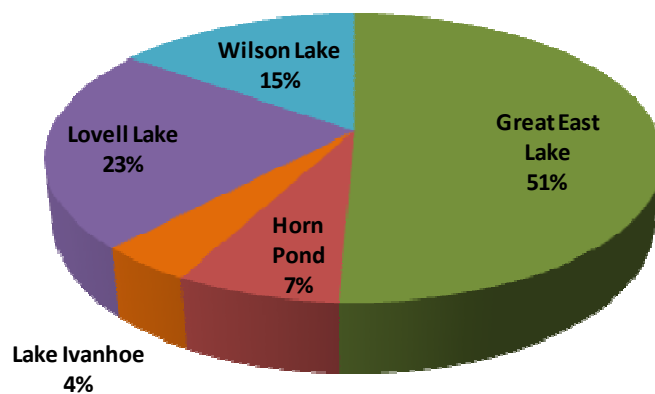


Figure 2.8: SF headwater lakes subwatershed annual phosphorus loads, by percentage.

Table 2.9: SF headwater lakes subwatershed annual phosphorus loads, by source.

STEPL Phosphorus Load by Source (lb/year)						
Watershed	Urban	Cropland	Pastureland	Forest	Septic	Atmospheric
Great East Lake	203	84	322	411	162	195
Horn Pond	18	26	33	67	27	26
Lake Ivanhoe	20	0	47	24	14	8
Lovell Lake	96	11	233	144	73	62
Wilson Lake	36	64	92	146	45	30
Total	374	185	727	793	321	321

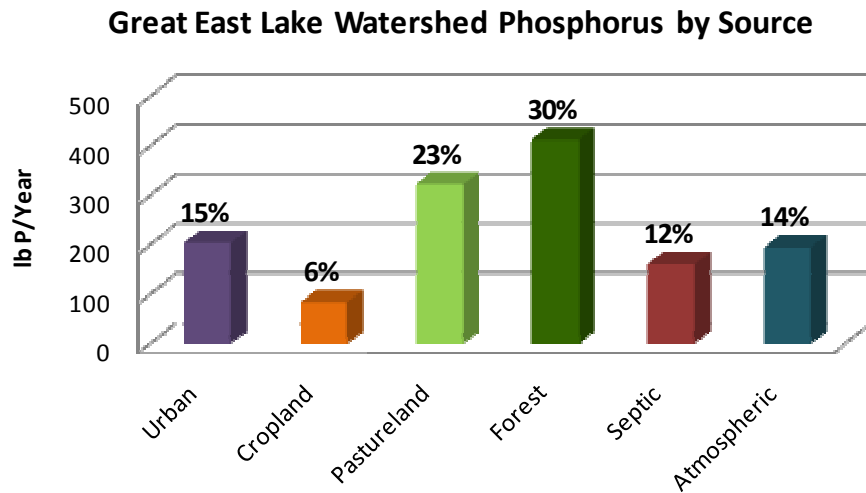


Figure 2.9: Great East Lake subwatershed phosphorus loads by source.

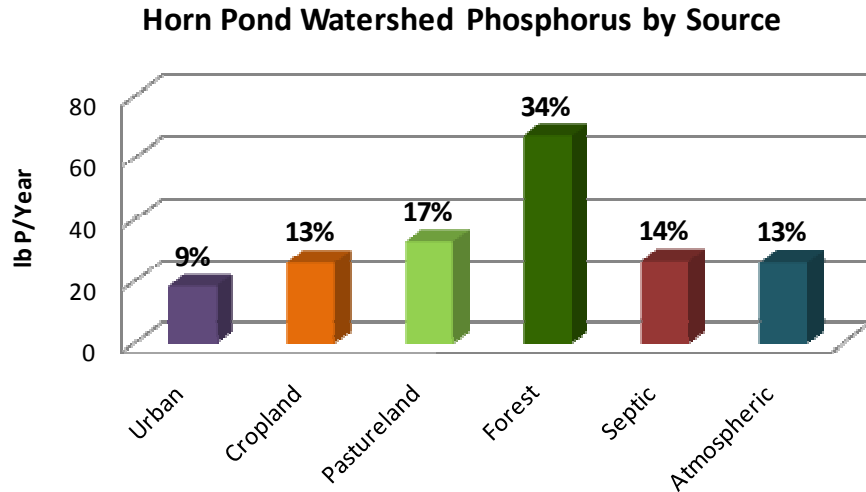


Figure 2.10: Horn Pond subwatershed phosphorus loads by source.

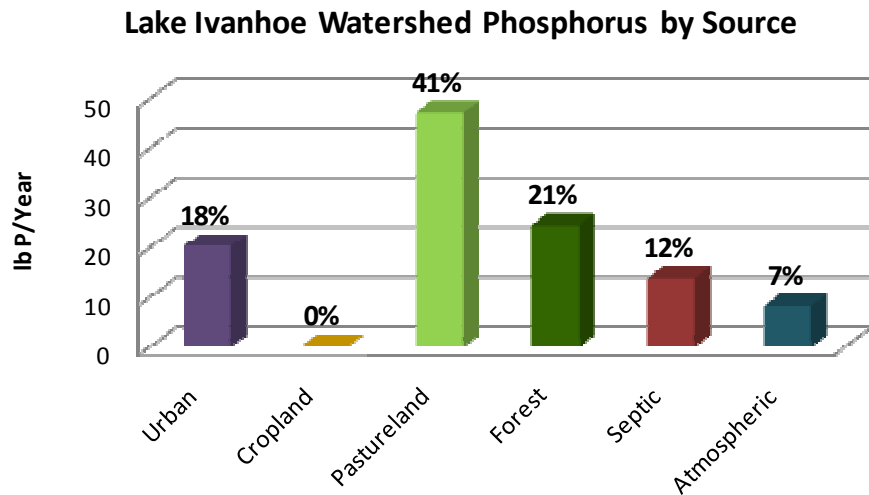


Figure 2.11: Lake Ivanhoe subwatershed phosphorus loads by source.

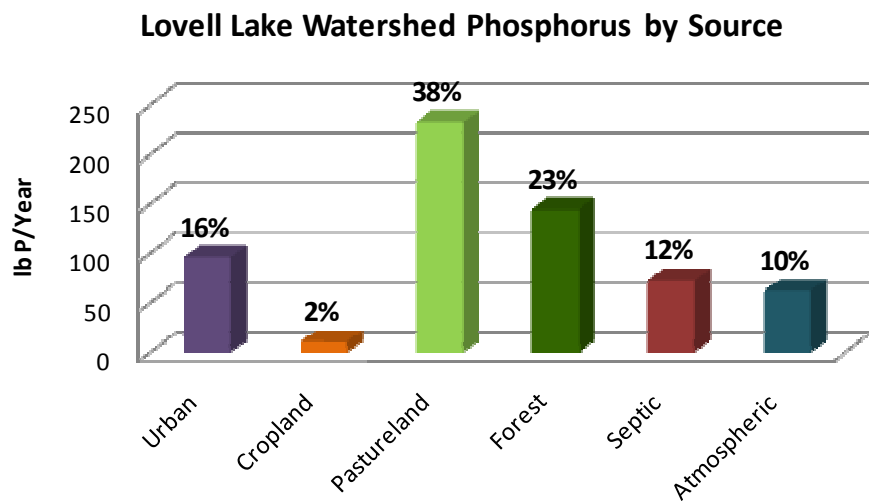


Figure 2.12: Lovell Lake subwatershed phosphorus loads by source.

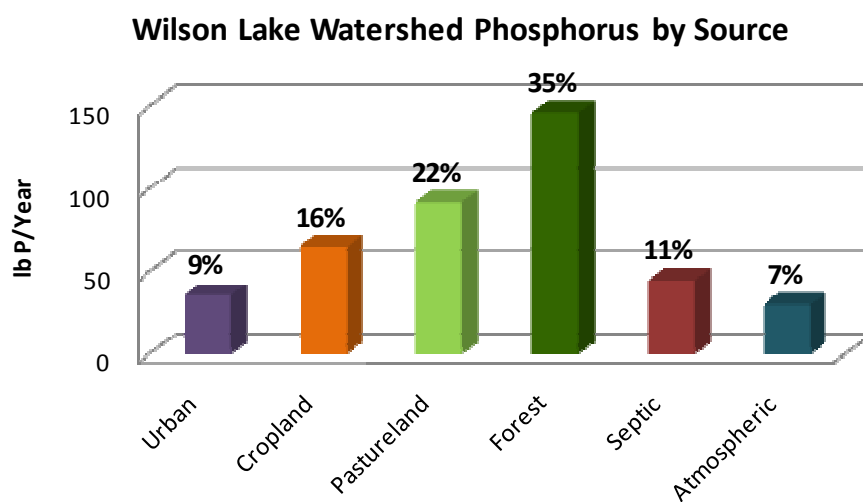


Figure 2.13: Wilson Lake subwatershed phosphorus loads by source.

3. WATER QUALITY ASSESSMENT

This Watershed Management Plan focuses on nutrients (total phosphorus) as an indicator of lake health. This choice acknowledges that lakes with excess nutrients are generally “over productive” in terms of plant growth and algal blooms. This biological response to nutrients can serve as the “tipping point” for lake water quality, in which lakes that are rich in phosphorus often experience many symptoms of water quality decline including algal blooms, fish kills, decreased water clarity, loss of aesthetic values, and beach closures.

This section provides an overview of the water quality standards that apply to these lakes, the methodology used to assess the water quality, and the recommendations for managing these lakes to prevent water quality decline in the future. Further, this section will describe why several of the SF headwater lakes may not be considered High Quality Waters and the evidence that shows that they are experiencing a decline in water quality.

3.1 Applicable Water Quality Standards

The SF headwater lakes provide a unique opportunity to minimize differences in cross-border water quality standards between Maine and New Hampshire. Both states are required to follow federal regulations under the **Clean Water Act (CWA)**, yet each state has some flexibility as to how those regulations are enacted.

*The **Clean Water Act (CWA)** requires states to establish water quality standards and conduct assessments to ensure that surface waters are clean enough to support human and ecological needs.*

Therefore, slight differences exist among the standards and criteria used to determine if a lake is impaired or not.

Water quality regulations have several main components including designated uses, water quality standards and criteria, and antidegradation provisions. The Federal Clean Water Act, *RSA 485-A Water Pollution and Waste Control*, and the NH Surface Water Quality Regulations (Env-Wq 1700) are the regulatory authorities for water quality protection in NH. In Maine, *MRSA Title 38 §465-A Standards for Classification of Lakes and Ponds* define the criteria for classification. These authorities form the basis for many of the state’s regulatory and permitting programs related to water. States are required to submit biennial water quality status reports to Congress via EPA. The reports provide an inventory of all waters assessed by the state and indicate which waterbodies are in violation of the state’s water quality standards.

3.1.1 Designated Uses

The CWA requires states to determine designated uses for all surface waters in the state’s jurisdiction. The designated uses protect surface waters to support fish, shellfish and wildlife, and human uses including public water supply, recreation, agriculture, and others. A lake can have several designated uses.

<u>NH's designated uses (Class B):</u>	<u>Maine's designated uses (GPA Lakes):</u>
Drinking water after adequate treatment	Drinking water after disinfection
Primary Contact Recreation (swimming)	Recreation in and on the water
Secondary Contact Recreation (boating)	Fishing
Aquatic Life	Agriculture
Fish Consumption	Industrial process and cooling water supply
Wildlife	Hydroelectric power generation
	Navigation
	Habitat for fish and other aquatic life
	Habitat must be characterized as natural

3.1.2 Water Quality Classification

New Hampshire classifies all surface waters as being Class A or B. The classifications provide a protective framework to further support individual designated uses. Class A waters are generally of highest quality and are potentially usable as drinking water supplies. Discharge of sewage or other waste is prohibited in Class A waterbodies. Class B waters are of the second highest water quality and are suitable for multiple uses including swimming, fishing, and other recreational purposes. All lakes in the study area are Class B waterbodies and their designated uses include Drinking Water After Adequate Treatment, Primary Contact Recreation, Secondary Contact Recreation, Aquatic Life, Fish Consumption, and Wildlife. NH recognizes the deficiencies in this classification system and will be proposing a new classification system in the near future based upon inherent qualities of the surface water (Chapman, 2010).

Maine state statutes define lakes and ponds greater than ten acres in size as Great Ponds (GPA), which entail additional regulatory protections, including Shoreland Zoning, and permitting review for habitat disturbance among others. The classification system is used to direct the management of lakes and ponds and to protect water quality for their designated uses. Maine further classifies lakes into four subcategories (Outstanding, Good, Moderate-Stable, and Poor-Restorable). These management categories are based on current water quality status and fishery value, as well as the lake's sensitivity to change, and are used to set lake protection levels and limit further increases in total phosphorus as a result of new development at the watershed level. This will be discussed more in the section on establishing water quality goals (Section 3.2.4).

3.1.3 Water Quality Standards and Criteria

Both Maine and New Hampshire's water quality standards provide a baseline measure of water quality that surface waters must meet in order to support designated uses. The water quality standards are the "yardstick" for identifying water quality violations and for determining the effectiveness of state regulatory pollution control and prevention programs. Water quality criteria are designed to protect the designated uses. In order to determine if a water body meets its designated uses, water quality standards for various water quality parameters (e.g., Chlorophyll-a, Total Phosphorus and Secchi Disk Transparency) are applied to the criteria. If a waterbody meets or is better than the water quality criteria, the designated use is supported. If the water body does not meet water quality criteria, it is considered impaired for the assessed use.

In Maine, Great Ponds Class A (GPA) waters are required to have a stable or decreasing trophic state (based on appropriate measures, e.g., **total phosphorus**, **chlorophyll-a**, **Secchi disk transparency**) that is subject only to natural fluctuations, and is free of culturally induced algal blooms that would impair their potential use and enjoyment. Maine DEP's functional definition of nuisance algal blooms include episodic occurrence of Secchi disk transparencies (SDTs) < 2 meters for lakes with low levels of apparent color (<30 SPU), and for higher color lakes where low SDT readings are accompanied by elevated chlorophyll-a levels (>8 ppb).

Water quality criteria for each classification and designated use in New Hampshire may be found in RSA 485A:8, IV and in the State's surface water quality regulations (NHDES 1999). However, the state is in the process of revising its current criteria. The previous phosphorus standard for NH lakes of 15 ppb was based

on a one size fits all standard, such that if a lake exceeded 15 ppb it was likely to become eutrophic (symptoms include frequent algal blooms). The proposed water quality standard was set by analyzing 233 New Hampshire lakes (or about one-fourth of all lakes in NH), for phosphorus and chlorophyll-a, trophic class, and impairment status. The results determined that statistically significant impairment values for phosphorus could be determined for each trophic class: 8 ppb for oligotrophic lakes, 12 ppb for mesotrophic lakes, and 28 ppb for eutrophic lakes. These thresholds are based on summer median TP, and were incorporated into the *Consolidated Assessment and Listing Methodology* for determining impairment status for the 2010 water quality report to Congress. The impairment thresholds mean that when phosphorus levels exceed these values, the lake is likely to exhibit characteristics of lakes in the next trophic class. The ramifications of impairment for lake quality are that continued declining trends in water quality could result in the lakes losing the clarity characteristics for which they are now highly valued.

3.1.4 Antidegradation

The Antidegradation Provision (Env-Wq 1708) in NH's water quality regulations serves to protect or improve the quality of the state's waters. The provision outlines limitations or reductions for future pollutant loading. Some types of development projects, such as those requiring an Alteration of Terrain Permit or 401 Water Quality Certification from NHDES, may be subject to an Antidegradation Review to ensure compliance with the state's water quality regulations. The Antidegradation Provision is often invoked during the permit review process for projects adjacent to waters that are designated Impaired or High Quality Waters (HQW). HQW is a special designation NHDES can assign if waters are determined to be of significantly better quality than what the water quality standards afford.

Key Lake Water Quality Parameters

Chlorophyll-a is a measurement of the green pigment found in all plants including microscopic plants such as algae. Measured in parts per billion (ppb), it is used as an estimate of algal biomass; the higher the Chl-a number, the higher the amount of algae in the lake.

Secchi Disk Transparency - a vertical measure of the transparency of water (ability of light to penetrate water) obtained by lowering a black and white disk into the water until it is no longer visible. Transparency is an indirect measure of algal productivity and is measured in meters (m).

Total Phosphorus (TP) - is one of the major nutrients needed for plant growth. It is generally present in small amounts and limits the plant growth in lakes, and measured in parts per billion (ppb). Generally, as the amount of lake phosphorus increases, the amount of algae also increases.

In Maine, the Antidegradation Provision states that no change of land use in the watershed of a Class GPA waterbody may, by itself or in combination with other activities, cause water quality degradation that would impair designated uses of downstream GPA waters or cause an increase in their **trophic state**. Maine's anti-degradation policy requires that "existing in-stream water uses and the level of water quality necessary to sustain those uses, must be maintained and protected."

3.1.5 Lake Nutrient Criteria

Both Maine and New Hampshire incorporate specific criteria in their water quality regulations to help determine if nutrients are affecting lake water quality. New Hampshire has a narrative nutrient criteria with a numeric translator, consisting of a "nutrient indicator" (phosphorus) and a "response indicator" (chlorophyll-a). The results from both the nutrient indicator and the response indicator are used to assess primary contact recreation (PCR) and aquatic life uses (ALU) in NH Lakes (Table 3.1).

Table 3.1: Aquatic life nutrient criteria by trophic class in NH.

Trophic State	TP (ppb)	Chl-a (ppb)
Oligotrophic	< 8.0	< 3.3
Mesotrophic	8-12	3.3- 5.0
Eutrophic	> 12-28	> 5-11

Primary Contact Recreation

Nutrient response indicators chlorophyll-a (Chl-a) and cyanobacteria scums (cyano) are secondary indicators for PCR assessments. They can cause a "not support" assessment, but, by themselves, cannot result in a "full support" designation (the primary indicator *E. coli* is needed for a "full support" assessment). The logic is that elevated Chl-a levels or the presence of cyano scums interfere with the aesthetic enjoyment of swimming and, in the case of cyano, may also pose a health hazard. Non-support for Chl-a is defined as concentrations greater than or equal to 15 ppb. Non-support for cyano scums is described as follows: "The surface water contains color, foam, debris, scum, slicks, odors and/or surface floating solids in significant amounts and for durations that significantly interfere with the primary contact recreational use, and they are not naturally occurring."

Aquatic Life Use

The Aquatic Life Use designation ensures that waters provide suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms. For ALU assessments using the lake nutrient criteria, the combination of total phosphorus (TP) and Chl-a nutrient indicators are used make support determinations. The ALU nutrient criteria vary by lake trophic class. The logic is that each trophic class has a given phytoplankton

Trophic state - the degree of eutrophication of a lake. Transparency, chlorophyll-a levels, phosphorus concentrations, amount of macrophytes, and quantity of dissolved oxygen in the hypolimnion can all be used to assess trophic state.

Parts per billion (ppb): A ppb is equivalent to one microgram per Liter (µg/L), a unit of measurement of a substance in the water. For example, if you are talking about 8 ppb phosphorus in a lake that means in one billion "drops" or parts of water, there are 8 "drops" or parts of phosphorus.

biomass (Chl-a) representing a balanced, integrated and adaptive community for that trophic class, and exceedances of the Chl criterion suggest the phytoplankton community is out of balance. TP is the limiting growth nutrient for Chl-a so it is evaluated as well.

For ALU assessment determinations, the Chl-a and TP results are combined according to the decision matrix presented in Table 3.2. The Chl-a concentration will dictate the assessment if both Chl-a and TP data are available and the assessments differ.

Table 3.2: Decision matrix for aquatic life use assessment determinations in NH.

	TP threshold exceeded	TP threshold <u>not</u> exceeded	Insufficient information for TP
Chl- <u>a</u> threshold exceeded	Impaired	Impaired	Impaired
Chl- <u>a</u> threshold <u>not</u> exceeded	Fully supporting	Fully supporting	Fully supporting
Insufficient information for Chl- <u>a</u>	Impaired	Fully supporting	Insufficient information

The basis for Maine lake nutrient criteria methodology is the recognition of a stable or decreasing trophic state for any given lake. Maine's guidelines for trophic evaluation is similar to NH, but instead represent ranges rather than thresholds (Table 3.3).

Table 3.3: Numerical guidelines for evaluation of trophic status in Maine.

Parameter	Oligotrophic	Mesotrophic	Eutrophic
Secchi Disk Transparency	> 8.0 m	4-8 m	< 4 m
Chlorophyll-a	< 1.5 ppb	1.5-7 ppb	> 7 ppb
Total Phosphorus	< 4.5 ppb	4.5-20 ppb	> 20 ppb
Trophic State Index	0-25	25-60	> 60 and/or repeated algal blooms

Both NHDES and Maine DEP conduct trophic surveys on lakes to determine trophic status. The trophic surveys evaluate physical lake features and chemical and biological indicators. Trophic state includes: oligotrophic, mesotrophic and eutrophic. These are broad categories used to describe how productive a lake is. Generally, less productive lakes have higher water quality (oligotrophic), while very productive lakes (eutrophic) exhibit frequent algal blooms. All lakes in the this plan have been designated **oligotrophic**, yet several of the lakes may be bordering on mesotrophic based on recent water quality modeling results.

Oligotrophic- Refers to a class of lakes that exhibit low productivity, low levels of phosphorus and Chl-a, few rooted aquatic plants and algae, deep transparency readings [8.0 m (26.5 ft) or greater] and usually high dissolved oxygen levels throughout the water column. These lakes are considered to have excellent water quality.

Lake Ivanhoe:

From High Quality Water to Impaired?

Lake Ivanhoe provides an example of how a lake can turn from “High Quality” to “Potentially Impaired”. Further analysis by NHDES is needed to determine whether Lake Ivanhoe should be listed as Impaired and put on the State’s 303(d) list of impaired waters.

Under the CWA, EPA requires states to conduct a Total Maximum Daily Load study of impaired waters to identify pollution sources, determine pollutant reductions, and describe restoration actions needed to bring the water body into compliance. Impaired water bodies are subject to more regulatory control, including antidegradation reviews (as mentioned in Section 3.1.4) at the state level to prevent further degradation.

3.1.6 Relating and Interpreting Water Quality Data and Lake Nutrient Criteria

The five lakes that make up the headwaters of the Salmon Falls River were thought to be high quality waters at the onset of this project. However, if the Lake Nutrient Criteria are applied to the results of the water quality analysis, at least three of these lakes do not meet the definition of a high quality water based on NH’s Lake Nutrient Criteria (See Table 3.4). The exception is for Wilson Lake, which will follow Maine Water Quality Standards because it is located entirely in Maine. A description of the study design and data analysis is provided in the next section.

Results of this analysis are important because the SF headwater lakes were thought to be high quality waters, fully supporting their designated uses. This suggests a need for enhanced management particularly for Lake Ivanhoe, Horn Pond, and Lovell Lake to ensure that water quality standards are being met. If the assessed data indicates median TP/Chl-a in excess of the oligotrophic threshold, then a final determination of use support status by NHDES for lakes could be either “Potentially Non-supporting” or “Impaired”. The determination illustrated here is for planning purposes only.

Table 3.4: Lake nutrient criteria applied to water quality assessment for each of the five Salmon Falls Headwater Lakes *.

Lake	Lake Nutrient Criteria Category
Lake Ivanhoe	Non-supporting for Designated Uses in NH
Great East Lake	Fully Supporting for Designated Uses in NH
Horn Pond	Potentially Non-supporting for Designated Uses in NH (P is at nutrient criterion; NHDES would make use determination)
Lovell Lake	Potentially Non-supporting for Designated Uses in NH
Wilson Lake	Meets ME Standards-Lake Water Quality Category = “Good”

* The determination illustrated here is for planning purposes only.

3.2 Assessment Methodology

Pollution threats to the SF headwater lakes include sediment and nutrients from existing and future development, aging septic systems and roads in the watersheds. All of these land uses have the potential to deliver phosphorus, the **limiting** nutrient in freshwater systems, via stormwater runoff to streams and lakes in the watershed. A water quality assessment is a key component to assessing the health of the lakes and determining how watershed activities may be affecting them. The water quality assessment for this plan required several steps. This required gathering existing data, analyzing data, determining the median phosphorus concentration for each lake, determining the total, reserve, and remaining assimilative capacity, identifying whether each lake fell in Tier 2 (High Quality Waters), or Tier 1 (within the reserve assimilative capacity), organizing and meeting with a Water Quality Threshold Committee, presenting results to the committee, and setting water quality goals/thresholds.

3.2.1 Water Quality Data Acquisition

Historical water quality monitoring data was analyzed by FB Environmental to determine the median phosphorus value and the assimilative capacity for Great East Lake and Horn Pond located in both Maine and New Hampshire, Lake Ivanhoe and Lovell Lake located in New Hampshire; and Wilson Lake located in Maine. Historical water quality data for lakes in Maine is collected by the Maine Volunteer Lakes Monitoring Program (VLMP) and the Maine Department of Environmental Protection (Maine DEP). The New Hampshire Volunteer Lake Assessment Program (VLAP) and the New Hampshire Lakes Lay Monitoring Program (LLMP) are the two primary volunteer groups collecting water quality data on lakes in New Hampshire. The LLMP is administered jointly by the UNH Center for Freshwater Biology (CFB) and UNH Cooperative Extension (UNHCE). Data from the VLAP is available through the New Hampshire Department of Environmental Services Environmental Monitoring Database (EMD).

Data acquisition and analysis followed protocols set forth in the Site Specific Project Plan (SSPP) in Appendix A. Data availability was variable between lakes, dating back to the year in which each lake was first sampled and ending with the most recent sampling event (Table 3.5).

Water quality data was combined into a common spreadsheet for each lake, and then sorted by date and station for Quality Assurance/Quality Control (QA/QC) in order to avoid duplicating data sets. All duplicates were removed. An initial analysis was conducted to determine median Total Phosphorus (TP) based on all samples regardless of multiple samples on the same day, or whether it was a **grab** or **epilimnetic core (EC) sample**. Data were then separated by EC only and grab only. Using EC data only, values were calculated for all EC

Limiting- *The nutrient or condition in shortest supply usually referring to growth. Plants will grow until stopped by this limitation; for example, phosphorus is typically limiting in summer and temperature or light is limiting in fall or winter.*

Grab Sample- *Grab samples are taken just below the surface or with a depth sampler at a specified depth or location in the water column.*

Epilimnetic Core (EC)- An EC is a sample of the epilimnion, or the top layer of water, and represents a vertical sample of the water column obtained by using flexible plastic tubing, usually ½ inch in diameter. The tubing is lowered to the desired depth, clamped at the water's surface, raised, and then the sample is decanted into a collection jug. This integrated sample is then tested for TP as well as other water quality parameters.

Table 3.5: Description of available sampling data for Salmon Falls headwater lakes.

Lake	Location	Water Quality Data			Phosphorus Data		
		First Sampled	Last Sampled	# Years Sampled	First Sampled	Last Sampled	# Years Sampled
Great East Lake	ME/NH	1974	2008	30	1974	2008	17
Lovell Lake	NH	1979	2008	23	1979	2008	23
Lake Ivanhoe	NH	1981	2008	19	1981	2008	18
Horn Pond	ME/NH	1982	2008	11	1982	2008	7
Wilson Lake	ME	1977	2007	29	1977	2006	9

Source: NH Environmental Monitoring Database (EMD), UNH Cooperative Extension (includes data from LLMP and CFB), Maine DEP, and PEARL.

values in all years regardless of whether they were taken on the same day. A second analysis was conducted to calculate the median EC value using a mean of samples collected on the same day. Where limited EC data was available (Horn Pond), grab samples taken on the same day at multiple depths near the surface were used in conjunction with the EC samples. A historic analysis was performed, and included samples collected before 1999, while recent data was analyzed to include all samples from 1999 to the present. A seasonal analysis included only samples that were collected between May 15 and September 30.

Lakes with multiple basins were analyzed on a per basin basis, and statistical analysis was used to determine if there were significant differences between stations within the same lake. Greater scrutiny was needed to assess multiple basins on Great East Lake. The question of interest is whether the TP conditions are similar across all stations, and whether a lake-wide average could be used for management purposes. The data used for this analysis were EC samples taken from the same date at four stations, over 20 dates between 7/11/2002 and 9/23/2008. All six pair wise comparisons (paired by date sampled) between the 4 stations were evaluated using a paired t-test, or non-parametric alternative.

3.2.2 Water Quality Analysis

The water quality analysis for the SF headwater lakes required examination of several key parameters to look for water quality trends over time (increasing, decreasing, or unchanged). In addition to a comprehensive analysis of total phosphorus for each of the five lakes (described above), the other key parameters included secchi disk transparency (also referred to as water clarity), *dissolved oxygen*, chlorophyll-a, and *color*. A full summary of the water quality analysis for each lake is presented in the Lake Fact Sheets (Appendix F).

Dissolved Oxygen (DO)- a measure of the amount of oxygen dissolved in the water. All living organisms, except for certain types of bacteria, need oxygen to survive. Organisms living in the water breathe the oxygen dissolved in the water. Low oxygen can directly kill or stress organisms such that they are not able to successfully reproduce or grow, and can release phosphorus from the bottom sediments.

Color- tells us about the influence that soils and geology, plants and trees, and land cover type in the watershed have on a lake. Color is measured by comparing a sample of the lake water to Standard Platinum Units (SPU). Lakes that are considered colored (>25 SPU) can have reduced transparency. This does not mean the lakes are more productive, the color simply interferes with transparency test.

As discussed in Chapter 2, each of the five headwater lakes has unique physical characteristics that affect their chemistry and biology. These characteristics include the actual size of the lake measured from bank to bank around the perimeter (area); the amount of water in the lake (volume); the number of times each year that the entire volume of the lake is replaced (flushing rate); and the average depth. Table 3.6 shows the differences in these characteristics from lake to lake.

Table 3.6: Physical characteristics of Salmon Falls headwater lakes.

Lake	Lake Area (m ²)	Lake Volume (m ³)	Flushing Rate (yr ⁻¹)	Mean Depth (m)
Ivanhoe	275,186	992,000	0.90	3.6
Great East	6,906,800	75,589,500	0.30	10.9
Horn	801,300	3,155,000	8.20	3.9
Wilson	1,190,000	6,756,766	0.85	5.2
Lovell	2,173,000	8,623,000	0.70	4.0

Great East Lake is clearly the largest and deepest of the five lakes. Lake Ivanhoe, which is potentially “Impaired” according to NH water quality standards, is the smallest and shallowest lake. A small, shallow lake is more prone to plant and algal growth because sunlight can penetrate through the water column to the bottom where plants can easily establish themselves. Lake Ivanhoe’s measured flushing rate is low (less than a full flush every year), and the lake does not have a large source of freshwater inflow other than overland runoff. Lake Ivanhoe is the only lake of the five that does not stratify. This means that water temperature and dissolved oxygen levels are relatively the same from the surface to depth. In contrast, Horn Pond flushes more than 8 times each year.

On average, large oligotrophic lakes flush approximately 1-1.5 times each year (PEARL, 2009). So, Horn Pond exceeds the average for lakes, while the others flush less than the average. The low flushing rates of the two upstream lakes (Great East and Wilson) provide a unique hydrological setting which may effectively keep phosphorus concentrations lower in Horn Pond than would be expected of a shallow lake with a high flushing rate (Dennis 2010).

Secchi Disk Transparency

Secchi disk transparency is one of the simplest techniques for tracking water quality of a lake over time. Trends in transparency over several decades are clues to how the lakes is responding to the environment. Major watershed changes may not be evident for several years after the land use change occurs (new development, land clearing, etc.). For this reason, it is important to continue these measurements on a bi-weekly basis through from spring through summer, especially at the deep holes (see monitoring recommendations, Section 6.3).

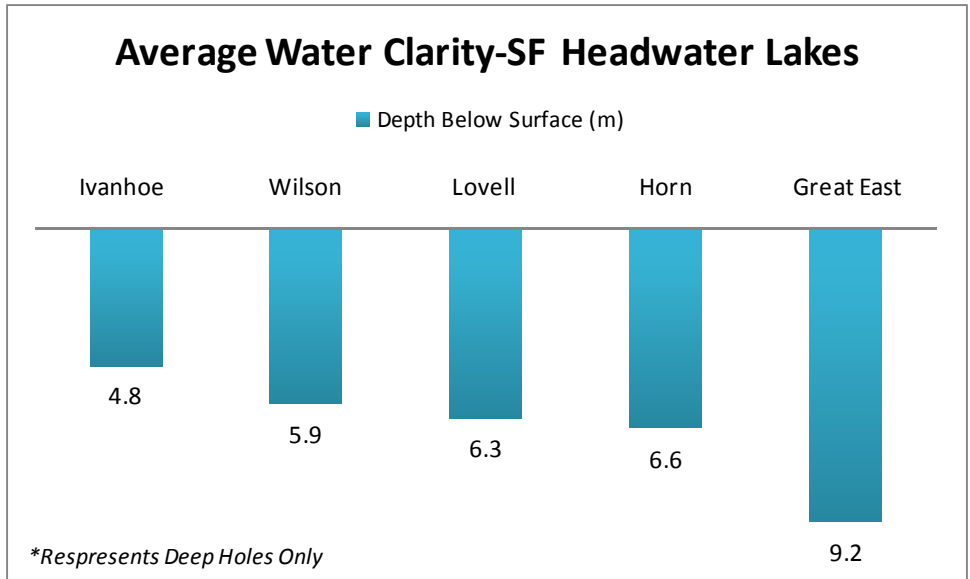


Figure 3.1: Mean water clarity for Salmon Falls headwater lakes.

Transparency readings are reported in meters (m) where 1 meter is equivalent to 3.28 feet. Factors that reduce clarity include algae, zooplankton, watercolor and soil particles such as silt that are washed in from the watershed. Since algae have the greatest effect on clarity, measuring transparency indirectly measures the algal productivity. For the SF headwater lakes, average secchi disk transparencies ranged from a low of 4.8 m (Lake Ivanhoe) to a high of 9.2 m (Great East Lake) (Figure 3.1). Two of the five lakes (Lovell Lake and Wilson Lake) exhibit a slight decline in transparency over the period of record. The other three lakes have remained relatively the same or improved slightly.

Color

The amount of "color" in a lake refers to the concentration of natural dissolved organic acids which give the water a tea color. In Maine lakes, color varies from 0 to 250, with the average being 28 Standard Platinum Units (SPU). For the five SF headwater lakes, the average color ranges from approximately 12 (Ivanhoe) to 16 (Horn & Wilson). All five lakes are considered "non-colored", which is one of the

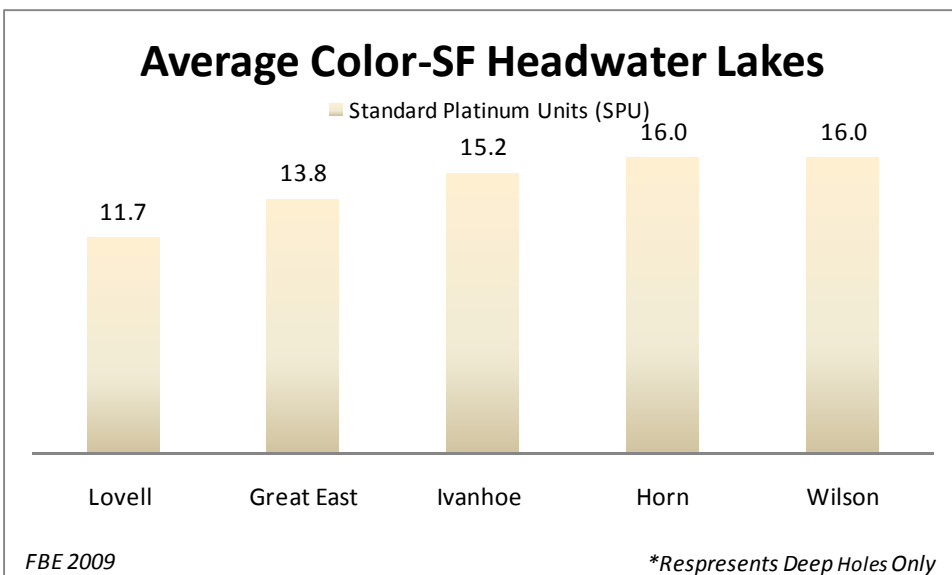


Figure 3.2: Mean water color of Salmon Falls headwater lakes.

reasons that the water in the lakes appears relatively clear. Lake Ivanhoe, Horn Pond, and Great East Lake exhibited an increase in color over the period of record, while Wilson and Lovell both show a decrease (Figure 3.2).

Chlorophyll-a

As mentioned previously, Chlorophyll-a (Chl-a) is a measure of the green pigment found in plants, and is used to estimate algal biomass; the higher the Chl-a number, the higher the amount of algae in the lake. Since water clarity and algal biomass are intricately connected, we'd expect that the lakes with the lowest water clarity would also have the highest Chl-a values. Figure 3.3. demonstrates that the lakes with the best water clarity also have the lowest Chl-a. If we look at trends in Chl-a for all five lakes, it is Wilson and Lovell, the two lakes with the highest average Chl-a, that exhibit a trend of increasing Chl-a over the period of record. Note that Lake Ivanhoe (in NH) does not currently meet NH standards for Chl-a (< 3.3 ppb for Oligotrophic lakes).

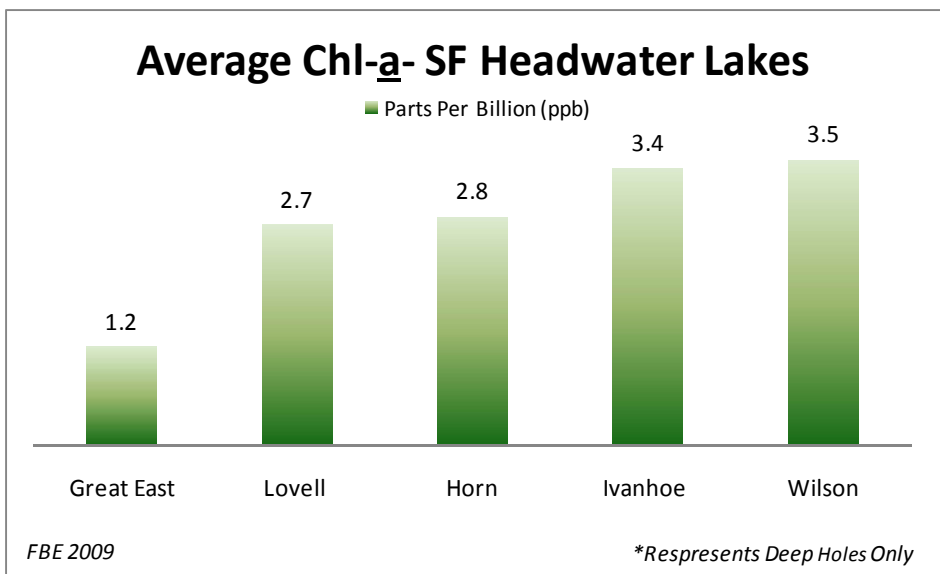


Figure 3.3: Mean chlorophyll-a for Salmon Falls headwater lakes.

Dissolved Oxygen (DO)

Organisms living in lakes breathe the oxygen dissolved in the water. Too little oxygen can severely affect aquatic communities, often reducing diversity and population sizes. Low oxygen can directly kill or stress organisms such that they are not able to successfully reproduce or grow. Dissolved oxygen (DO) less than 5 parts per million (ppm) can stress cold water fish, and a persistent loss of oxygen may eliminate or reduce habitat for sensitive cold water species.

Lakes that are productive (have lots of plant growth, especially algae) tend to have decreased oxygen levels in deep areas of the lake because decaying plant material sinks to the bottom of the lake, and uses up oxygen as it decomposes. Thermal **stratification** prohibits well oxygenated water at the surface from mixing with deeper water. The deep water of a productive lake can become anoxic, meaning there is less than 1ppm of dissolved oxygen in the water. Anoxia promotes the release of phosphorus from the sediments on the bottom of the lake, and can lead to excessive algal growth, especially for lakes that already have high levels of phosphorus.

Stratification- Refers to distinct layers of water in a lake differing in temperature and density. Deep lakes commonly stratify into three distinct layers: the epilimnion (upper), metalimnion (middle), and hypolimnion

Closer examination of DO profiles for the five SF headwater lakes reveals that Wilson lake is exhibiting low levels of DO in deeper areas of the lake, and that the potential for phosphorus release from the sediments is high (Figure 3.4). Historical profiles for Great East Lake show little DO depletion at depth. The limited DO data available for Lovell Lake also indicates low DO at depth, while Horn Pond shows low to moderate DO depletion. Lake Ivanhoe is the exception because it is the shallowest lake, and does not stratify. Therefore, the amount of oxygen at the surface is relatively the same at the bottom. Regular DO monitoring is needed for the deep holes of all five lakes to determine how DO levels are changing over time, and to help quantify any internal phosphorus loading that may be occurring in these lakes.

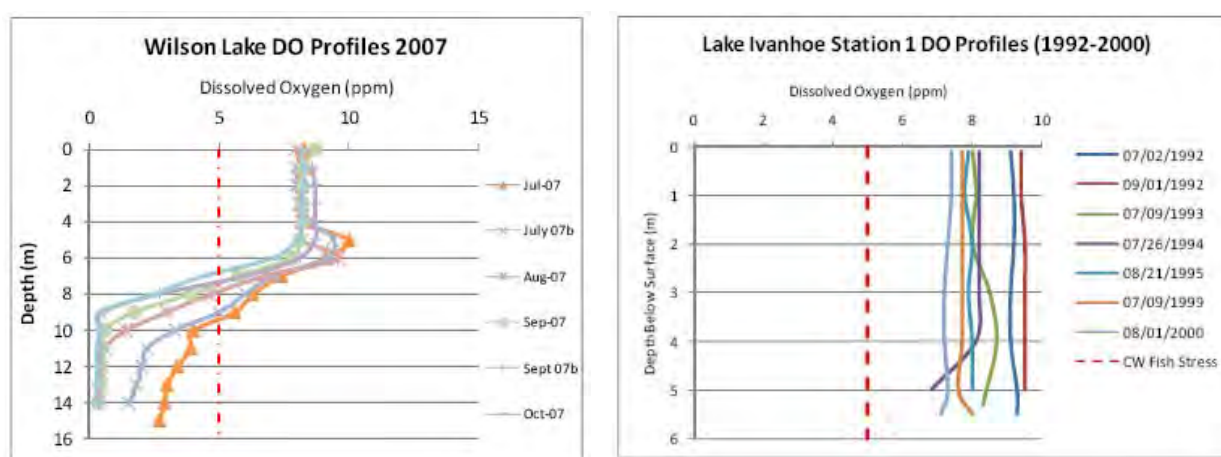


Figure 3.4: Contrasting dissolved oxygen profiles for two of the Salmon Falls headwater lakes.

Total Phosphorus (TP)

Phosphorus is what is known as a “limiting nutrient” in lakes. In a pristine setting, a lake receives inputs of phosphorus in the form of runoff from the watershed. This is because phosphorus is bound to tiny soil particles that flow into the lake as a result of erosion from rainfall and snowmelt. Phosphorus that enters lakes will either be taken up by organisms, settle to the bottom, or flow downstream. In most freshwater lake systems in the northeast, phosphorus is the limiting nutrient, a chemical necessary for algae growth, but available in quantities smaller than needed for increased growth and abundance. Increasing the limiting nutrient will increase algal populations until another nutrient is in short supply, and therefore becomes the new limiting nutrient. When excess phosphorus flows into the lake as a result of poor land management practices, phosphorus is no longer a limiting nutrient, and plants and algae will thrive. Over the long-term, these inputs can have dire consequences and lead to frequent blue/green algal blooms.

Average (median) TP was determined for each water quality monitoring station for all five lakes, and then further refined for the deep holes (since statistically significant differences were not found to occur between the deep hole and other monitoring stations on the same lake). Results of the phosphorus analysis are generally in line with the results of other water quality parameters (Figure 3.5).

Both recent (1999-present) and historic (pre-1999) data were examined to determine if recent TP values were different than the previous time period. Several of the lakes show increasing levels of TP over the period of record. Wilson Lake, Horn Pond and Great East Lake show significant increases (2-5 ppb) in the recent time period compared to the historic period. Further review of weather patterns, and development in the watershed would provide help determine if this is a real shift in

trophic state, an episodic, weather driven change that will correct itself overtime, or a case of limited data. Lovell Lake (Station 2) and Lake Ivanhoe (Station 1) both exhibit a slight increase in TP over the period of record.

Horn Pond is currently considered “Potentially Non-supporting” according to NHDES water quality standards. Median TP for Horn Pond is close to NH’s 8 ppb standard for oligotrophic lakes based on 7 years of epicore and epigrab samples collected during a specified period ending September 30th. A more robust set of epicore data is needed for Horn Pond to clearly define TP trends, and to assist NHDES with a final listing determination (supporting vs. non-supporting). Lakes with similar characteristics (shallow with a high flushing rate) typically have higher trophic states and exhibit higher Chl-*a* concentrations and lower secchi depths, suggesting that Horn Pond has a lower trophic state (better water quality) than would be expected of a lake of its type (Dennis 2010). Horn Pond receives 182 kg/yr of additional phosphorus from two *indirect watersheds* (Great East Lake accounts for 80% of the indirect load and Wilson Lake accounts for 20%). This represents one-third of the TP entering Horn Pond from the surrounding watershed. Great East Lake and Wilson Lake are deep, and have very low flushing rates, which allows P to settle out of the water column and onto the lake bottom, thereby filtering the water that flows into Horn Pond. If these upstream lakes were not there to effectively filter phosphorus from the water column, then the TP concentration in Horn Pond would be much higher (Dennis 2010). Internal recycling of phosphorus is not considered a factor that would increase TP concentrations in Horn Pond. This is because the sandy, granitic, low pH, soils in the watershed export dissolved aluminum to area lakes. The aluminum is deposited as aluminum hydroxide in the bottom sediments, effectively preventing phosphorus from being released from the sediments under anoxic (low oxygen) conditions (Dennis 2010).

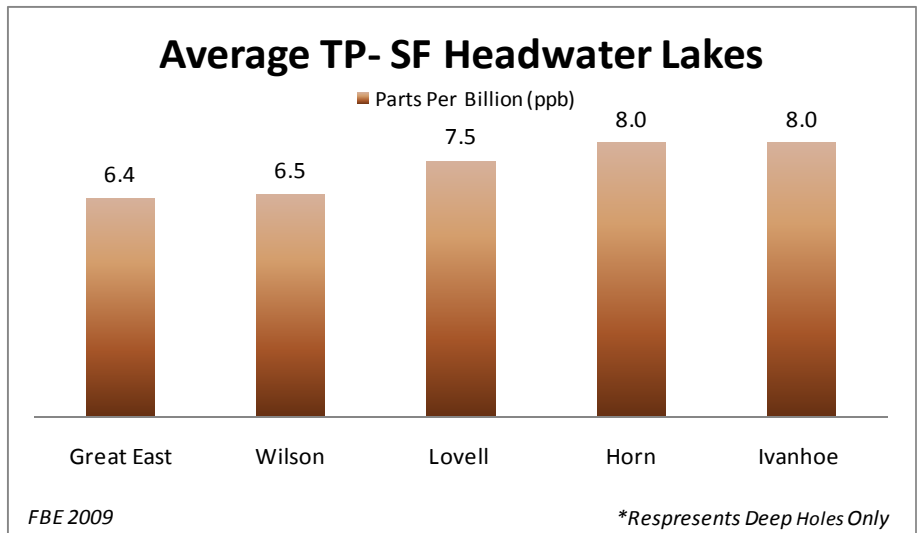


Figure 3.5: Median total phosphorus for Salmon Falls headwater

Indirect Watershed– The land area that drains to a waterbody that is immediately upstream of the study lake. Phosphorus delivered by indirect watersheds can be of particular concern, especially if the TP concentration and volume of water in the upstream lake is greater than the downstream lake.

3.2.3 Assimilative Capacity Analysis & In-Lake Phosphorus Modeling

Once the median water quality was determined for each of the five lakes, the total, reserve and remaining **assimilative capacity** for each waterbody was determined using procedures described in the Standard Operating Procedures for Assimilative Capacity Analysis for New Hampshire Waters (Table 3.7; NHDES 2008). Tier 2, or high quality waterbodies are described as having water quality in which one or more parameters is better than the water quality standard plus the reserve capacity (the reserve capacity is 10% of the total assimilative capacity). Tier 2 waters have some assimilative capacity remaining, whereas impaired and Tier 1 waters do not. The assimilative capacity analysis was conducted for total phosphorus.

Assimilative Capacity- The capability of a lake to resist the effects of landscape disturbance without water quality impairment. The Assimilative Capacity Analysis for the five Salmon Falls headwater lakes is based on each lake's ability to resist the effects of excess phosphorus from non-point source pollution in the watershed.

Table 3.7: Results of the assimilative capacity analysis for Salmon Falls headwater lakes.

Lake	WQ Monitoring Station	Existing Median TP (ppb)	TP Water Quality Threshold (ppb)	Assimilative Capacity Threshold (ppb)	Remaining Assimilative Capacity (ppb)*	Results Assimilative Capacity Analysis	Acceptable TP Increase (ppb)**	Impaired (Y/N)
Great East	1	6.4	8.0	7.2	0.8	Tier 2	0.8	No
Wilson	1	6.5	8.0	7.2	0.7	Tier 2	0.7	No
Ivanhoe	2	8.0	8.0	7.2	-0.8	Tier 1	0.0	No
Horn	1	8.0	8.0	7.2	-0.8	Tier 1	0.0	No
Lovell	2	7.5	8.0	7.2	-0.3	Tier 1	0.0	No

* Remaining Assimilative Capacity = (TP Threshold - Median TP) - (Reserve Capacity or 10% x TP Threshold).

** Wilson Lake is located in Maine, and therefore follows ME standards which allows for an increase of 1 ppb for TP.

For consistency and for sake of comparison, the NH methodology was applied to Wilson Lake, the only lake located entirely in Maine. Results of this analysis suggest that Great East Lake and Wilson Lake fall within the Tier 2 classification for High Quality Waters in New Hampshire, while Ivanhoe, Horn and Lovell Lake are Tier 1 waterbodies. Lovell Lake is currently on the cusp of a Tier 2 status, while Ivanhoe and Horn appear to be on the cusp of an Impaired status based on total phosphorus only.

This means that three Tier 1 lakes are within the 10% reserve remaining assimilative capacity. While Lovell Lake has a small amount of remaining capacity, Lake Ivanhoe and Horn Pond are at their threshold. This means that any new development within these watersheds may require phosphorus controls to prevent

Tier 2- Better than the standard + reserve capacity.

Tier 1- Better than the standard but within the reserve capacity.

Impaired- Worse than the standard, no remaining assimilative capacity, and not within the reserve.

additional phosphorus from entering these lakes, and that phosphorus controls are needed to address existing sources of phosphorus in the watershed if these lakes are going to meet Tier 2, or High Quality Water status in the future. As stated earlier, more TP data is needed for Horn Pond before a final use determination can be made by NHDES.

A second analysis was used to link watershed loading conditions with in-lake total phosphorus concentrations to predict the effect of existing watershed development on in-lake phosphorus concentrations. Referred to as total phosphorus retention modeling, the model estimates in-lake phosphorus concentrations based on physical and chemical lake characteristics including lake volume, watershed area, a precipitation runoff coefficient (which is unique to each lake) and estimated watershed phosphorus loading from STEPL (Section 2.5), as well as indirect loading calculations (for Horn Pond). Because of the imperfect nature of any model to predict processes within natural systems, the modeling compared six different in-lake phosphorus models including Vollenweider 1969; Chapra 1974; Dillon-Rigler 1976; Kirchner-Dillon 1975; Larsen-Mercier 1976; Jones-Bachman 1976; and Reckhow 1977).

Table 3.8: Results of the in-lake total phosphorus retention modeling.

Lake	STEPL Watershed TP Load (kg/yr)	Current Median TP (ppb)	Estimated In-Lake Concentration (ppb)	Diff. Between Actual & Estimated In-Lake Concentration (ppb)
Great East	625	6.4	7.3	0.9
Wilson	187	6.5	9.3	2.8
Ivanhoe	52	8.0	12.2	-4.2
Horn	273 (91 direct + 182 indirect)	8.0	7.7	-0.3
Lovell	281	7.5	8.6	1.1

These models are not used to set water quality goals, but instead as a tool to examine how phosphorus controls and future land use changes in the watershed will effect these lakes. These numbers are also compared to the results of the NH Assimilative Capacity Analysis (Table 3.7) to verify that the model outputs are close to actual in-lake conditions. Final modeling results for all six models were assessed to determine which model/models were best suited to the individual lake. Final estimated in-lake phosphorus concentrations (Table 3.8) are based on either Reckhow (1977), or Jones-Bachman (1976). These results align well with the NH Assimilative Capacity Analysis methodology which shows that Lake Ivanhoe and Horn Pond have no remaining assimilative capacity, and that Great East Lake and Wilson Lake have remaining capacity to treat phosphorus. The large spread between the estimated in-lake concentration for Lake Ivanhoe compared with the current measured in-lake phosphorus concentration may indicate that existing land uses in the watershed may eventually catch up, causing a significant decline in water quality unless dealt with promptly. Lakes may not exhibit the effects of large landscape changes until several years after a disturbance occurs (Bouchard 2009). As mentioned previously, Lovell Lake is on the cusp of the Tier 1 and Tier 2 classification, meaning it is within its reserve assimilative capacity. Small improvements in the watershed to reduce soil and sediment runoff into Lovell Lake, and planned development which reduces phosphorus inputs will help Lovell Lake achieve its Tier 2 (High Quality Waters) status.

3.2.4 Establishing Water Quality Goals

The SF headwater lakes Water Quality Threshold Committee was developed to review the results of the water quality data analysis, and to help guide the goal setting process. The committee is composed of qualified water quality experts and watershed managers from both Maine and New Hampshire including: the Acton Wakefield Watersheds Alliance, Maine DEP, NHDES, and representatives of the University of New Hampshire LLMP Center for Freshwater Biology, and facilitated by FB Environmental. The committee met in person for two separate meetings in February and April of 2009 to discuss goal setting. The committee was faced with two major challenges throughout the



Wilson Lake is the only lake of the three located entirely within the state of Maine. Photo: Jeanne Achille, AWWA

threshold setting process. First, several of the lakes do not meet the criteria for High Quality Waters under New Hampshire’s revised water quality standards. This is because under previous draft water quality standards these lakes were considered Tier 2, but are now considered Tier 1 under the revised water quality standards. Secondly, two of the waterbodies (Great East Lake and Horn Pond) fall within the jurisdiction of both the State of Maine and New Hampshire. As described above, each state has different criteria and standards for assessing water quality, and different management strategies for addressing potential declines.

Discussions among the water quality committee focused heavily on how to harmonize Maine and New Hampshire water quality standards so that recommendations in the management plan could be regionalized across towns and states. Since acceptable increases in TP for the two border lakes (Great East and Horn Pond) differ between states (Table 3.9), the most stringent standards apply. In this case, it is the NH water quality standards that are more stringent, and therefore were used to set water quality thresholds for all but Wilson Lake, which is the only lake located entirely within Maine. Final water quality threshold recommendations combine information presented in Tables 3.7 and 3.9, and Figure 3.6.

Table 3.9: Acceptable increases in phosphorus concentrations for the Salmon Falls headwater lakes by state.

Lake	ME Water Quality Category *	ME Acceptable Increase	NH Water Quality Category	NH Acceptable Increase
Ivanhoe	N/A	N/A	Oligotrophic	0.0
Lovell	N/A	N/A	Oligotrophic	0.3
Great East	Good	1	Oligotrophic	0.8
Horn	Good	1	Oligotrophic	0.0
Wilson	Good	1	N/A	N/A

*“Good” refers to one of five categories of water quality for Maine lakes that are generally clear with relatively low algae and phosphorus levels. Secchi disk transparency ranges from 20-30 ft., Chl-a from 2-4 ppb, and TP from 5-10 ppb.



Figure 3.6: Final water quality recommendations for the Salmon Falls headwater lakes.

While only two of the five lakes (Ivanhoe and Lovell) are candidates for watershed-wide phosphorus reductions, all five lakes are candidates for phosphorus control standards, or ordinances designed to limit future phosphorus inputs from new development. The Buildout Analysis (Appendix E) clearly shows how local phosphorus control standards can help negate the impacts of future development in these watersheds. More data is needed for Horn Pond in order to clearly establish whether this lake is non-supporting according to NH water quality standards. For now, the recommended action is to maintain the existing water quality.

In order to achieve the water quality goals set forth in this plan, the two towns will need to work together to set aggressive load reduction regulations for future development, and focus efforts to implement BMPs to address existing sources of phosphorus throughout the watershed. The towns of Acton and Wakefield should set any land use standard they think is appropriate for their lakes as long as these standards meet state minimums. For the two bi-state lakes, the more conservative standard (more protective of water quality) applies.

These recommendations should be viewed as long-term management strategies for each lake, with the intention that five lake associations, two towns and two states can work together to limit future phosphorus increases to these waterbodies. AWWA will continue its efforts to bring these groups to the table to solve problems, and achieve long-term goals to protect these lakes.

3.3 Master Plan Review & Local Ordinance Review

Municipal Master (or Comprehensive) Plans are important documents that are often referred to as “road maps” for community growth and development. They provide a sense of a community’s overall character and describe how, why, where, when and at what pace development will occur. Ideally, Master Plans derive from a meaningful and broadly participatory public process that creates an overall community vision.

Maine and New Hampshire both have legislation that requires communities to develop and periodically update municipal Master Plans (Maine refers to these documents as Comprehensive Plans). Maine’s Comprehensive Plan Review Criteria Rule (Chapter 208) establishes the criteria used by the State Planning Office to review community comprehensive plans for consistency with the goals and guidelines of the Growth Management Act. New Hampshire’s RSA 674 (Local Land Use Planning and Regulatory Powers) establishes the components of community Master Plans that will: “set down as clearly and practically as possible the best and most appropriate future development of the area under the jurisdiction of the planning board (NH Title LXIV, Chapter 674.2).”

The legislation requiring Master or Comprehensive Plans for both states explicitly expresses a concern for natural resource protection and preservation, among many other important community growth and development considerations. The Towns of Wakefield, New Hampshire and Acton, Maine have each developed their own plans that broadly address environmental concerns and more specifically refer to water resource protection. Wakefield’s Master Plan identifies the importance of “preventing severe run-off and erosion (and) contamination of wetlands and ground water resources (2001), while Acton’s Comprehensive Plan also addresses water quality concerns in several places throughout the document. For example, Acton’s Comprehensive Plan notes that “areas of sandy, steeply sloped soils are quite vulnerable to erosion and are a concern from a water quality standpoint” and identifies the importance of insuring that “erosion and storm water control measures are reviewed prior to approval of large development proposals and also inspected during the construction phase” in an effort to protect water resources (2005).

Both communities also have local land use regulations that provide some specific measures of protection to the SF headwater lakes water resources. A review of municipal land use ordinances for Acton and Wakefield was conducted to provide recommendations for how these documents could be better aligned with development practices that are more protective of local water quality. Acton’s most recent Zoning Ordinance, Subdivision Regulations and Road Ordinance were included in the review as were Wakefield’s most recent Zoning Ordinance, Subdivision Regulations and Site Plan Regulations. The reviews were based on model development principles created by the Center for Watershed Protection (CWP, 1998). These principles promote the reduction of IC, conservation of natural areas, and prevention of stormwater pollution while simultaneously preserving and enhancing the quality of life in local communities. The model principles are grouped into the following three primary categories as a means of facilitating comparisons with other municipal land use ordinances:

- Transportation infrastructure
- Residential and commercial development

- Open spaces and natural areas

The assessment methodology was used to measure and compare local land use regulations for Acton and Wakefield against CWP's model development principles, which represent an idealized development scenario. The CWP methodology assigns a relative score for "planning benchmarks," each of which assesses a single site design practice depending on how closely local development regulations conform to the ideal model ordinance. In some cases, determining scores for the ordinances was subject to interpretation since specific ordinance language could not be directly related to the model development principles. Additionally, while not all of the principles are entirely applicable to the rural nature of the SF headwater lakes region, they still provide a useful means for identifying opportunities for improving municipal land use regulations.

The highest possible overall score for the assessment is 95 and the CWP generally recommends reforming local development rules if the score is less than 80% of the total (Table 3.9). The overall scores for Acton and Wakefield are 71 and 68 (75% and 68% of the total), respectively, suggesting there are considerable opportunities for improvement by both towns (Table 3.10). Appendix D provides a more detailed discussion of the scoring results in the full Municipal Ordinance Review Report.

An additional consideration not specifically addressed in the Master Plan and Ordinance Review but of particular importance to maintaining and protecting the SF headwater lakes exceptional water quality is the establishment of phosphorus control regulations. Phosphorus is generally the essential limiting nutrient for plant growth in freshwater systems. In excessive amounts, it can result in algal growth and corresponding decreases in water quality. The most significant sources of phosphorus in lake watersheds are often closely related to development. As more undeveloped land in a watershed is converted to developed uses (e.g., residential, commercial, recreational, etc.), the likelihood that phosphorus will be transported by stormwater runoff to nearby surface waters increases.

Table 3.10: Center for Watershed Protection Community Scoring Guidelines.

SCORING (A total of 95 points are available):	
Your Community's Score	
90- 100 %	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 - 89 %	Your local development rules are pretty good, but could use some tweaking in some areas.
79 - 70 %	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 - 69 %	Development rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
less than 60 %	Your development rules definitely are not environmentally friendly. Serious reform of the development rules is needed.

Table 3.11: Summary of Codes and Ordinance Worksheet scores for Acton and Wakefield.

HABITAT TYPE	CWP Maximum	Acton's Score	Adequate	Needs Improvement	Wakefield's Score	Adequate	Needs Improvement
Transportation Infrastructure	35	21		√	17		√
Residential & Commercial Development	36	26		√	30		√
Open Spaces & Natural Areas	24	24	√		21		√
Totals:	95	71	75% ←	% Total	68	72% ←	% Total

Fortunately, phosphorus concentrations in the SF headwater lakes have not reached the critical level at which excessive algal growth occurs. However, three of the five lakes are close to a threshold at which water quality conditions could gradually deteriorate – particularly given the desirability of the area as a residential and recreational destination. Therefore, in addition to the recommendations in the Master Plan and Ordinance Review (almost all of which will help to decrease phosphorus runoff), the towns of Wakefield and Acton should also consider establishing phosphorus control regulations to mitigate against the potential adverse effects from development. These regulations could include (but are not limited to) the following:

- A watershed or region - wide P control ordinance for all new development.
- Reduction or removal of grandfathering (for both subdivisions & shoreland zone).
- Ordinance revisions to encourage cluster development & open space.
- Ordinance revisions to require Low Impact Development principles with individual building permits.
- Increasing fines for non - compliance, especially in the shoreland zone.
- Prohibiting the use of phosphorus lawn fertilizer unless a soil test determines it is needed.
- Establishing a septic system maintenance tracking program to identify inadequate or failing systems.
- Prohibiting the use of phosphate-based detergents.

Numerous communities throughout northern New England have established phosphorus control ordinances to protect lake watersheds. In particular, many Maine communities have adopted the practices developed in *Volume II: Phosphorus Control in Lake Watershed: A Technical Guide to Evaluating New Development* (MEDEP 2008), which addresses long-term phosphorus loadings to lakes by setting standards to limit phosphorus contributions from new developments, and outlines guidelines to meet these standards. This document could prove to be a very useful guide for the towns of Wakefield and Acton should they decide to establish phosphorus control regulations.

3.4 Future Land Use Projections: Build Out Analysis

A buildout analysis was conducted by FB Environmental for the SF headwater lakes watersheds (Appendix E). The analysis combined projected population estimates, current zoning restrictions, and a host of additional development constraints (conservation lands, steep slopes, wetlands, existing buildings, soils with low

development suitability, unbuildable parcels) in order to determine the extent of buildable area in the watershed. Buildable land covers 48% (8,055 acres) of the AWWA watersheds.

Based on current growth rates and municipal zoning regulations in the towns of Wakefield and Acton, full buildout within the watersheds of the target AWWA lakes is projected to occur by the year 2054, at which time the number of buildings in the watersheds would potentially increase from an estimated 1,317 to 4,239. Nearly 78% (2,274 buildings) of the new development would take place in Wakefield (Figure 3.7). Full ‘Buildout’ refers to the time and circumstances whereby, based on a set of restrictions (e.g. environmental constraints and current zoning), no more building growth may occur, or the point at which lots have been subdivided to the minimum size allowed and there is no more ‘developable’ land. At 30% buildout, it’s anticipated that there will be a total of 876 new parcels developed, with the greatest number of units being build in the Great East Lake watershed (482 new units) and the Lovell Lake watershed (229 new units).

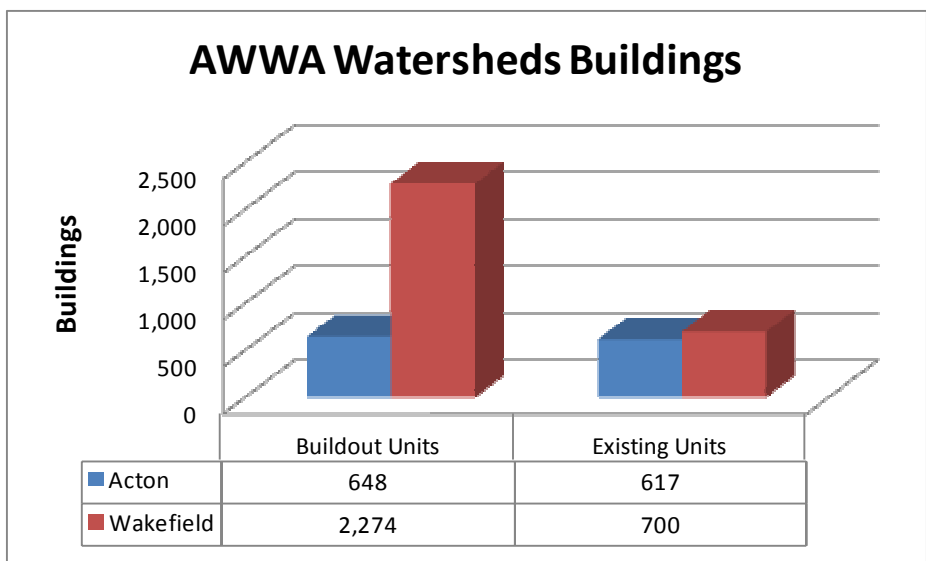


Figure 3.7: Existing and projected buildout units in Acton and Wakefield.

Results of this analysis reinforce the concept of comprehensive planning at the watershed scale in order to address future development and its effect on the water quality of the region. Projected phosphorus estimates based on the buildout analysis and using current zoning was calculated at 30% buildout, which is estimated to occur in the year 2030 based on current growth rates. Phosphorus loading from this new development without phosphorus reduction measures in place is estimated to contribute an additional 86 kg (190 lbs) of phosphorus/year to the target AWWA waterbodies. With phosphorus controls in place (including required P management plans for all new development watershed-wide), this load would be reduced to just 3 kg more P/year.

***FLASH FORWARD:
Target Salmon Falls Headwater
Lake Watersheds***



- ***4,239 new buildings***
- ***9,000 more people***
- ***Residential water use will increase by
500 million gallons/ year***
- ***Residential energy use will increase by
>400 million BTU's/year***

3.5 Shoreline Survey Assessment

Shoreline Survey Assessments aim to identify potential pollution problems associated with stormwater runoff from properties in the immediate shoreline area. In the summer of 2008, Shoreline Survey Assessments were conducted for Great East Lake, Lovell Lake, Horn Pond, Wilson Lake, and Lake Ivanhoe by representatives from FB Environmental, NHDES, and AWWA. Surveyors assessed each lake shoreline by boat, from approximately 50 feet off shore. For all lots with dwellings, surveyors estimated both the distance between the structure and the waterline and the overall impact of the property on the water quality of the lake. Impact assessments were made by estimating both the amount of exposed soil and the width of vegetated buffers between the property and the water. Generally, shoreline properties with bare soil and inadequate vegetative buffers will have a higher impact on water quality. The impact of public areas without dwellings was also assessed. Survey findings for each lake are discussed below.

GREAT EAST LAKE

A majority of the shoreline development on Great East Lake consists of medium density residential (77%) with some high density development in the main basin (Figure 3.8). Approximately 8% of the shoreline is undeveloped. High density residential development accounts for 14% of all shoreline development along GEL. These lots are small with multiple rows of houses visible from the water. Overall, 64% of the structures on Great East Lake are located within 50' of the shoreline. Only 28% of structures are set back 50' to 100' and approximately 8% have setbacks greater than 100'. In general, the houses on shoreline of the main basin have much smaller setbacks on average than those on the eastern basins, which have average setbacks of 50' to 100' from the shoreline.



Photo: L. Schier

Properties with shorter setbacks generally have a greater impact on water quality due to the lack of room for an adequate vegetated buffer. Vegetated buffers function to slow, absorb and filter stormwater runoff from land before it reaches the lake. On some lots, bare soil that could potentially be carried by runoff was noted, which contributed to a higher impact rating. On Great East Lake, 45% of surveyed properties were rated as high impact, 42% were rated as medium impact and 13% were assessed as having low impact. The main basin has a much greater frequency of high impact lots than the eastern basins (51% versus 31%) which correlates with the increased density along the shoreline.

Some public and private shoreline lots without structures were also examined for potential impact. A rope swing area adjacent to the canal dam was noted as a potential hotspot due to large amounts of exposed and loose soil on a sloped area. Extensive use of this public area could result in increased erosion and runoff, which could increase siltation and nutrients in the lake. All undeveloped shoreline parcels were rated as low impact.

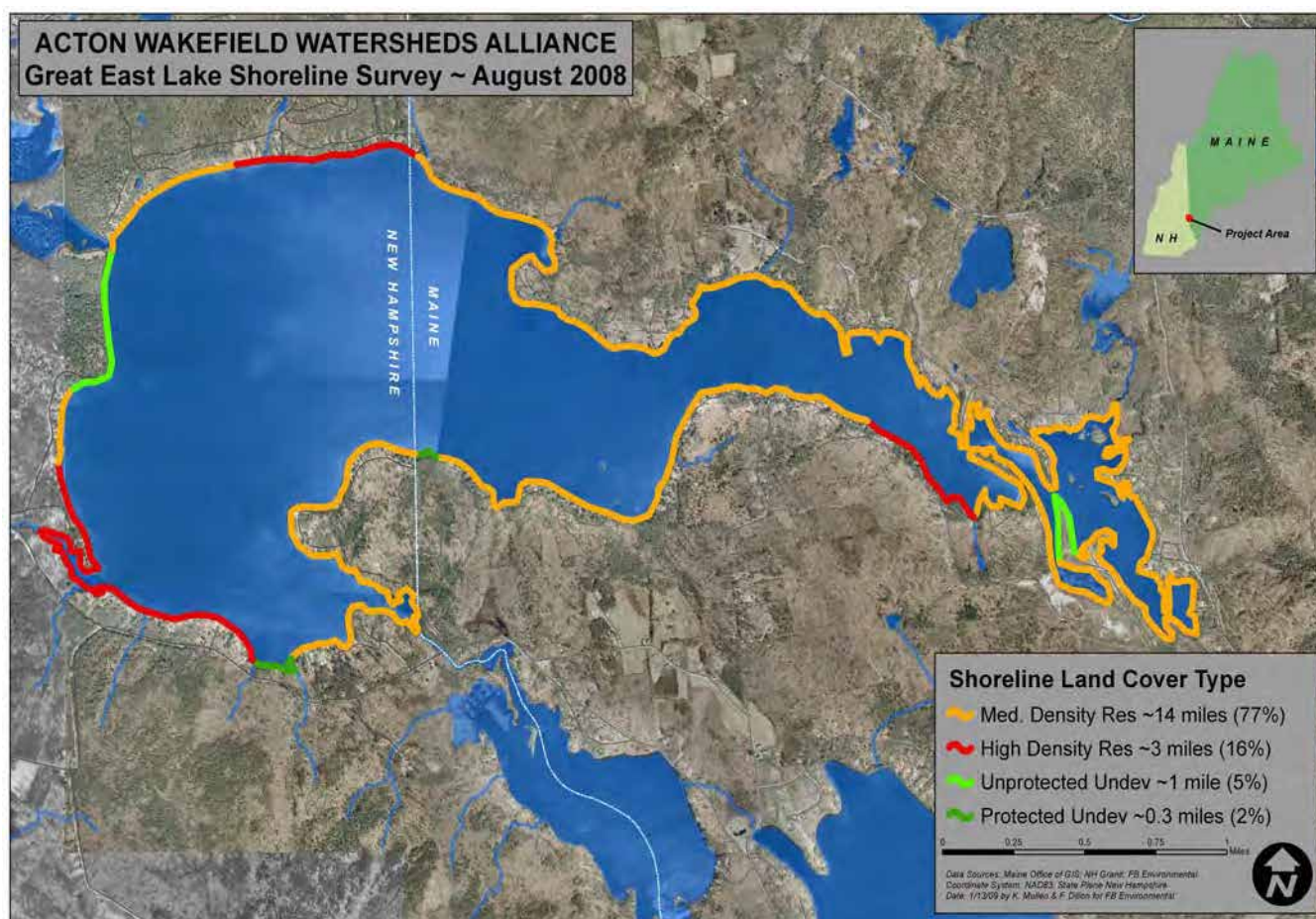


Figure 3.8: Great East Lake shoreline survey results.

LOVELL LAKE

The majority of development along the shoreline of Lovell Lake consists of low density residential (87%). High density development, consisting of many small houses and cabins clustered on the shore, is located along only 0.4 miles of the 8.4 mile lake perimeter. The islands in the west end of the lake are largely undeveloped (Figure 3.9). Of the 250 residences noted on the shore, 68% are located within 50' of the shoreline and only 14% have setbacks greater than 100'.

Due mostly to the large percentage of structures within 50' of the lake, about 46% of lots were assessed as having high impact. Medium impact lots were equally as frequent (46%) making the number of low impact lots minimal (7%). Although the Lovell Lake has large areas of natural buffers, many shorefront lots are still lacking adequate vegetated buffers, as indicated by the percentage of lots rated as high impact. On 23 lots, paved driveways between the structure and the shoreline were noted. On these properties, the estimated setback distance included the paved area, which may have increased the impact rating if loose soil or a lack of buffer was evident on the road sides.

Notable areas with a high potential water quality impact include Route 109 and the area of high density development on the northern shoreline (Figure 3.9). Route 109 is sited extremely close to the lake and offers

very little opportunity for diverting and infiltrating stormwater. With heavy traffic throughout the summer months, this site has the potential to contribute high inputs of heavy metals and gasoline as well as sediment and nutrients to the lake. A small amount of conserved and/or undeveloped shorefront was also observed, along the lake's eastern shore and the two islands.

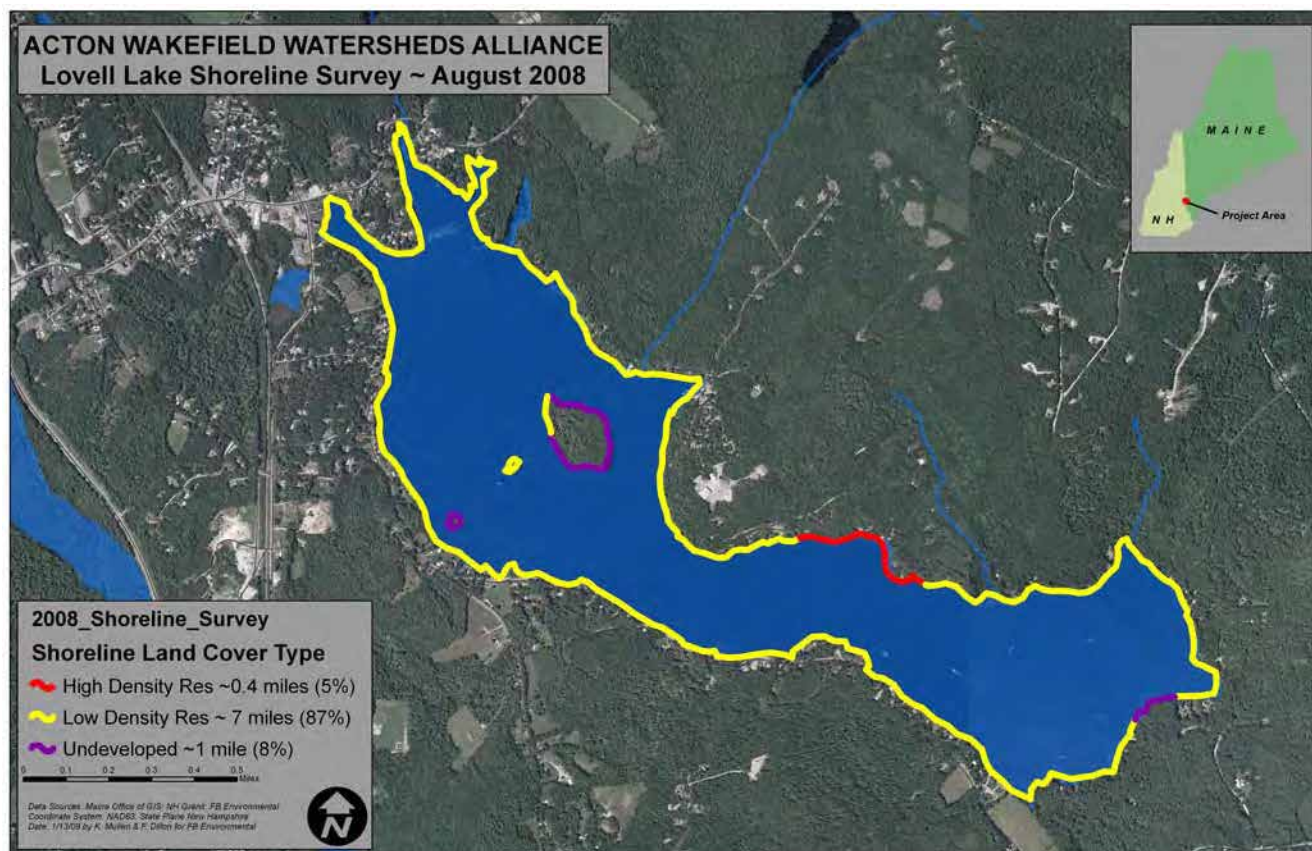


Figure 3.9: Lovell Lake shoreline survey results.

HORN POND

The shoreline of Horn Pond is the least developed of the five target SF headwater lakes, with 44% undeveloped land (Figure 3.10), and 71 dwellings observed. A majority of the developed land along Horn Pond is low density residential (51%).

Approximately 70% of structures along Horn Pond's shoreline are located within 50' of the waterline, with 20% set back 50' to 100', and the remaining 10% of structures set back greater than 100'. Despite the high percentage of low density residential and undeveloped shoreline lots, nearly 43% of Horn Pond's shoreline properties were rated as having a high impact on lake water quality, due primarily to short setback distances. Approximately 47% of the shoreline properties were rated as medium impact, indicating that vegetative buffers on these properties can be augmented and that most of the soil is stable. The remaining 10% of the properties were rated as low impact.

An additional non-residential high impact property was noted along New Bridge Road. This site is used as a public recreation area in the summer months. High pedestrian traffic, combined with steep road shoulders and

bare soil, has resulted in increasing erosion and decreasing stability at this site. The remaining non-residential areas along Horn Pond are undeveloped.

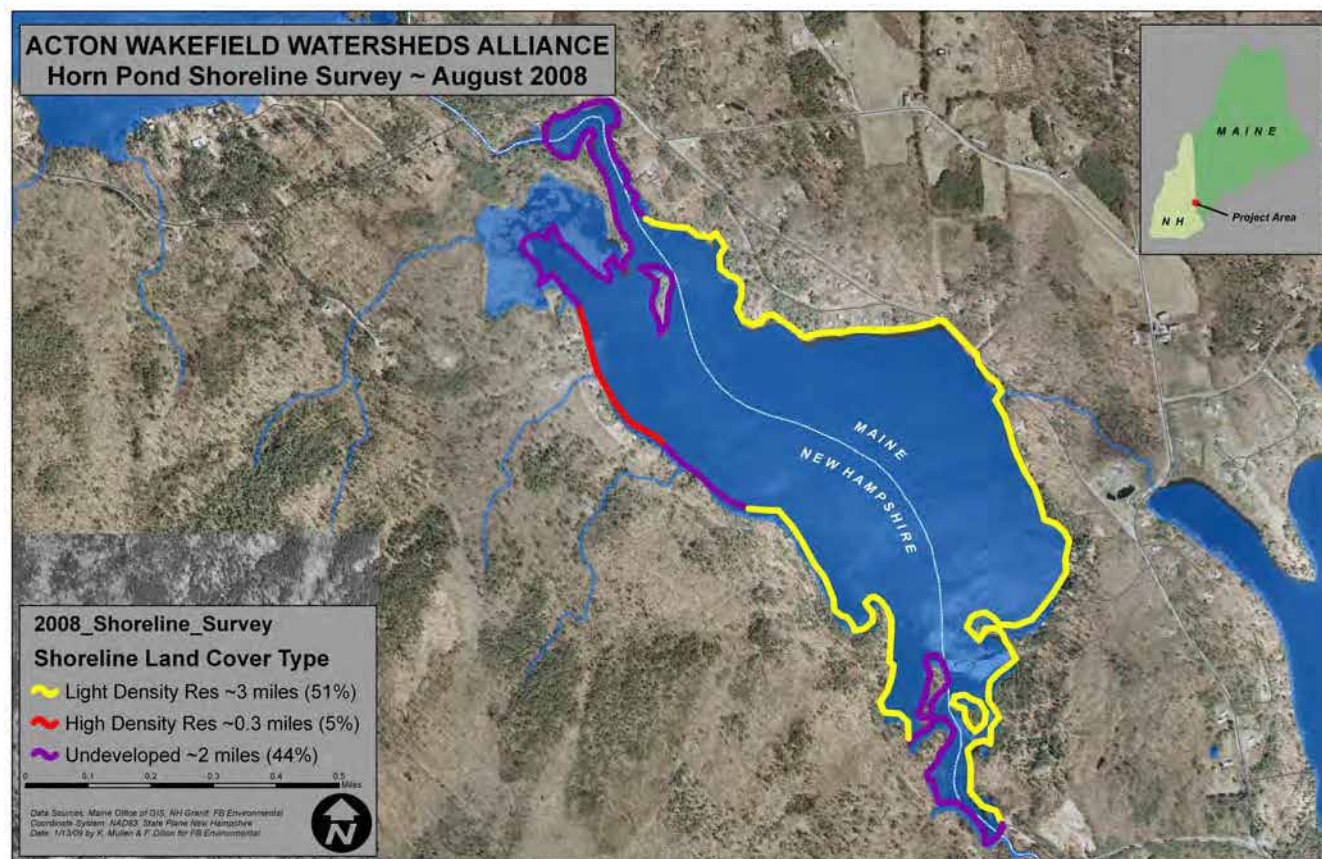


Figure 3.10: Horn Pond shoreline survey results.

WILSON LAKE

Like Lovell Lake, a majority of the shoreline development along Wilson Lake, primarily along the western shore, consists of low density residential (63%). The remaining properties (27%), along the eastern shore, are high density residential development, frequently with setbacks of less than 50' from waterline (Figure 3.11). Overall, 70% of residences are located within 50' of Wilson Lake's shoreline, 25% are set back 50' to 100' and only 5% of the structures are set back greater than 100'.

High density development along Wilson Lake was generally noted as having setbacks of 50' or less, and most were identified as high impact sites. High and medium impact lots were the most prevalent ratings at 48% and 45%, respectively, meaning that low density residential lots were also frequently ranked as high or medium impact. The remaining 7% of properties were rated as low impact.

The only non-residential area noted is used as the public boat ramp. There were no undeveloped or conserved areas observed along Wilson Lake's shoreline.

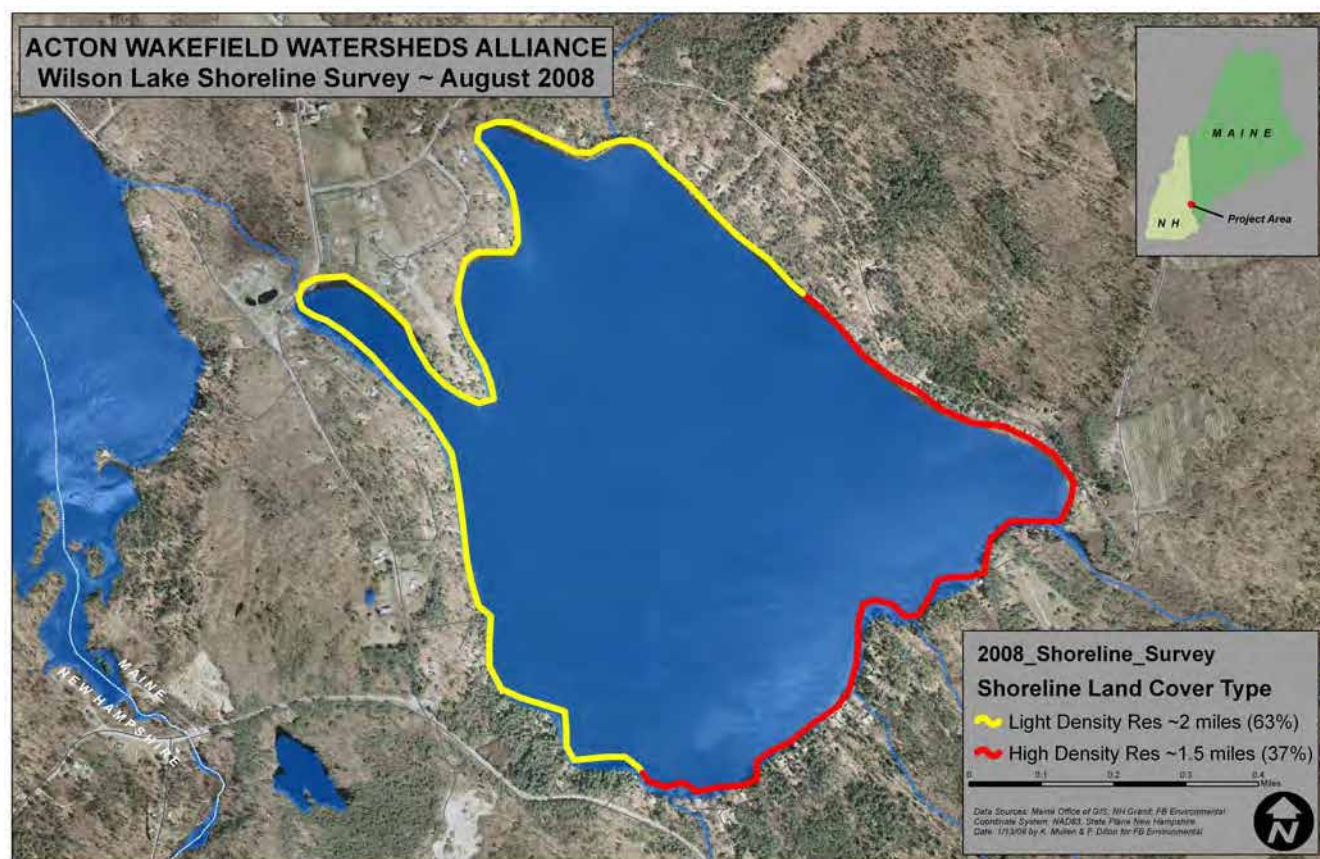


Figure 3.11: Wilson Lake shoreline survey results.

LAKE IVANHOE

With a perimeter of less than 2.5 miles, Lake Ivanhoe has 73 residences, 66% of which are low density residential development. High density development makes up 26% of the shoreline and is dispersed in short segments around the perimeter (Figure 3.12). Nearly 88% of structures are located within 50' of the waterline, 12 are set back 50' to 100' and no structures were set back greater than 100'.

Due to the close proximity of structures to Lake Ivanhoe's waterline, the majority of lots (70%) were rated as high impact. Many lots had inadequate buffers and large tracts of bare soil. Much of the shorefront was also sandy and steeply sloped which can lead to increased erosion and sedimentation in the lake. Only 4% of the lots were rated as low impact, and 26% were rated as medium impact.

The only undeveloped land was an island in the lake, and the conservation status was unknown. Additionally, the boat ramp property at the eastern end of the lake showed signs of erosion.



Signs of erosion were noted near the Lake Ivanhoe boat launch.

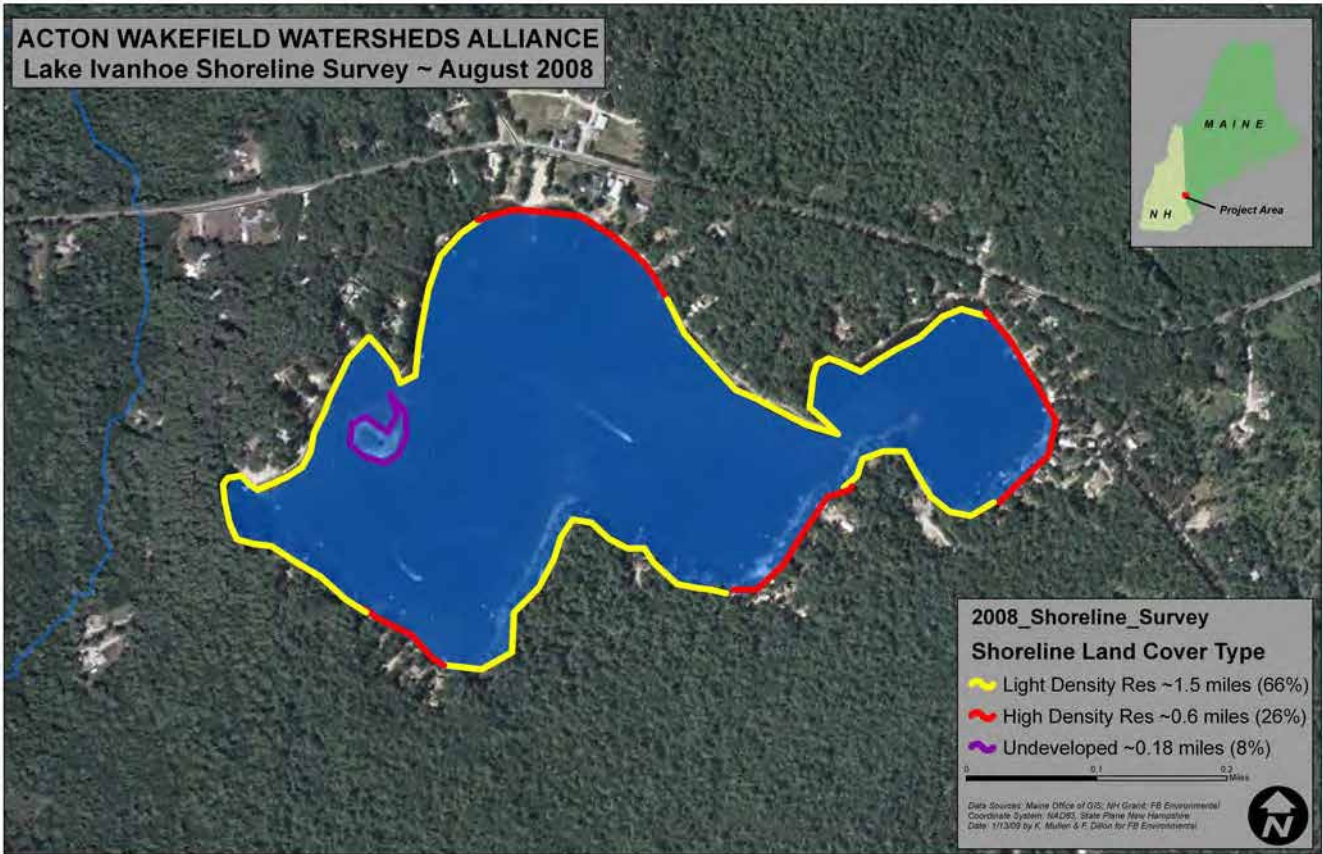


Figure 3.12: Lake Ivanhoe shoreline survey results.

4. MANAGEMENT PLAN RATIONALE AND APPROACH

4.1 Goals for Long Term Protection

The ultimate aim of the Salmon Falls Headwater Lakes WMP is to improve watershed conditions sufficiently to maintain current levels of water quality. The underlying premise supporting this ambitious effort is that existing and new development do not have to cause damage to watershed health, and that citizens, businesses, government, and other stakeholder groups can be responsible stewards of the SF headwater lakes watershed. The broad goals needed to maintain current phosphorus levels in the lakes include:

- **Land Protection:** Enhance current efforts in the watershed to protect high value habitat and critical areas.
- **Improvements to Physical Habitat:** Restore aquatic and lakeshore habitat conditions in support of key ecological functions including increased productivity, diversity and distribution of native fish and macroinvertebrate communities throughout the SF headwater lakes watersheds.

The objectives following from these goals are indicated in the Action Plan (Section 5.4). Achieving the goals and objectives for future implementation work in the SF headwater lakes will require a comprehensive and integrated set of activities as identified below.

4.2 Non-structural Restoration Rationale

Non-structural watershed restoration practices prevent or reduce stormwater related runoff problems by reducing the exposure and generation of pollutants and providing a regulatory framework that minimizes impervious surfaces. Non-structural approaches to watershed restoration can be the most cost-effective and holistic practices within a watershed management framework. The non-structural approaches recommended in this plan can not only improve water quality but can also enhance watershed aesthetics (e.g., through shade tree planting, expanded landscaping and trash reduction), streamline the permitting process (e.g., by removing conflicting design or stormwater codes) and reduce development costs (e.g., by minimizing impervious area development).

There are two primary components of non-structural Best Management Practices (BMPs):

- Planning, design and construction that minimizes or eliminates adverse stormwater impacts;
- Good housekeeping measures and education and training to promote awareness regarding the first component.

In watersheds with future development potential, it is critical for municipal staff and Boards to develop and enforce stormwater management criteria to prevent any increase in pollutant loadings that may offset reduced loads as a result of implementing watershed management plans. Zoning in the SF headwater lake watersheds presents considerable opportunity for continued development (see Build Out Analysis, Appendix E), and by extension increased threats to aquatic habitat.

In watersheds with significant development potential, the Center for Watershed Protection identifies “requiring stormwater treatment for development projects” as the single greatest mechanism for enhanced stormwater management over the long-term. Additionally, a recent publication by American Rivers identifies local land use planning and zoning ordinances as the most critical components of watershed protection despite federal Clean Water Act requirements (American Rivers, 2007). Seven guidelines outlined in the American Rivers document as vital steps toward local water policy innovation are as follows:

1. Review current zoning ordinance for regulatory barriers and quick improvements
2. Set performance based standards
3. Take additional measures to reduce impervious surfaces
4. Promote the use of a few specific Low Impact Development (LID) designs
5. Use overlay districts to add new requirements to existing zoning districts
6. Establish standards or incentives to improve stormwater management in developed areas
7. Address storage/use of pollutants that contact stormwater

4.3 Structural Restoration Rationale

AWWA and its stakeholders documented 491 sites that deliver an estimated 92 kg (203 lbs) of phosphorus per year to the lakes from specific sites in five watershed surveys. Consequently, structural BMPs are a necessary and important component of helping to improve and protect the water quality of these lakes that form the headwaters of the Salmon Falls River. The best method for treating these sites is to:

- Address the highest priority sites with an emphasis on sites with low-cost fixes.
- Work with landowners to get commitments for treating and maintaining sites.
- Work with experienced professionals on sites that require a high technical level of knowledge (engineering) to install, and ensure proper functioning of the BMP.
- Measure the pollutant load reduction for each BMP installed.

These basic criteria will help guide the proper installation of BMPs in the watershed. AWWA has a proven track record of proper installation of BMPs throughout the watershed.

4.4 Addressing Current and Future Pollutant Sources

Current pollutant sources as identified in the five watershed surveys indicate that a large amount of phosphorus is delivered annually to the project lakes. While there are undoubtedly other sources of phosphorus that are affecting the lakes, this is the “known” quantity of pollutant loading. It is important to mention that the model used for this Plan, STEPL (Section 2.5), models pollutant loads in a general sense while the watershed surveys allow for more specific pollutant load estimating. The following table (Table 4.1) represents the sites identified in the watershed surveys and combines the estimated future loads calculated as part of the watershed buildout analysis utilized for this plan.

Table 4.1: Estimated future P loads for SF headwater lakes subwatersheds.

Lake	<u>Current:</u> KG P per year Exported (WS survey)	<u>Future:</u> Loading Est. per year (30% buildout)	Total KG per year of P
Great East	40	47	87
Horn	4	3	7
Ivanhoe	16	6	22
Lovell	22	23	45
Wilson	10	7	17
TOTALS	92	86	178

As discussed in Section 3.4, the 86 kg represented in the in the future load estimate is derived from the number of new buildings projected in these watersheds in the next 11-20 years based on current growth rates and other factors. Combining this future estimate of pollutant loading with the current pollutant loading estimated from the 491 (identified) untreated sites in the watershed results in 178 kg per year of phosphorus that is entering SF headwater lakes. These may be treated through remediation of existing development, and by implementing phosphorus control standards for all new development.

This 178 kg per year provides watershed stakeholders with a goal for future reductions of phosphorus to the project lakes. Presumably, if all 491 sites were effectively treated with BMPs and all new development contained proper phosphorus controls, this 178 kg of P could be eliminated to near 0.

It is important to note that while this plan focused on phosphorus, the treatment of stormwater will result in the reduction of many other kinds of harmful pollutants that could have a negative impact on these waters. These pollutants would likely include:

1. Other nutrients (nitrogen)
2. Bacteria
3. Heavy metals (cadmium, nickel, zinc)
4. Petroleum products

Without a monitoring program in place to determine these pollutant levels, it will be difficult to track successful reduction efforts. However, there are different spreadsheet models available that can estimate reductions in these pollutants depending on which types of BMPs are installed.

4.5 Adaptive Management Approach

An adaptive management approach is widely recommended for protecting these watersheds. Adaptive management enables stakeholders to conduct restoration activities in an iterative manner. This provides opportunities for utilizing available resources efficiently through BMP performance testing and watershed

monitoring activities. Stakeholders can evaluate the effectiveness of one set of restoration actions and either adopt or modify them before implementing effective measures in the next round of restoration activities. The adaptive management approach recognizes that the entire watershed cannot be restored with a single restoration action or within a short-time frame (e.g., 2 years). Rather, adaptive management features establishing an ongoing program that provides adequate funding, stakeholder guidance, and an efficient coordination of restoration activities. Implementation of this approach will ensure that required restoration actions are implemented and that these waters are monitored to document restoration over an extended time period. The adaptive management components for future implementation efforts should include:

- ***Creating an Organizational Structure for Implementation.*** Since the watershed spans two municipalities, a cooperating group representing both towns and states should be established for the implementation of future efforts in the watershed and to help coordinate the implementation of restoration activities. In addition to municipal officials, this collaborative should involve the various business interests in the watershed to allow for a full consideration of all issues relevant to an effective, efficient and cost-effective restoration program.
- ***Establishing a Funding Mechanism.*** A long-term funding mechanism should be established to provide the financial resources to ensure that lake watershed restoration actions can move forward over an extended time period. In addition to construction and organizational management costs, consideration should also be given to the type and extent of technical assistance needed to design, inspect and maintain stormwater BMPs. Technical assistance costs for the annual field monitoring program should also be considered. Clearly, funding is a critical element of sustaining the restoration process and once it is established, the management plan can be fully vetted and restoration activities can move forward.
- ***Synthesizing Restoration Actions.*** This watershed management plan provides prioritized recommendations to support restoration (e.g., structural/nonstructural recommendations for priority areas identified in the five watershed surveys). All recommendations were developed by AWWA, technical consultants (FBE), and NHDES in collaboration with the project stakeholder group. These recommendations, or action items, need to be revisited and synthesized to create a unified watershed restoration strategy. Once a funding mechanism is established, the lake watershed restoration program should begin in earnest by developing detailed designs for priority restoration activities on a project area basis and scheduling their implementation accordingly.
- ***Continuing the Community Participation Process.*** The development of the SF headwater lakes Watershed Management Plan has greatly benefited from the active involvement of an engaged group of watershed stakeholders with a diversity of skills and interests. The implementation of the Plan will require their continued and ongoing participation as well as additional community outreach efforts to involve even more stakeholders throughout the watershed. A sustained public awareness and outreach campaign is essential to secure the long-term community support that will be necessary to successfully implement this project.

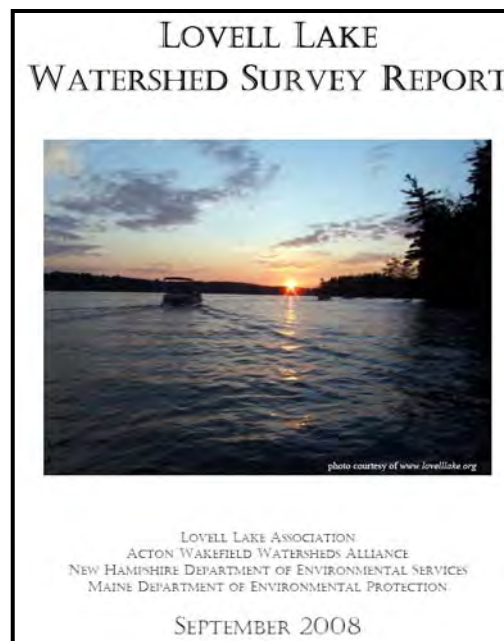
- ***Developing a Long-Term Monitoring Program.*** Although current monitoring efforts are strong, A detailed monitoring program (including watershed tributaries) is necessary to track the aquatic health of the SF headwater lakes. Indeed, the overall goal of the watershed management planning process is the protection of the aquatic health of these lakes. For more information on future monitoring please see Section 6.3.
- ***Establishing Measurable Milestones.*** A restoration schedule that includes milestones for measuring the implementation of restoration actions and monitoring activities in the SF headwater lakes is critically important. Once the level of funding has been established to determine the extent of recommended action strategies that can be implemented each year, a detailed schedule featuring step-by-step implementation and monitoring activities should be developed. A list of measurable milestones are listed later in this document in Chapter 6.

5. PLAN IMPLEMENTATION

5.1 Structural NPS Reduction Opportunities

Installation of Best Management Practices (BMPs) in the lake watersheds is necessary for the long term protection of SF headwater waterbodies. AWWA staff and partners have identified opportunities within focus areas that exhibit the most potential for water quality enhancement with minimum costs and maximum partnership potential. Many recommendations have been identified through field evaluation and some sites will require detailed survey and engineering design in order to determine the appropriate final implementation strategy for maximum water quality benefits.

Watershed surveys resulted in the identification of several hundred individual BMP opportunities. Field evaluation of BMP opportunities was accomplished through working with watershed citizens and technical staff from AWWA, Maine DEP, NHDES, and York County SWCD. These teams focused on identifying sites in both shoreline and upland areas. These sites were organized and given rankings based on impact to the lake, estimated remediation cost, and site remediation priority. Details on the results of the surveys are summarized in Chapter 1.3.1 and Appendix C. Complete copies of the survey reports are available online at awwatersheds.org/programs/watershed-surveys/.



Watershed Survey reports have been completed for all five SF headwater lakes featured in this watershed management plan.

Example Structural BMPs

Generally, lake protection and restoration structural BMPs are categorized by the land use that they are designed to treat. A brief summary appears below.

- **Roadways-** Roadways often contribute large amounts of sediment to lake watersheds. In northern New England, many private roadways (often referred to as camp roads) are poorly designed and maintained and are often need of repair and continued maintenance. Types of roadway BMPs that will need to be installed in SF headwater lakes watersheds include proper ditching, turnouts, proper crowning of roads, and proper installation of culverts.
- **Shoreline Residential-** Shoreline residential areas can also contribute high volumes of pollutants including phosphorus to these lakes. It is commonly believed that the cumulative impact of many problematic properties can contribute to lake degradation. Common shoreline BMPs that have and will be installed for these waterbodies include rain gardens, infiltration steps, rain barrels, vegetated shoreline buffers and driveway repair and maintenance.



Rain Gardens are often effective residential BMPs for treating stormwater on-site.

- **Septic Systems**– Septic systems can provide excess nutrients to lakes, particularly where systems are poorly sited or excessively drained (sandy) soils are present. Observations of shoreline lots indicate that there is potential for septic leachate to reach the lakes to close proximity of septic fields to the lake and the age of many of the dwellings which may not have had septic systems updated. The BMPs for septic systems are

straightforward: 1) Replace failing systems and 2) have the functioning systems pumped on a regular basis (every two to three years).

5.2 Non-structural and Land Protection Opportunities

Stormwater Best Management Practices (BMPs) are technology and education based controls that reduce the discharge of pollutants from impervious surfaces and developed land areas. Non-structural BMPs generally refer to operational activities and educational measures that are employed to reduce the release and discharge of pollutants. For the purposes of this plan, non-structural BMPs refer to stormwater runoff management techniques that do not require extensive construction efforts and either limit the generation of stormwater runoff or reduce the amount of pollutants contained in the runoff. The EPA promotes the use of non-structural BMPs to increase awareness of the primary need for pollution prevention rather than treatment in long-term watershed management programs. However, watershed management plans often do not emphasize the importance of non-structural BMPs in overall restoration efforts. The EPA recommends that a comprehensive management plan includes the implementation of a combination of non-structural and structural BMPs for existing and new development to ensure long-term restoration success.

There are two primary components of non-structural BMPs:

1. Planning, design and construction that minimizes or eliminates adverse stormwater impacts;
2. Good housekeeping, education and training to promote increased awareness of the previous component.

Recommendations offered below for the planning non-structural BMP components is based on watershed characteristics, expected reliability, implementation potential, and anticipated community and environmental acceptance.

5.2.1 Land Use Planning Recommendations

Land use planning plays a critical role in watershed management and restoration. The American Rivers report on Local Water Policy Innovation expresses the importance of local planning solutions for stormwater pollution based on the following:

- Local governments have the experience and authority to regulate land use;
- The site plan review process is ideal for stormwater regulations;

- Local governments can remove barriers to Low Impact Development;
- Local action is vital to the Federal Clean Water Act permitting system; and
- Individuals have the power to make changes on a local level.

There are a variety of planning tools available to address stormwater management issues as summarized below.

Specific Recommendations: Implement Code, Zoning and Design Guidelines Revisions

The SF headwater lakes watersheds include land area within two municipalities, in two states. Much of the currently developed land occurs primarily in near the lakeshores of the watershed. Much watershed land area available for development exists in the upland portions of the watershed. These existing and future potential land uses highlight the relevance of the following restoration tools, some combination of which are likely to be critical for future water resource protection in each municipality.

- **Consider exceeding ME and NH stormwater thresholds for new development.** Sites with less than one acre of impervious surface can contribute to stormwater pollution but are not currently required to provide post-construction stormwater management. Reduced performance standards could be considered for less than one acre sites (e.g. detain and filter 0.5 inch of runoff from impervious surfaces) and more flexible BMP design standards could be allowed to maximize designer opportunities and minimize cost.
- **Modify and/or clarify redevelopment stormwater management requirements.** Current state stormwater management laws do not comprehensively require redevelopment projects to meet post-construction stormwater management standards. Consider modifying local code or redevelopment definitions to require post-construction stormwater management on projects that modify existing drainage infrastructure, change traffic patterns or modify the existing land use of a given parcel. Simply relying on hydraulic capacity changes to a parcel will not guarantee stormwater structural BMPs.
- **Reduce or eliminate regulatory barriers in local code, design standards and guidelines.** A 2008 national study by American Rivers indicates that architects, developers and builders have cited existing code standards and requirements as the primary barrier to using/applying Low Impact Development (LID) techniques on new and redevelopment projects. The basis of LID techniques is the minimization of impervious surfaces on a developed site. Recommendations for these techniques specific to Acton and Wakefield appear in Chapter 5.3.

5.2.2 Good Housekeeping, Training and Education

There are two primary types of good housekeeping and training/pollution prevention tools that can help to minimize polluted stormwater runoff from impervious surfaces in the Acton-Wakefield region. These include: Pavement sweeping, and proper ditching and road maintenance. The removal of winter sands is a practice that is increasingly utilized in urban areas and areas with high-value water resources. With heavy spring rains much of the winter sands can be washed into ditches, tributaries and eventually the lakes. Some communities have combined resources to purchase or rent vacuum sweepers to remove this sand as early in the spring as possible.

Proper ditching and road maintenance is a concern that can be easily addressed by providing hands-on training to public works employees. It is critical that these trainings include all personnel working on roads, not just the directors or foremen.

5.3 Other Opportunities

5.3.1 Municipal Ordinance Revisions

The efforts of the Acton Wakefield Watersheds Alliance (AWWA) and other affiliated lake associations are crucial in ensuring the long-term protection of the waters in the Acton-Wakefield region. However, in the absence of adequate land use controls on development, the potential exists for adverse impacts to the region's valuable water resources. Numerous studies have shown that the extent and type of development can degrade water quality. Municipal land use regulations are a guiding force for where and what type of development can occur in the SF headwater lakes watersheds, and therefore how water quality is impacted as a result of this development.

A Municipal Ordinance Review was conducted by FB Environmental to supplement this WMP (Appendix D). The review suggests that the Towns of Wakefield and Acton have considerable room for improvement in order to protect the water quality of these waterbodies into the future. Three categories of town regulations were reviewed: transportation infrastructure; residential and commercial development; and open space and natural areas. The review, based on guidelines put forth by the Center for Watershed Protection (CWP), scored towns ordinances within each category. The highest possible overall score for the review is 100 and the CWP generally recommends reforming local development rules if the score is less than 80. As Table 5.1 illustrates, both Acton and Wakefield are in need of ordinance reforms, with overall scores of 71 and 64 points, respectively.

Table 5.1: Summary of the CWP codes and regulations worksheet score for Acton and Wakefield.

HABITAT TYPE	Acton	Wakefield	CWP Maximum
Transportation Infrastructure	21	15	40
Residential & Commercial Development	26	30	36
Open Spaces & Natural Areas	24	19	24
Totals:	71	64	100

Following are examples of recommendations from the Acton-Wakefield Municipal Ordinance Review (additional recommendations for each town are included in Appendix E):

- **Transportation Infrastructure:** Recommendations include establishing mechanisms that encourage or require the use of shorter street lengths; allowing narrower right-of-ways for new development projects; reducing sidewalk widths; and allowing for a reduction in cul-de-sac radius, among others.
- **Residential and Commercial Development:** Recommendations include allowing for minimum side

setbacks of 8' or less between buildings; allowing minimum sidewalk widths of 4' or less; allowing sidewalks to be sloped to adjacent lawns or pervious areas to direct stormwater runoff away from streets or gutters; allowing driveways to be built to a width of 9' or less, among others.

- ***Open Spaces and Natural Areas:*** Recommendations in this category are applicable to Wakefield, as Acton achieved the maximum score in this category. Recommendations include increasing the buffer requirement for all significant local water resources to at least 75'; requiring that a portion of shoreline, wetland and stream buffers consists of native vegetation; and allowing developers some flexibility in meeting regulatory or conservation requirements.

Additionally, both are encouraged to consider promoting the use of Low Impact Development type BMPs for future development projects.

The Action Plan (Section 5.4) lists additional recommendations to improve ordinances in Wakefield and Acton. These recommendations are in keeping with the Municipal Ordinance Review.

5.3.2 Watershed Education and Outreach

This WMP includes an educational component that will be used to enhance public understanding of the project and encourage community participation in watershed restoration and protection activities. AWWA is committed to coordinating with local, state and regional agencies, watershed residents, and other interest groups on issues of water quality and watershed protection. As a critical community resource for relevant and timely information regarding the state of the region's surface waters, AWWA will serve as the primary entity to implement this portion of the Plan. Efforts will be made to encourage people to understand the current problems associated with declining water quality in the waterbodies, and help promote lake/watershed stewardship. The educational goal of the plan is to elevate public understanding of the connections between land use and water quality and to encourage actions that maintain the highest water quality and a healthy watershed ecosystem. Action items related to education and outreach are outlined in the Action Plan (Section 5.4).

5.4 Watershed Action Strategy including Schedule and Estimated Costs



A. INTRODUCTION

This Action Plan was developed through contributions from area stakeholders and participants at a community forum and two successive meetings held during the winter and spring of 2009. Preliminary action items are presented here as ideas to foster further thinking about long-term strategies for protecting the high-quality waters and related natural resources located within the SF headwater lakes watersheds, and to promote communication between citizens, municipalities, Maine DEP and NHDES. This Action Plan incorporates these ideas and outlines responsible parties, potential funding sources, approximate costs (where available), and an implementation schedule for specific tasks within each of the five categories identified below. Current cost estimates for each action item will need to be adjusted based on further research and site design considerations.

The SF headwater lakes Steering Committee, which is an important outgrowth of the stakeholder participation process, will work toward refining and improving the Action Plan, which consists of action items within five major categories:

1. *Private and Public Roadway BMPs*
2. *Community Planning & Development*
3. *Residential BMPs- Riparian Buffers, Low Impact Development and Septic Systems*
4. *Education and Outreach*
5. *Land Conservation*

The Action Plan will be incorporated into the Watershed Management Plan for implementation by the SF headwater lakes Steering Committee. It is important for local stakeholders to take an interest in and gain valuable knowledge from water quality management, assessment, and improvement strategies. As such, the SF headwater lakes Steering Committee will need to meet regularly and be diligent in coordinating resources to implement practices that will reduce NPS pollution in the Acton-Wakefield region. This effort will require the support of a number of other entities, including the municipalities of Acton and Wakefield, the York County Soil and Water Conservation District, Maine DEP, NHDES, consultants/contractors, area schools, local business owners, and individual landowners.

Each of the five Action Plan categories are presented below with identified threats and a table of proposed action items (compiled from the community forum and subsequent meetings). The tables contain several acronyms which are defined as follows:

- **CELCP**- Coastal and Estuarine Land Conservation Program
- **NHDES 319** – New Hampshire Department of Environmental Services Clean Water Act Funds
- **Maine DEP 319** – Maine Department of Environmental Protection Clean Water Act Funds
- **PREP** – Piscataqua River Estuary Partnership
- **NH DOT** – New Hampshire Department of Transportation
- **Maine DOT** – Maine Department of Transportation
- **FEMA** – Federal Emergency Management Agency

B. COMPONENTS of the ACTION PLAN

1. Private & Public Roadway BMPs

Stakeholder concerns focused on improper culverts, eroding stream banks around crossings, and eroding road shoulders. Action items on this issue involve installing BMPs such as diversions for stormwater, check dams on hillsides, and vegetated ditches along roadways. Reducing sediment loads to the lakes and tributary streams is a priority and can be accomplished through the stabilization and reinforcement of road crossings and roadsides to trap pollutants before entering the watercourses. In all cases, stakeholders recommended distinguishing between private, local and state roads since BMP implementation strategies will be somewhat unique for each ownership type.

Identified Roadway Threats: *Specifications for gravel road layout and design; maintenance restrictions; lack of education regarding stormwater runoff for state & local road maintenance crews; excessive winter road sand and salt applications and inadequate post-winter sand removal; soil erosion on camp roads; lack of understanding about camp road maintenance; improperly / inadequately maintained roads; considerations for paving roads; regulations defining impervious surface limitations; lack of funds to fix roads.*

ROAD BMP ACTION ITEMS	How?	Who?	Funding	Schedule	Suggested Annual Cost*
1. Develop and deliver contractor training and certification program	Convene meeting of potential stakeholders to develop and implement training & certification program. Use T2 Roads Scholar program for camp road maintenance practices (including certification component) and ME NEMO's training materials as resources.	UNH, AWWA, Lake and Road Associations	DES 319, PREP	2010 and ongoing	\$25,000
2. Initiate formation of private road associations	Provide training on "How to Form a Road Association" and follow-up with assistance/capacity building (refer to ME's Guide to Forming Road Associations).	AWWA, Lake Associations, Residents	DES 319, PREP	2010 and ongoing	\$5,000
3. Standardize camp road maintenance practices	1) Develop and adopt camp road maintenance standards including considerations for ongoing maintenance needs (refer to UNH Roads Scholar Program and ME Camp Road Maintenance Manual). 2) Develop a list of certified contractors.	Private Road Associations, Contractors	Volunteer	1) 2011 2) 2012 and ongoing	N/A
4. Install / Implement BMPs on private roads	1) Use watershed survey results to identify priority action areas. 2) Select and implement appropriate BMPs using UNH Roads Scholar references & Maine Camp Road Manual (including considerations for winter sand removal).	Landowners, contractors, Road Associations, NH Stormwater Center	FEMA, DES 319, DEP 319	1) 2009 and ongoing 2) 2010 and ongoing	\$75,000

5. Install / Implement BMPs on public roads	1) Use watershed survey results to identify priority action areas. 2) Select and implement appropriate BMPs using UNH Roads Scholar references (including considerations for winter sand removal).	NHDOT, ME DOT and local road crews, road agents & commissioners	FEMA, DES 319, DEP 319	2010 and ongoing	\$200,000
6. Evaluate all tributary crossings in consideration of stream ecology and stability (geomorphology)	1) Identify stream crossings that do not meet specifications according to the <i>New Hampshire Stream Crossings Guidelines</i> (UNH, 2009) 2) Work with towns and DOT to develop a plan to replace non-conforming stream crossings 3) Replace non-conforming stream crossings	NHDOT, ME DOT, local road crews, road agents & commissioners, NH Fish & Game (F & G), NH DES	FEMA, DES 319, DEP 319 (??), NHF&G	2010-2012 (survey); 2012-ongoing (planning and replacement)	\$20,000
Total Annual Cost					\$325,000

* Suggested Annual Costs will likely need to be revised following review of watershed survey results and other related research.

2. Community Planning & Development

The importance of responsible community planning and development in providing adequate shoreland and water resource protection cannot be overstated. Proper planning and development are essential not only to maintain and enhance the water quality and scenic value of New Hampshire's shores, which are so critically important to its \$9.7 billion dollar tourism industry, but also to protect property investments on shorelines vulnerable to erosion. While New Hampshire's Comprehensive Shoreland Protection Act (CSPA) has established the basic mechanisms to protect its scenic and ecologically valuable shorelines, the Act in its present form, and the ability of NHDES to provide adequate regulatory oversight, enforcement and education, are often ineffective. Maine's experience might provide a useful model in supporting local community efforts to protect scenic shorelines for the mutual benefit of the tourism economy and private property owners. Maine's popular LakeSmart Program effectively engages local and regional organizations (e.g., Lake Associations, Soil & Water Conservation Districts) in collaborative partnerships to remove barriers for lake water quality protection and restoration efforts. Additionally, the recently completed municipal ordinance review for the towns of Acton and Wakefield provides numerous recommendations for strengthening the role of community planning and development in water resource protection. The steering committee should identify whether there is a need for a Watershed District that would help coordinate watershed efforts across state, town and county political lines.

Identified Community Planning & Development Threats: The NH Comprehensive Shoreline Protection Act (CSPA) alienates residents; permitting issues make it difficult to fix erosion problems; perceived conflict between individual rights & community use of lakes; enforcement is a problem at both local & state levels; need to build public support for town decisions/initiatives (including municipal ordinance revisions to provide greater water resource protection); inadequate enforcement/education; disregard for rules/laws; inconsistency of enforcement.

COMMUNITY PLANNING & DEVELOPMENT ACTION ITEMS	How?	Who?	Funding	Schedule	Suggested Annual Cost*
1. Coordinate with DES and DEP enforcement staff to address local and state regulatory concerns.	Establish a working group to meet with DES/DEP staff to request more consistent application / enforcement of regulations from DES.	Towns / AWWA / Consultants	DES & DEP 319	2009 and ongoing	\$1,500
2. Strengthen ordinances to control impact from polluted runoff	1) Provide recommendations for local ordinances (use the WBMP Ordinance Review and "Innovative Land Use Guide" as references).	Towns / AWWA / Consultants	DES 319, PREP	1) 2010 and ongoing 2) 2010	\$25,000

3. Encourage and implement installation of LID practices	1) Use local ordinances to protect WQ through promotion of LID measures.	AWWA, Towns	DES 319, DEP 319, Stimulus Funds	1) 2009 and ongoing 2) 2011 and ongoing	\$60,000
4. Increase and improve existing enforcement	1) Ensure that town boards are aware of enforcement issues. 2) Strengthen enforcement at the parcel level. 3) Include Code Enforcement staff in regulatory/plan reviews. 4) Consider providing training workshops for CEO's. 5) Promote increased funding at local level to provide adequate regulatory oversight and enforcement. 6) Develop greater local capacity to enforce state regs.	Towns / AWWA / Consultants	Towns	1-6) 2011 - 2014	\$7,500
5. Develop build out analysis for watershed and develop action items related to results	1) Being completed as part of watershed based plan. 2) Present findings / recommendations to planning boards in support of needed changes to local ordinances.	AWWA, DES, FBE	DES 319	2009	N/A
6. Consider establishing a Watershed District	1) If substantial headway is not being made to implement planning strategies, and lake water quality continues to decline then a watershed district should be seriously considered	AWWA, Towns, Legislators	Tax revenues set aside, permit fees, grants	Examine changes in water quality	TBD
Total Annual Cost					\$94,000

* Suggested Annual Costs will likely need to be revised following review of watershed survey results and other related research.

3. Residential BMPs - Riparian Buffer, LID, and Septic Systems

The residential action items place a strong emphasis on improving protection of shoreland vegetated buffers, promoting and demonstrating low impact development (LID) techniques, and proper operation and maintenance of septic systems. Action items include encouraging stewardship through a variety of social marketing techniques, and a preliminary assessment of septic systems to identify the potential extent of system failures. This latter action item will first require identifying the communities' capacity to conduct a cursory septic system evaluation entirely on their own or with the assistance of a consultant. In all cases, coordination with the landowners will be crucial because mitigation measures will frequently need to be implemented on private land (including privately owned roads). This set of tasks will also strongly encourage the use of native plant species.

Identified Threats from Residential Land Uses: Shoreline vegetation clearing along SF headwater lakes; stormwater runoff from roads, roofs & steep sites without buffers; lack of buffers on small streams; inadequately maintained and malfunctioning septic systems.

RESIDENTIAL BMP ACTION ITEMS	How?	Who?	Funding	Schedule	Suggested Annual Cost*
1. Enhance current residential BMP and technical assistance program	1) Develop Technical Assistance pledge sheets. 2) Continue promoting YCC services to property owners with identified erosion problems. 3) Design and Install BMPs.	AWWA, Lake Associations	DES 319	1-4) 2009 and ongoing	\$50,000
2. Initiate incentive-based watershed wide erosion control BMP installation program	1) Implement program to encourage land owners to install erosion control BMPs with cost share option for plants and materials. 2) Install demonstration projects throughout watershed.	AWWA, land owners, lake associations	DES 319	2010 and ongoing	\$25,000

3. Conduct a sanitary survey to identify potential problem septic systems	1) Conduct cursory assessment of malfunctioning septic systems to estimate extent of potential impact and establish clear need for survey (e.g., review septic files at town offices, inspect lots via survey from boat or on land). 2) Identify capacity to administer project; if inadequate establish capacity improvement plan. 3) Have road associations accept some role in helping to facilitate survey project.	AWWA, Towns, Road Associations, Consultants	DES 319, PREP	1-3) 2011 - 2013	\$20,000
Total Annual Cost					\$95,000

* Suggested Annual Costs will likely need to be revised following review of watershed survey results and other related research.

4. Education and Outreach

Education and outreach are vital components to watershed protection and improvement. Fortunately, AWWA has already established an exceptional capacity and reputation in this regard. The organization has served as a critical community resource for relevant and timely information regarding the state of the region's surface waters. As such, AWWA will continue to play a central role in helping to coordinate efforts among various stakeholders and interest groups in the region, particularly with local lake associations. They will also be instrumental in any efforts to communicate with seasonal residents as emphasized by comments at recent community forums. Refining water quality monitoring activities to provide the most relevant data will also be an important aspect of the Education and Outreach action items. The Watershed Management Plan includes numerous recommendations for enhancing current water quality monitoring efforts, including sample collection from various tributaries and consideration for establishing an invasive species screening program. Since volunteers typically conduct so many monitoring activities, it will be critical to continue building on the success of AWWA's ongoing education and outreach program.

***Identified Threats from Inadequate Awareness:** Lack of knowledge of rules & laws and the impact of human activities; lack of understanding about how water quality is important for the entire community; inadequate awareness for non-shorefront property owners and visitors about how their activities can adversely affect water quality; negative impacts of ATV activity; poor communication with landowners; seasonal residents aren't engaged enough with water quality protection efforts.*

EDUCATION & OUTREACH ACTION ITEMS	How?	Who?	Funding	Schedule	Suggested Annual Cost*
1. Develop comprehensive strategic education & outreach plan that coordinates and unifies efforts of various organizations.	1) Convene meeting of potential stakeholders (e.g., lake associations, towns, land trusts, etc.) to develop unified E&O strategy. 2) Develop initiative to encourage greater citizen involvement in planning and regulatory process through improved E&O.	AWWA	Dorr Foundation	1) 2009 2) 2010	\$10,000
2. Provide more tools to lake associations to promote "lake smart" practices.	1) Strengthen relationships between AWWA and lake associations. 2) Press releases, on-boat education program, media tools (e.g., ThinkBlue ME's Rubber Ducky and / or YouTube videos). All should have sound scientific basis.	AWWA	DES 319	2010 and ongoing	\$5,000
3. Implement wide scale education and outreach program	Expand existing efforts with help of committees.	AWWA	DES 319, DEP 319	2011	\$35,000

* Suggested Annual Costs will likely need to be revised following review of watershed survey results and other related research.

4. Seek citizen participation for expanded monitoring and evaluation program (based on WBMP recommendations) that include watershed streams.	1) Implement monitoring recommendations from WBMP. 2) Identify critical tributaries and develop appropriate sampling study design. 3) Recruit volunteers to participate in the Volunteer River Assessment Program for tributary monitoring. Also revitalize lake monitoring programs through involvement of local schools. 4) Present WQ monitoring results to town boards. 5) Establish volunteer-based invasive species assessment programs (aquatic & terrestrial) for areas where they don't currently exist.	DES-VRAP, Lake Associations, AWWA	DES 319	1&2) 2011 3-5) 2012 and ongoing	\$20,000
6. Provide education for summer residents and short-term visitors	1) Conduct a survey to identify behaviors, barriers to change, and incentives to promote desired outcomes. 2) Develop program to provide incentives for behavior change.	AWWA	DES 319	1) 2010 2) 2011	\$15,000
7. Provide watershed-based education so that people "identify" with their watershed	Provide flyers and maps to people to help them visualize their watershed connection.	AWWA	PREP, DES 319, DEP 319	2011	\$2,000
Total Annual Cost					\$87,000

* Suggested Annual Costs will likely need to be revised following review of watershed survey results and other related research.

5. Land Conservation

Land Conservation can have tremendous benefits for water quality protection. Protection of the "upland" areas of the SF headwater lakes watersheds will ensure that some land remains in an undisturbed state, which will help reduce total phosphorus runoff. Efforts for land conservation need to be coordinated among the local land trusts, regional planning commissions, lake associations, and the municipalities, so that the tasks are shared and communication is open and ongoing.

Identified Threats from Inadequate Land Conservation: Development is improperly planned; particular focus needed for upper watershed development; expansions and seasonal modifications of waterfront properties are inadequately monitored; threats posed from commercial development are not adequately understood.

LAND CONSERVATION ACTION ITEMS	How?	Who?	Funding	Schedule	Suggested Annual Cost*
1. Develop coordinated and unified land acquisition strategy that relates directly to (and informs) local development rules to maximize program effectiveness.	1) Convene stakeholder meeting to identify initial program goals and objectives. 2) Develop clear plan for sustaining land acquisition program. 3) Coordinate with towns to integrate land protection considerations into their development rules.	Land Trusts in collaboration with Towns and Lake Associations	CELCP	1-3) 2010 - 2011 and ongoing	widely variable
2. Identify and purchase ecologically and aesthetically sensitive land.	1) Identify critical lands and potential funding sources. 2) Initiate land owner contact. 3) Strengthen ties to and coordinate activities with local land trusts.	Land Trusts in collaboration with Towns and Lake Associations	CELCP	1-3) 2011 and ongoing	widely variable

* Suggested Annual Costs will likely need to be revised following review of watershed survey results and other related research.

C. CONCLUSIONS

The elements described in the preceding Action Plan will be a major part of the Watershed Management Plan, particularly in providing a “road map” for the Salmon Falls headwater lakes Steering Committee. The Steering Committee will work toward implementing the Action Plan, which outlines responsible parties, potential funding sources, approximate costs, and an implementation schedule for each task within five major categories: Private and Public Roadways BMPs; Community Planning & Development; Residential BMPs; Education and Outreach; and Land Conservation. **The total estimated annual cost to complete all of the associated tasks is approximately \$600,000.**

The Steering Committee shall meet (at a minimum) annually to provide periodic updates to the plan, track any progress made, maintain and sustain the action items, and make the plan relevant on an ongoing basis. An adaptive management approach is recommended in order to assess annual progress, determine key projects and focus areas for the following year, and provide a venue for sharing information within the Salmon Falls headwater lakes region. Adaptive management is the process by which new information about the health of the watershed is incorporated into the WMP. This process allows stakeholders the opportunity to evaluate the effectiveness of restoration and monitoring activities before implementing future actions. Tasks listed in the Action Plan should be tracked and recorded as they occur, and new tasks should be added to the plan as determined through the adaptive management process. All achievements, such as press releases, outreach activities, number of sites repaired, number of volunteers, amount of funding received, number of sites documented, will be tracked. The Steering Committee will use established indicators within the watershed-based management plan to determine the effectiveness of the Plan.

6. METHODS FOR MEASURING SUCCESS

6.1 Measurable Milestones

Establishing interim milestones to measure progress provides short term input on how successful the plan has been in meeting the established goals and objectives for the watershed. These interim measures, or measurable milestones, are used to determine whether management practices or other control actions are being implemented, and to outline what needs to be accomplished over time to fully implement the practice or management measure. Establishing measurable milestones provides for periodic updates to the plan, maintains and sustains the action items, and makes the plan relevant on an ongoing basis. In addition to water quality monitoring the following environmental, social, and programmatic indicators will be used to measure the progress of the SF Headwater Lakes WMP. The following indicators are intricately tied to the action items identified in the Action Plan (Section 5.4):

Programmatic indicators are indirect measures of watershed protection and restoration activities. Rather than indicating that water quality reductions are being met, these programmatic measurements list actions intended to meet the water quality goal.

- Amount of funding secured for plan implementation
- Number of BMPs installed on private roads
- Number of BMPs installed on public roads
- Number of stream crossings that meet the *New Hampshire Stream Crossings Guidelines* (UNH, 2009)
- Number of new road associations formed
- Number of LID practices implemented
- Number of residential BMPs installed
- Number of residential BMP demonstration projects completed
- Number of septic systems assessments or septic system upgrades
- Number of acres of protected critical lands
- Number of watershed-based educational materials distributed
- Completion of a draft bi-state phosphorus control ordinance

Social Indicators measure changes in social or cultural practices and behavior changes that lead to implementation of management measures and water quality improvement.

- Number of new AWWA members
- Number of homeowners who participate in residential demonstration projects
- Number of people who sign Technical Assistance Pledge sheets
- Number of homeowners who participate in residential stormwater educational programs
- Number of contractors completing a training and certification program

- Citizen support as evidenced by the number of ordinances amended to support the plan
- Decrease in number of ordinance violations
- Number of volunteers participating in the Volunteer River Assessment Program for tributary monitoring
- Number of new volunteer-based invasive species assessment programs established and volunteers trained under existing programs

Environmental Indicators are a direct measure of environmental conditions. They are measurable quantities used to evaluate the relationship between pollutant sources and environmental conditions.

- Improvement in water clarity
- Reduction in the phosphorus concentration in the lake
- Improvement in the dissolved oxygen levels in deep areas of the lakes and ponds
- Reduction in the frequency of peak flows
- Reduction of visual NPS pollution during storm events

6.2 Criteria for Measuring Load Reductions

In addition to establishing interim measures to track implementation of activities over time (Section 6.1), this plan also provides indicators to help determine whether load reductions are being achieved over time and progress is being made toward overall watershed goals. The indicators outlined below will provide quantitative and qualitative measurements of progress toward meeting the WMP goals.

Tracking Implemented BMPs to Measure Load Reductions

The BMPs that are proposed in this plan are projected to provide a reduction in total phosphorus loading. Careful tracking of successful BMP projects that occur as a result of this plan is needed, and will be used to calculate phosphorus load reduction estimates using methods approved and recommended by the EPA. These include both structural and non-structural BMPs (ordinance revisions, education and outreach activities, etc.). For structural BMPs, the first step in checking BMP projects includes a visual inspection by the Project QA Officer to ensure that the BMPs were installed properly and are functioning as designed. This inspection occurs after a rainfall event that results in significant runoff. This includes no visible sediment deposition into the waterway and no visible signs of erosion or transport of sediment. If the visible inspection shows that the BMPs are not performing as designed, the Project QA Officer records the failures in a notebook and has crews correct the construction. An additional inspection occurs following a significant rain event subsequent to the repairs or modifications. AWWA's Youth Conservation Corps (YCC) uses this inspection method for all YCC soil stabilization projects implemented in the Acton-Wakefield region, and will continue to provide ongoing tracking of YCC 319 BMP implementation projects into the future.

Tracking Water Quality to Measure Load Reductions

A plan for long-term water quality assessment and monitoring is outline below in Section 6.3. Tracking changes and improvements in measured water quality can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality goals. Criteria that can be monitored over time to track load reductions include:

- Improved lake water clarity and transparency;
- Measured reduction in phosphorus concentrations;
- Measured reduction in chlorophyll-a concentrations;
- Visibly less turbidity; and
- Visible reductions in sediments deposits.

As described in the Action Plan, annual meetings will be organized to review the status of goals and objectives in this WMP. An adaptive management approach should be used to assess annual progress and determine key projects and focus areas for the following year and provide a venue for sharing information. Adaptive management is the process by which new information about the health of the watershed is incorporated into the WMP. This process allows stakeholders the opportunity to evaluate the effectiveness of restoration and monitoring activities before implementing future actions. Tasks listed in the Action Plan should be tracked and recorded as they occur, and new tasks should be added to the plan as determined through the adaptive management process. All achievements, such as press releases, outreach activities, number of sites repaired, number of volunteers, amount of funding received, and number of sites documented, will be tracked. The stakeholders will use the established indicators (Section 6.1) to determine the effectiveness of the Plan.

6.3 Long-Term Monitoring and Assessment Program

A well designed monitoring program is crucial to evaluating the effectiveness of watershed planning activities, and to determine if water quality goals are being achieved over the long-term. With two lakes in New Hampshire, one lake in Maine, and two lakes in both states, water quality monitoring, data collection, and ongoing data analyses is mandatory to ensure that the right type of data is collected, at the right time of year, included into the existing historical trend analysis that was conducted for this plan, and presented to the threshold committee on an annual basis.

Water quality analysis for this plan began in 2008 for all five SF headwater lakes. Currently there is no central clearinghouse for collecting, storing and analyzing sampling data on a regional, bi-state level. For example, water quality data for Horn Pond was retrieved from four different entities including Maine Department of Environmental Protection (Maine DEP), Maine Volunteer Lake Monitoring Program (VLMP), UNH Lay Lakes Monitoring Program (LLMP) and the NH Department of Environmental Services (NHDES). This required a major effort to cross reference data points to ensure that the results captured all the data that had been collected without redundancies.

The LLMP is in the final stages of developing a Quality Assurance Project Plan (QAPP) specific to the sampling of all five lakes. This means that in the future, the LLMP will be the primary data source in NH for

these lakes. The VLAP and VLMP are volunteer monitoring programs that will continue indefinitely monitoring these lakes. Volunteer monitors provide valuable data that is essential for tracking long-term trends in these lakes on a bi-weekly basis. VLAP data is sent to NHDES which in turn will be sent to the LLMP. The VLMP data is sent to Maine DEP, which in turn gets posted on the PEARL website (a site sponsored by the University of Maine).

Recommendations for each lake in this section were developed by the SF headwater lakes Water Quality Threshold Committee over the course of several meetings, emails, and phone conferences between February 2009 and May 2009. Specific monitoring recommendations are listed below for each lake, followed by general recommendations for all five lakes.

LAKE IVANHOE

Results of the water quality analysis suggest that Lake Ivanhoe is a potentially impaired waterbody, and requires a phosphorus reduction of 0.8 ppb to meet the definition of a high quality water. This is because the median phosphorus concentrations is at its limit (8 ppb) and chlorophyll-*a* (Chl-*a*) values (3.4 ppb) exceed the state standard (< 3.3 ppb). Lake Ivanhoe is at a critical tipping point and requires the State's immediate attention to determine if the decline in water quality is indicative of impairment. Ongoing monitoring of both phosphorus (epicore) and Chl-*a* on a monthly basis is imperative to track any changes in the water quality over time at the two primary sampling locations (Station 2-deep, and Station 1).



GREAT EAST LAKE

Great East Lake has seven different sampling locations (Map 8, Appendix B). Station 1 (deep hole) was used for the primary water quality analysis, while data from other sites was used as supporting evidence of changing trends. Secchi disk readings from Station 1 showed that there may be a slight decline in minimum water quality over the period of record. Phosphorus trends suggest that between 1978 and 1998 phosphorus values were fairly stable, while data from 1999-2008 appear to be on the rise. Further review of weather patterns, and development in the watershed would provide further insight into whether a real shift in trophic state exists, or an episodic, weather driven change occurred that will correct itself overtime. The following recommendations should be part of this monitoring plan:



- 1) Increase sampling frequency and frequency of field replicates to better characterize current conditions, on a monthly basis, especially over the next three years to determine if TP is on the rise.
- 2) Be watchful of 2nd Basin and Canal sampling sites due to higher TP concentrations.

- 3) Report back to WQ Committee if median TP continues to increase on an annual basis, the goal is to maintain a median TP concentration of 6.5 ppb for Station 1.

HORN POND

According to NH Lake Nutrient Criteria, Horn Pond is considered “Potentially Non-supporting”. This is because the median phosphorus concentration is at the tipping point (8 ppb) between a high quality lake (< 8 ppb) and the lower classification (> 8 and < 12ppb). The limited amount of sampling data (2 years for P and 2 years for Chl-a) suggest that more data is needed to determine any specific trend. In Maine, the criteria are slightly different from NH, and Horn Pond is not considered impaired (Bouchard 2009). Based on NH standards, there is no acceptable increase in P concentration in Horn Pond. NHDES will make a final use determination once sufficient TP data has been collected. More discussion is needed among NHDES and Maine DEP staff to align management strategies for this lake. Below are monitoring recommendations for Horn Pond.



- 1) Ensure that secchi disk measurements are collected at a minimum, monthly through the field season.
- 2) Collect epicore phosphorus and Chl-a samples monthly from May to the end of September to determine if trends are indeed increasing (data from 2004 and 2008 only), and if P values remain high in the future.
- 3) Monitor P concentrations and report back to threshold committee annually if median value increases.

WILSON LAKE

Wilson Lake is the only lake of the five located solely in Maine. Therefore, any recommended management strategies will be based on Maine water quality criteria. Wilson Lake has a median P concentration of 6.5 ppb, and has exhibited low dissolved oxygen levels (< 2ppm) in deep areas of the lake which can release phosphorus into the water column. Like Great East Lake, it is still unclear whether or not a recent increase in P is episodic in nature, or is indicative of a shift in trophic state. Careful land use planning is needed to maintain the existing in-lake TP concentration and ensure that this lake remains high quality waters in the future.



- 1) Ensure that secchi disk, epicore TP and Chl-a measurements are collected at least monthly from May through the end of September.
- 2) Increase sampling frequency and frequency of field replicates to better characterize current conditions,

especially over the next three years to determine if TP is on the rise (the last epicore TP sample was collected in 2004).

LOVELL LAKE

Lovell Lake is considered Potentially Non-supporting NH because it falls within the Tier 1 water quality classification (which indicates that Lovell Lake has limited capacity to treat additional phosphorus from the land). Water quality trends in Lovell Lake exhibit a slight decrease in water clarity. Like both Lake Ivanhoe and Horn Pond, recommendations for Lovell Lake include a phosphorus reduction of 0.3 ppb to meet the definition of a high quality water and to improve the existing in-lake phosphorus concentrations in Lovell Lake.



Photo: AWWA

- 1) Ensure that secchi disk, TP and Chl-a measurements are collected at both sampling locations at least monthly from May through the end of September.

GENERAL RECOMMENDATIONS

Sampling will be conducted by certified volunteer monitors and tracked by LLMP for data collected May through September. Lake Associations for each respective lake will be responsible for ensuring that an adequate number of volunteer monitors are trained annually to conduct monitoring according to standard procedures. Sampling should be conducted at two locations in Lake Ivanhoe, at four locations (Station 1, 2 Canal, 3 Mmann, and 2nd Basin) in Great East Lake, one location in Horn Pond, one location in Wilson Lake, and four locations in Lovell Lake. The following general recommendations should be considered for all five SF headwater lakes beginning in 2010:

- 1) Conduct biweekly sampling for temperature, dissolved oxygen, and secchi depth. Phosphorus sampling (epicore) and Chl-a will be collected according to standard methods monthly beginning early spring (after May 15) through fall (before September 30), with an emphasis on the deep holes.
- 2) Enter all water quality data into a common database to enable tracking and reporting of results on an annual basis. LLMP will report results to the SF Headwater Lakes Water Quality Threshold Committee on an annual basis.
- 3) Lake Associations for each lake will provide trained volunteers to conduct frequent routine surveys for aquatic invasive plants throughout the summer, and support courtesy boat inspections at public ramps.
- 4) Successful BMP implementation projects that occur as a result of this plan, and carried out by the AWWA Youth Conservation Corps, will track phosphorus load reduction estimates using methods approved and recommended by the EPA. These include both structural and non-structural (ordinance revisions, education and outreach activities, etc.).
- 5) Review monitoring plan annually for each of the five lakes to determine if additional monitoring is needed.

7. SUSTAINING THE PLAN

7.1 Inter-Local and Inter-State Cooperation

It is imperative that local cooperation occurs between landowners, residents, businesses and policy makers in order to prevent further water quality declines in the five lakes that form the headwaters of the Salmon Falls River. This includes voluntary compliance with local and state environmental regulations.

Since watersheds do not follow political boundaries, it is explicitly important that towns and states work together to implement watershed management strategies. This plan presents several ways that towns and states can work together. This includes: annual meetings attended by a bi-state steering committee made up of representatives from all five lakes and both towns; annual coordination of monitoring and water quality data analysis and reporting; and working together to align water quality ordinances (including a regional phosphorus control ordinance for all new development as well as redevelopment).

Another approach, which has been successful in many locations in Maine, New England, and beyond, is to form a Watershed district. Watershed districts are special government entities in the U.S. that monitor and regulate the use of water in watersheds surrounding lakes. The Districts are run by a board of managers who are appointed by County Commissioners. District boards coordinate watershed planning activities with state, county, town, and soil and water conservation districts.

Cobbossee Watershed District in Central Maine is an example of a District which has been successful at bringing state and local stakeholders together to address water quality problems. The success of the District has been nationally recognized (see insert).

A Watershed District at Work:

In the 1960s water quality in Cobbossee Lake began to deteriorate. Elevated phosphorus levels spurred the growth of noxious blue-green algae, which reduced water clarity, formed green surface scums, and depleted oxygen in the bottom waters of the lake. The excess phosphorus in Cobbossee Lake's watershed was caused by soil erosion and runoff from agricultural, residential, and commercial lands, and the gradual conversion of forested land into developed land. The other significant source of phosphorus came from Annabessacook Lake, immediately upstream of Cobbossee.

The Cobbossee Watershed District (CWD) was formed in 1973 to coordinate lake water levels and arrest declining water quality of major lakes. The District includes 13 towns in 2 counties, 22 dams, and 29 lakes and ponds over a watershed area of 240 square miles.

The CWD has helped towns and landowners adopt erosion control BMPs at homes, on town roads, and on private camp roads. In the early 1990s, five towns adopted ordinances requiring that new developments be designed to meet strict phosphorus allocation standards for stormwater runoff. Under two EPA section 319-funded projects in the 1990s, a significant number of erosion control and nutrient management practices were installed on dairy farms, along roads, and on residential properties.

Cobbossee Lake now meets water quality standards, which in Maine means that the lake has a stable or improving trophic state and has been free of culturally induced algae blooms. Maine DEP removed Cobbossee Lake from the state's 303(d) list in 2006.

Local cooperation and voluntary compliance with existing state and local environmental regulations remains a central focus of the District (EPA, 2009).

7.2 Sustainable Funding Mechanisms

The annual amount of estimated funds needed to complete all of the tasks listed in the Action Plan (Section 5.4) is \$601,000. This number is intended to be a realistic number that is attainable to be managed by the Town of Acton, the Town of Wakefield, and their partners including AWWA.

The following table summarizes the five action categories, primary and secondary potential sources of funds and the total annual amount needed to address the tasks in the action Plan.

Table 7.1: Primary and secondary potential funding sources.

Action Item	<u>Primary Funding Source</u>	<u>Secondary Funding Source</u>	<u>Total Annual Amount Needed</u>
Roadways	NHDES319/ ME 319	NH DOT/ME DOT	\$325,000
Community Planning and Development	NHDES 319/ME 319	PREP	\$94,000
Residential BMPs	NHDES 319	Maine DEP 319	\$95,000
Education and Outreach	NHDES 319	Foundations	\$87,000
Land Conservation	CELCP	Foundations	N/A
TOTAL			\$601,000

The challenge with funding watershed implementation work is that there are limited funds available for the work. In the likely absence of large amounts of funds to treat structural issues, watershed stakeholders should consider focusing on obtaining funds for non-structural measures. These non-structural measures including ordinances and training often have “more bang for the buck” and can greatly accelerate action in the watershed. The New Hampshire 319 and Maine 319 programs (Section 319 of the Clean Water Act – managed by the corresponding State environmental agencies) are well suited to funding non-structural tasks. These grant programs often fund watershed implementation projects at a level of \$50,000 - \$150,000 for two-to-three years of implementation work. Watershed organizations have creatively managed this work and spread funds in such a way that many sites are addressed. This is a good approach since the cumulative impact of untreated sites on a waterbody can have a substantial impact on water quality. However, complete protection of the project lakes will only be attained if the most severe sites are addressed.

There are many sources of short-term funding that are available for watershed groups including mini-grants, foundation grants, and project-related grants from various agencies. Diversifying funding sources is a positive step to take to ensure sustainability of project-related funds. Some of these funds could be used to maintain and grow the capacity of AWWA, who is charged with protecting the region’s waters. The best source for funding can be found on the EPA search engine dedicated to watershed funding:

<http://cfpub.epa.gov/fedfund/>.

Other potential funding sources:

- NHDES: <http://des.nh.gov/organization/divisions/water/wmb/was/categories/grants.htm>
- NOAA: http://www.nmfs.noaa.gov/habitat/restoration/funding_opportunities/nonfunding.html
- PREP: <http://www.nhep.unh.edu/programs/grant-programs.htm>
- Maine DEP: <http://www.maine.gov/dep/blwq/docgrant/319.htm>

Long-term, sustainable funding for lake watershed projects can be difficult to plan for. Several areas have developed stormwater utilities or watershed management districts to help manage watersheds with complex issues. Given its rural nature, the Acton-Wakefield region may not be the ideal location for this type of arrangement. However a formal, cooperative agreement between Acton and Wakefield could greatly help encourage collaboration and funding for future watershed protection efforts. Fortunately this model is already in place due to continued funding of the AWWA YCC program. A formalization of this agreement in the form of an “interlocal agreement” would allow for combining resources and further breaking down town and state boundaries for watershed protection. Interlocal agreements have worked well in the Bangor and Portland metropolitan areas of Maine. Since interlocal agreements are generally formed between municipalities in the same State, there may be obstacles towards formalizing an agreement through ordinance or resolution.

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APPENDIX A:
Site Specific Project Plan (SSPP)

Site Specific Project Plan

Watershed-Based Plan
for High Quality
Waters in the
AWWA Region

FB Environmental Associates
December 29, 2008

SITE SPECIFIC PROJECT PLAN FOR:

**WATERSHED BASED-PLAN FOR HIGH QUALITY WATERS IN THE ACTON
WAKEFIELD WATERSHEDS ALLIANCE (AWWA) REGION**

(NHDES PROJECT #B-08-C-02)

Under the New Hampshire 319 Nonpoint Source Grant Program Quality Assurance Project Plan
dated October 17, 2008 (RFA# 08262)

Final Draft
December 29, 2008

Prepared by:
FB Environmental Associates
97A Exchange St., Suite 305
Portland, ME 04101

Project Manager:

Signature/Date
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Technical Project Manager/QA Officer:

Signature/Date
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Sally Soule, NHDES

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Signature/Date
Jillian McCarthy, NHDES

NHDES Quality Assurance Manager:

Signature/Date
Vincent Perelli, NHDES

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1. Distribution List

Table 1 (below) lists people who will receive copies of the approved Site Specific Project Plan (SSPP) under the Watershed Based-Plan for High Quality Waters in the Acton Wakefield Watersheds Alliance (AWWA) Region dated December 29, 2008.

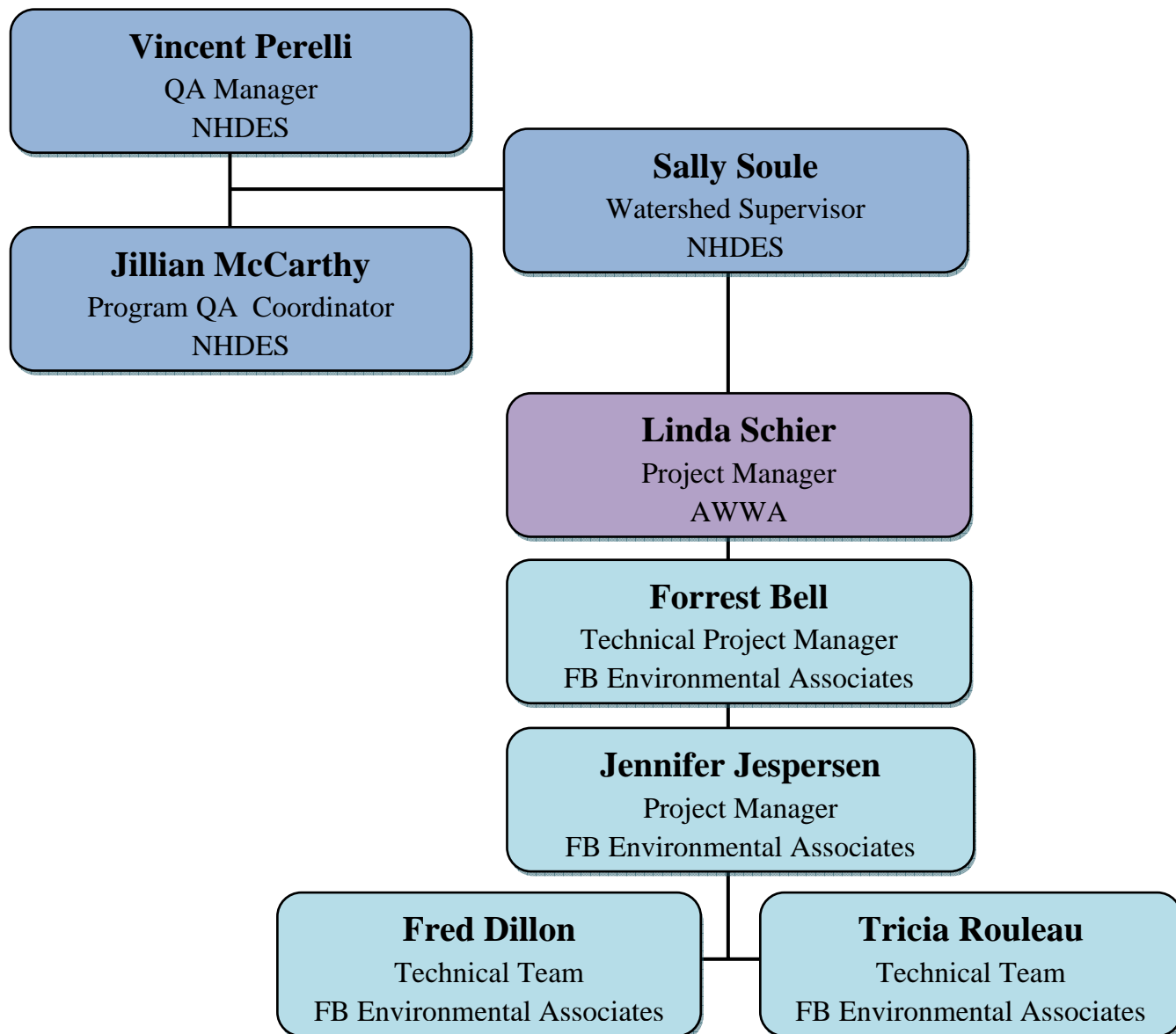
Table 1. SSPP Distribution List

SSPP Recipient Name	Project Role	Organization	Telephone number and e-mail address
Forrest Bell	Technical Project Manager	FB Environmental Associates	207-221-6699 info@fbenvironmental.com
Linda Schier	Project Manager	Acton Wakefield Watersheds Alliance	207-473-2500 info@AWwatersheds.org
Sally Soule	Coastal Watershed Supervisor	NHDES, Watershed Assistance Section	603-559-0032 sally.soule@des.nh.gov
Jillian McCarthy	Program QA Coordinator	NHDES, Watershed Management Bureau	603-271-8475 jmccarthy@des.state.nh.us
Vince Perelli	NHDES QA Manager	NHDES, Planning, Prevention, & Assistance Unit	603-271-8989 vperelli@des.state.nh.us

2. Project Task Organization

Figure 1 (below) outlines the organization structure of the project personnel.

Figure 1. Project Organizational Chart



3. Project Description and Methodology

A. Problem Statement

The communities within the Acton Wakefield Watersheds Alliance (AWWA) region are fortunate to have waters of exceptional quality. The natural amenities that make the AWWA region so unique and attractive also make it vulnerable to the impacts of increasing development. For example, according to the Strafford Regional Planning Commission, the Town of Wakefield, New Hampshire has experienced a population growth of nearly 57% from 1990 – 2005 (NHES 2007). Pollution threats related to development include sediment, nutrients and bacteria from existing and future shoreland development, aging septic systems and roads in the watershed.

The purpose of this project is to develop a Watershed-Based Plan that will help maintain or improve the high quality waters and habitat of the AWWA region lakes. Watershed modeling is a large component of this project, and will be used to determine long-term water quality goals, identify sources of pollution and estimate pollutant load reductions needed to accommodate future watershed development.

B. Historical Data

What type of data is going to be used? What is the Source of the data? What process will be used to determine that the quality of the data is acceptable for use in calculating existing water quality? Please describe.

Several different types of data will be used to complete the Watershed Based Plan for the High Quality Waters of the Acton Wakefield Watershed Alliance (AWWA) Region. The first major data component to be collected is the GIS land use data. These data will be used for determining the total land use area by land use type (in acres) for input into the watershed loading model (see below for model selection criteria). GIS land use data are available from State GIS websites for both Maine and New Hampshire. The Maine land use data, MECLD, is derived primarily from Landsat Thematic Mapping imagery from the years 1999-2001, which was further refined using panchromatic imagery from the spring and summer months of 2004 (MEGIS). The New Hampshire land use data, NH Land Cover Assessment 2001 or NHLCO1, consists of the most recent and detailed classification of land cover in New Hampshire based on satellite images acquired between 1990 and 1999, with further revisions in 2001 (GRANIT).

The second major data component is the historical water quality monitoring data for determining the median water quality value and assimilative capacity. These data will be obtained for all five AWWA lakes which include: Great East Lake and Horn Pond located in both Maine and New Hampshire, Lake Ivanhoe and Lovell Lake located in New Hampshire; and Wilson Lake located in Maine. Historical

water quality data for lakes in Maine is collected by the Maine Volunteer Lakes Monitoring Program (VLMP) and the Maine Department of Environmental Protection (Maine DEP). Both groups follow an approved Quality Assurance Project Plan developed by Maine DEP (Maine DEP, 2004) which includes Sampling and Analysis Plans (SAP) that follow Standard Operating Procedures (SOP) for all aspects of lake monitoring, from field procedures to data entry.

The New Hampshire Volunteer Lake Assessment Program (VLAP) and the New Hampshire Lakes Lay Monitoring Program (LLMP) are the two primary volunteer groups collecting water quality data on lakes in New Hampshire. Data is also collected by the UNH Center for Freshwater Biology (CFB). UNH Cooperative Extension (UNHCE) manages all data sampled by the LLMP and the CFB. Data from the VLAP is available through the New Hampshire Department of Environmental Services Environmental Monitoring Database (EMD). Only data that is flagged as final in the EMD will be used. UNHCE will follow the *Watershed-based Management Plan for High Quality Waters in the AWWA Region Water Quality Monitoring Quality Assurance Project Plan* that was developed specifically for this project (UNHCFB and UNHCE, 2008). Data from the UNHCE will only be used if QA/QC measures as outlined in the QAPP have been documented and followed.

Data availability varies by lake, dating back to the year in which each lake was first sampled and ending with the most recent sampling event. Phosphorus data is not always available for each year that data was collected. However, there is a deep data set (Table 2, below) that will be used to establish target water quality goals.

Table 2. Years of available sampling data for AWWA lakes

Lake	Location	Water Quality Data			Phosphorus Data		
		First Sampled	Last Sampled	# Years Sampled	First Sampled	Last Sampled	# Years Sampled
Great East Lake	ME/NH	1974	2008	30	1974	2008	17
Lovell Lake	NH	1979	2008	23	1979	2008	23
Lake Ivanhoe	NH	1981	2008	19	1981	2008	18
Horn Pond	ME/NH	1982	2008	11	1982	2008	7
Wilson Lake	ME	1977	2007	29	1977	2006	9

Source: NH Environmental Monitoring Database (EMD), UNH Cooperative Extension (includes data from LLMP and CFB), Maine DEP, and PEARL.

Water quality data will be combined to determine the median water quality and assimilative capacity for the two waterbodies that are situated within both Maine and New Hampshire (Great East Lake, and

Horn Pond). Where multiple stations exist for these lakes, best professional judgment will be used to determine which station is most representative of the whole lake. Where data was collected by two different state entities at the same sampling location, data will be combined to determine the median value.

Where available and applicable, shoreline and watershed surveys are a third data component that will be used in conjunction with the GIS land use data to model the external watershed load. Shoreline surveys were conducted by FB Environmental, AWWA, and NH DES staff on all five lakes during the summer/fall of 2008. Watershed surveys have been completed for Great East Lake, Lovell Lake, and Horn Pond.

Additional data needed for input into the watershed loading model include: the hydrological soil group and soil nutrient concentrations, which can be acquired from the USDA/NRCS STATSGO2 database, the number of agricultural animals, population using septic tanks, which can be acquired from the 2000 US Census Bureau; and the number of agricultural animals which can be estimated from the USDA 1997 Census of Agriculture.

C. Establishing Water Quality Goals

What pollutants are water quality goals being established for? What process will be used to determine the water quality goals? Please describe.

Pollution threats to the high quality waters of the AWWA region include sediment and nutrients from existing and future development, aging septic systems and roads in the watersheds. All of these land uses have the potential to deliver phosphorus, the limiting nutrient in freshwater systems, via stormwater runoff to streams and lakes in the watershed. As such, the water quality goals for the five lakes of the AWWA Region will focus on Total Phosphorus in the watershed.

Once the median water quality has been determined for each of the five waterbodies, the total, reserve and remaining assimilative capacity for each waterbody will be determined using procedures described in the *Standard Operating Procedures for Assimilative Capacity Analysis for New Hampshire Waters* (NH DES, 2008), on file on the NHDES Watershed Management Bureau network drive (H Drive). Tier 2, or high quality waterbodies are described as having water quality in which one or more parameters is better than the standard plus the reserve capacity (the reserve capacity is 10% of the total assimilative capacity). Tier 2 waters have some assimilative capacity remaining, whereas impaired and Tier 1 waters do not.

The process of establishing water quality goals will be guided by data analyses conducted by FB Environmental (FBE). FBE will first determine whether the current median water quality of each waterbody is greater than the reserve assimilative capacity. If median water quality values for each waterbody are greater than the reserve assimilative capacity (Tier 2- exceeds standards), then the water quality goal will be considered based on the current median value and historic water quality data. If the median water quality values fall within the reserve capacity (Tier 1), then the water quality goal will be determined based on historical water quality and potential reductions needed to get water quality values back to the high quality range.

A duplicate analysis will be conducted for calculating both the median water quality values and the assimilative capacity. Once the initial calculations have been completed, an advisory group consisting of town selectmen, conservation commission, and planning board members for the Towns of Acton and Wakefield, representatives of area lake associations, and NH DES staff will help finalize the water quality goals.

D. Loading Models

For each model please include the name, date, revision number, name of the organization or individual who developed the model/method, and the person(s) responsible for running the model as well as reference the user manual or method for the model.

Which model will be used to estimate the current and future pollution sources and loadings?

The US EPA Spreadsheet Tool for Estimating Pollutant Load (STEPL) Model will be used to estimate current nutrient and sediment loads from different land uses, and the load reductions that would result from the implementation of different best management practices (BMPs). This model provides the best fit for the watershed based on land use types (limited amount of agriculture), and is a commonly used and accepted model for watershed planning nationwide. Tricia Rouleau, Project Manager for FBE will be running the model. Tricia is proficient in the use of running watershed loading models, including direct experience with AVGWLF, PREDICT, and the USEPA Region 5 Model. FBE Senior Scientist, Ken Hickey, has direct experience using the STEPL model, and will provide necessary training and technical oversight of the modeling process.

The STEPL version 4.0 model and manual were downloaded directly from the US EPA STEPL website at: <http://it.tetrattech-ffx.com/stepl/>. Jennifer Jespersen, Project Manager for FBE will verify the input values and conduct a duplicate run to identify and correct potential transcription errors. STEPL version 4.0 was last updated on November 26, 2006, and was designed for the Grants Reporting and Tracking System of the U.S. Environmental Protection Agency (EPA) by the following individuals: EPA Work

Assignment Manager, Romell Nandi and Andrea Matzke; Tetra Tech Manager, Ting Dai; Tetra Tech developers, Ting Dai, Xingwen Chen, Jian Ouyang, Mira Chokshi, Khalid Alvi, and Henry Manguerra.

Which model will be used to estimate in-situ pollutant concentrations, and as a result, the pollutant reductions or limitations needed to meet the water quality goals?

Total Phosphorus Retention Model

The Dillon-Rigler model (Dillon and Rigler, 1974) will be used to model the increased phosphorus source loading under future watershed loading conditions and the reductions needed to meet in-lake phosphorus water quality goals. Previous use of the Dillon-Rigler type empirical model has been shown to be an effective approach for linking watershed total phosphorus (external) loadings to in-lake total phosphorus concentrations for thirty-two Maine Total Maximum Daily Load (TMDL) lakes between 2000 and 2008.

Indirect Watershed Loading Model

A simple indirect watershed loading model will be used to determine loading estimates from indirect watersheds. An indirect watershed contains a lake or pond that is hydrologically connected to the waterbody of interest without first passing through another waterbody. The indirect loading model has been utilized extensively by Maine DEP through their TMDL process to determine the extent of phosphorus loading to downstream lakes from their upstream counterparts. The indirect load is determined on the basis of [*flushing rate x lake volume x total phosphorus concentration*] of the upstream waterbody. Alternately, if an external watershed load was previously determined for the indirect watershed through other modeling methods (as described in A. above), then those data will be used.

Future Loading Model/Build-Out Analysis

FB Environmental has proposed two different methods for analyzing the effects of new development on the lakes in the AWWA region. The first is a simple, yet inherently conservative method for calculating phosphorus loading from new development, as it provides for relatively high-end regional growth estimates, and largely non-mitigated P-export from new development. Developed by Dennis et al. (1992), this method has been used exclusively in Maine for estimating loading from new development to TMDL lakes. The simple calculation multiplies a 1ppb change in trophic state (kg) by a known constant (either 0.75 if development pressure is high, or 0.5 if development pressure is considered moderate/low). The second method that has been proposed is a build-out analysis using GIS zoning data and CommunityViz software to estimate future development within the watershed. This method will determine the % of developable area in the watershed including the number of residential and commercial buildings, as well as their associated environmental impacts. This method will project future

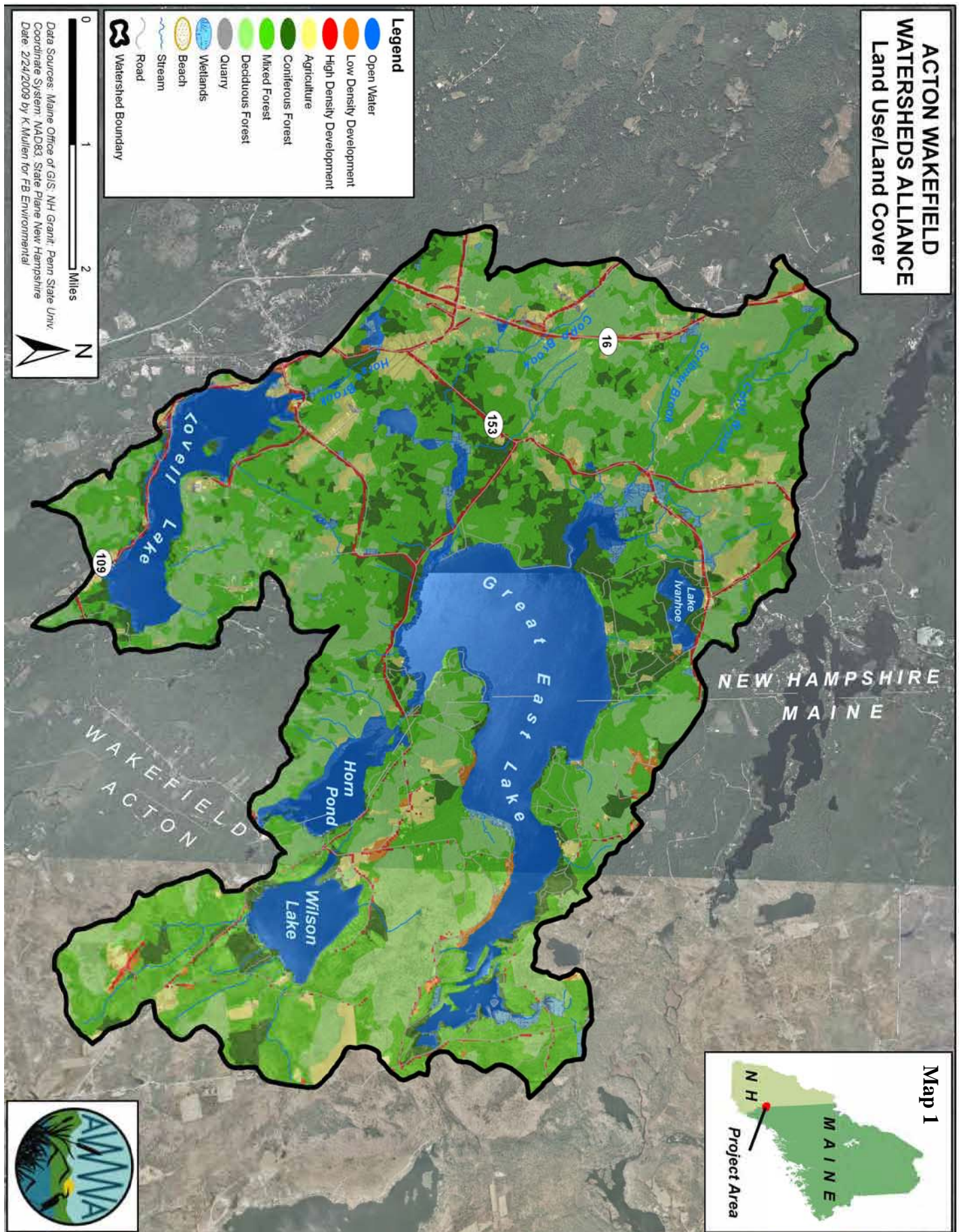
phosphorus loading under full build-out and an assessment of the potential effects of future development as it relates to water quality goals.

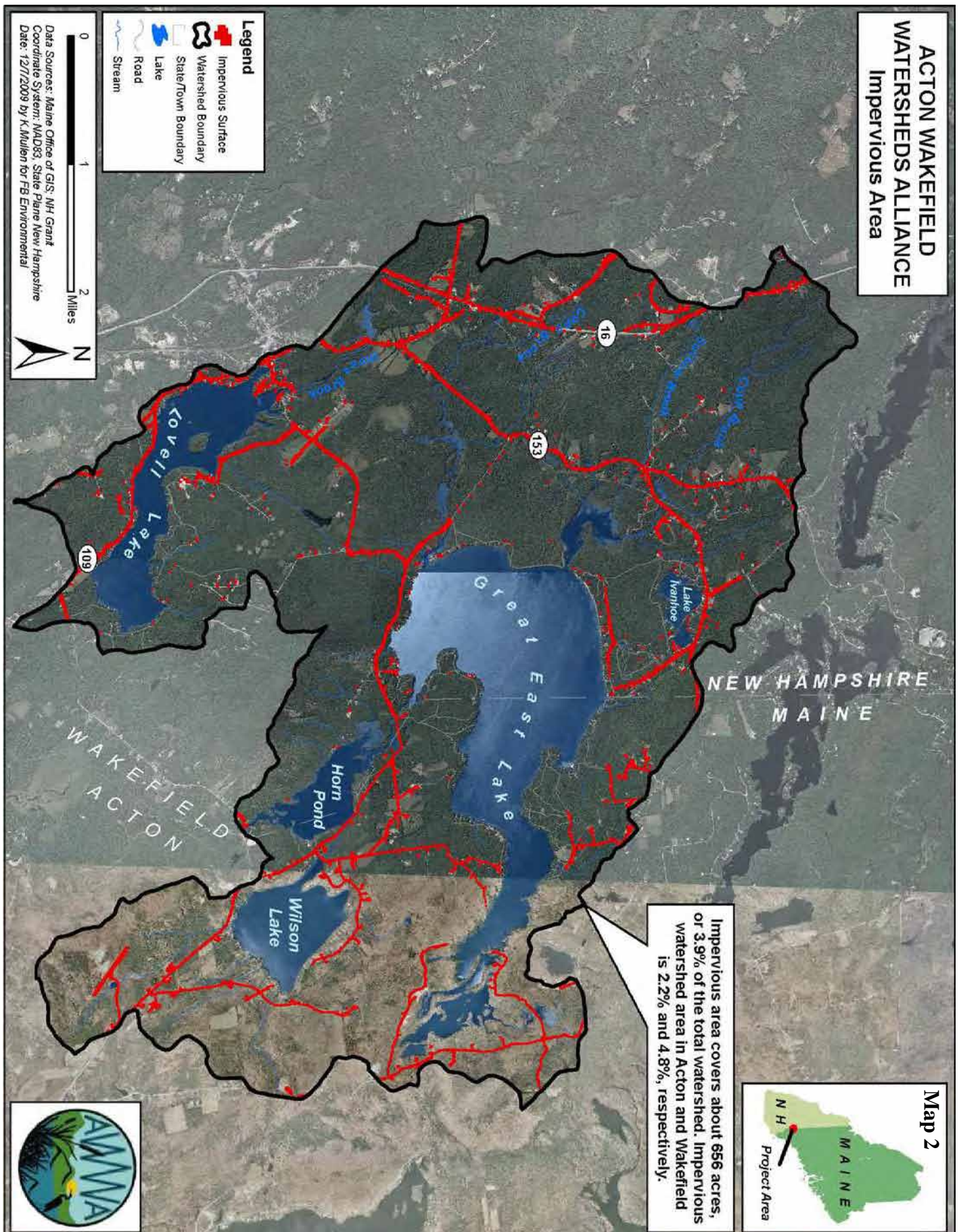
The Dillon-Rigler, indirect watershed loading model and future phosphorus loading estimate using Dennis et al. (1992) will be run by Jennifer Jespersen, Project Manager for FBE. Jennifer used these models to determine assimilative capacity, indirect watershed loading, and future loading for TMDL lakes in Maine (for the Maine Department of Environmental Protection and US EPA) between 2005 and 2008. Tricia Rouleau, Project Manager for FBE will verify the input values and conduct a duplicate run to identify and correct potential transcription errors. If the build-out analysis is added to the current AWWA/FBE contract, the Build-Out analysis will be conducted by Fred Dillon, Project Manager for FBE. Fred is an experienced GIS technician. His capstone at the University of Southern Maine involved running a build-out analysis for Penjajawok Stream Watershed in Bangor, Maine, which was utilized for watershed planning by both the City of Bangor and the Maine DEP.

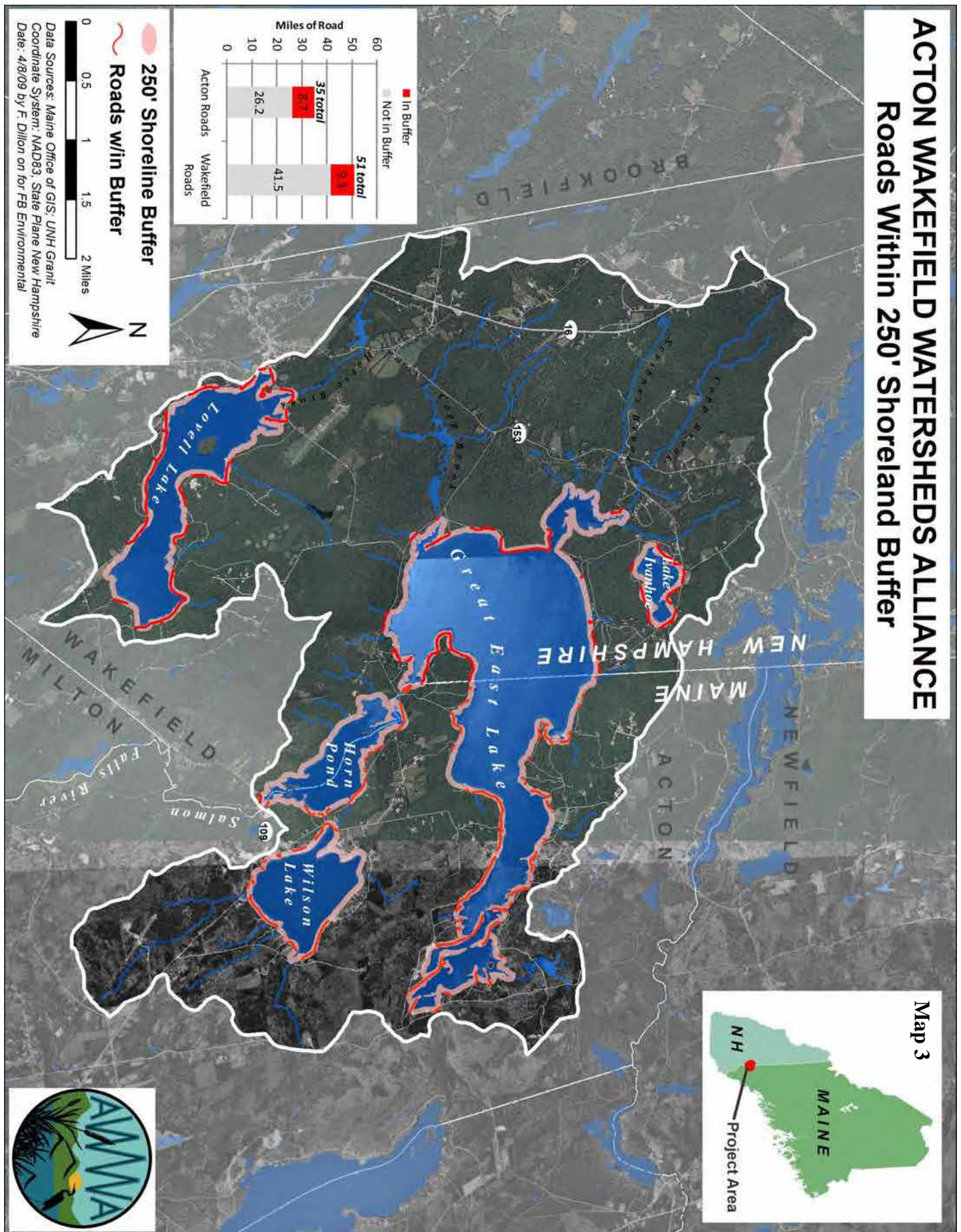
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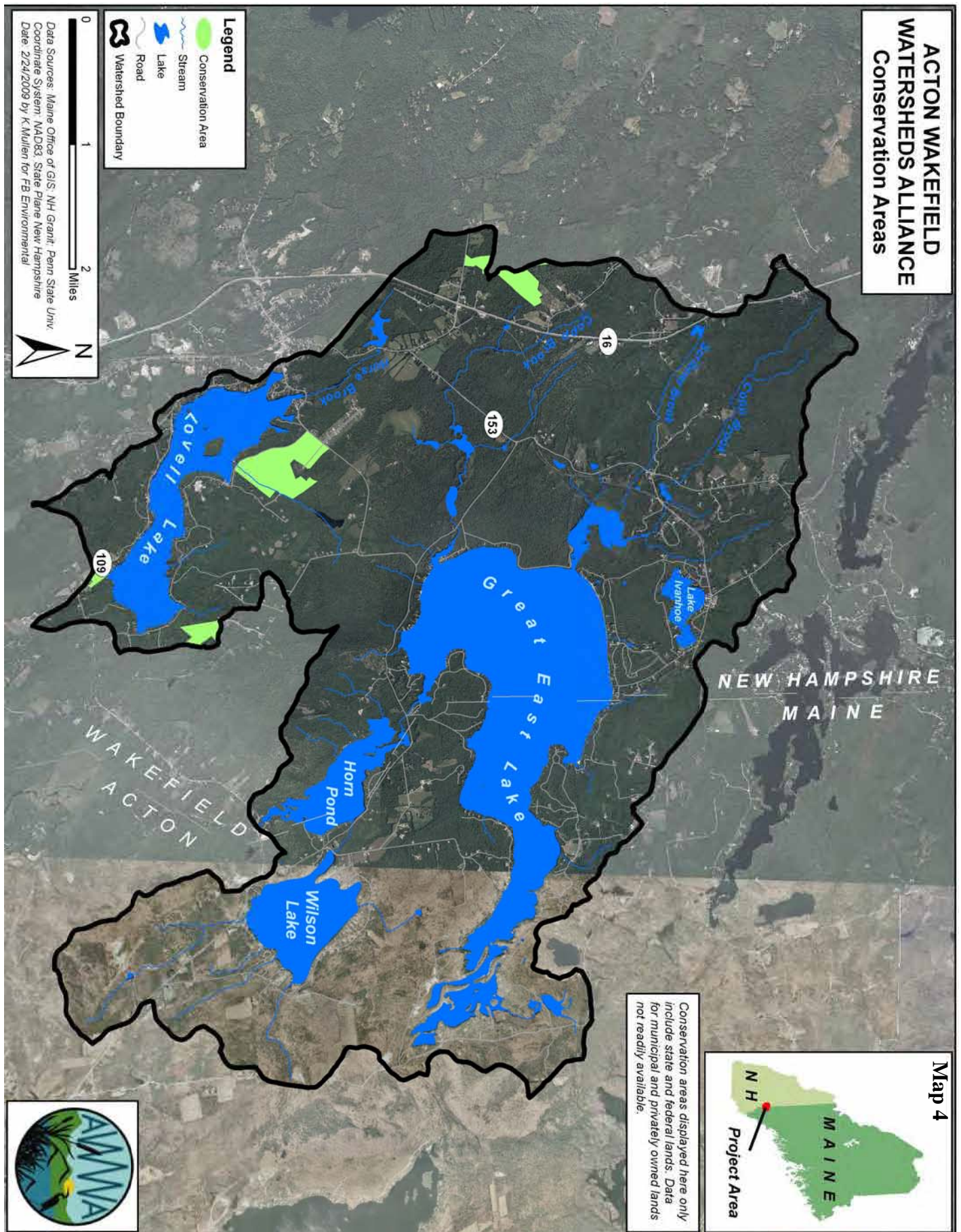
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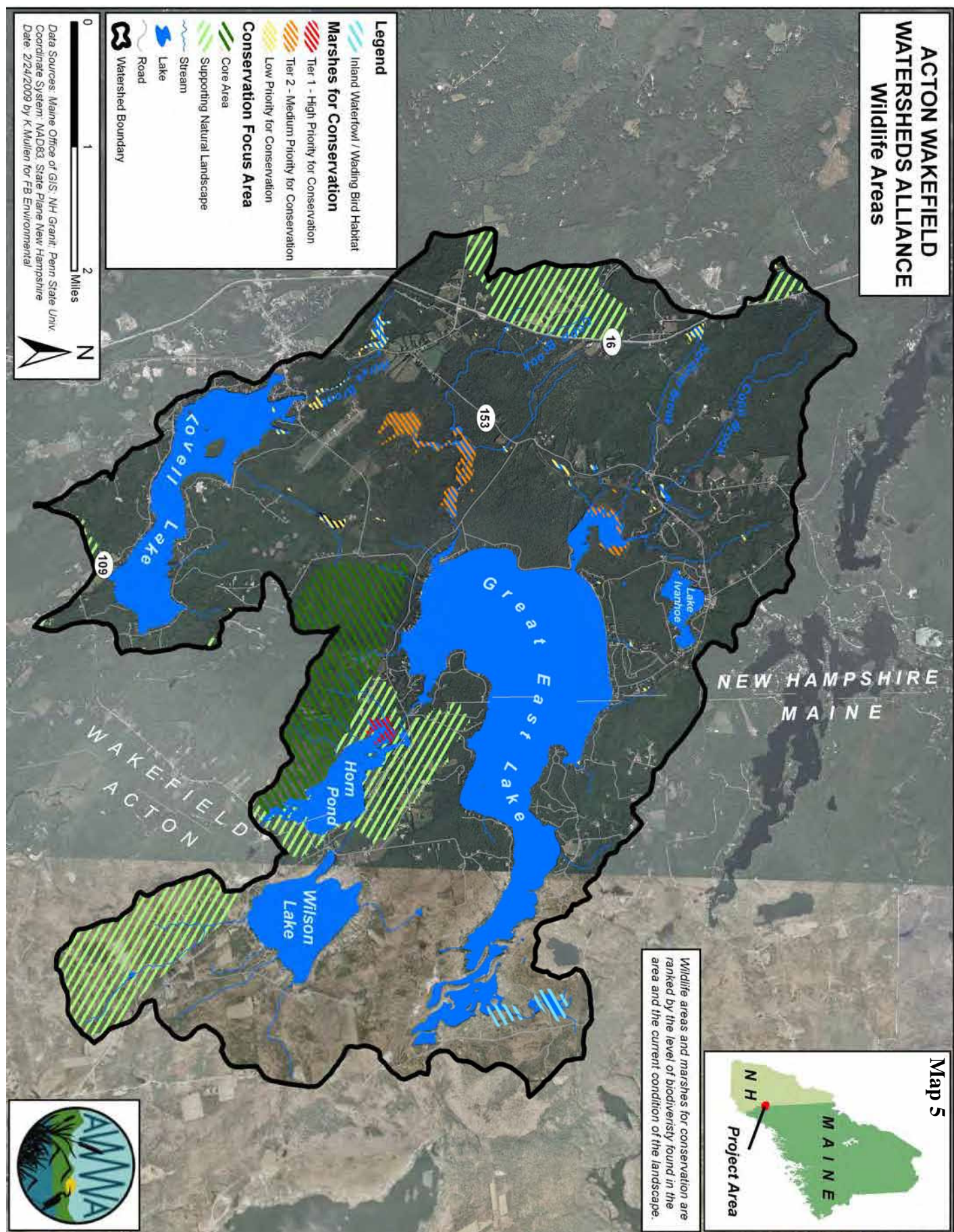
APPENDIX B: Watershed Maps

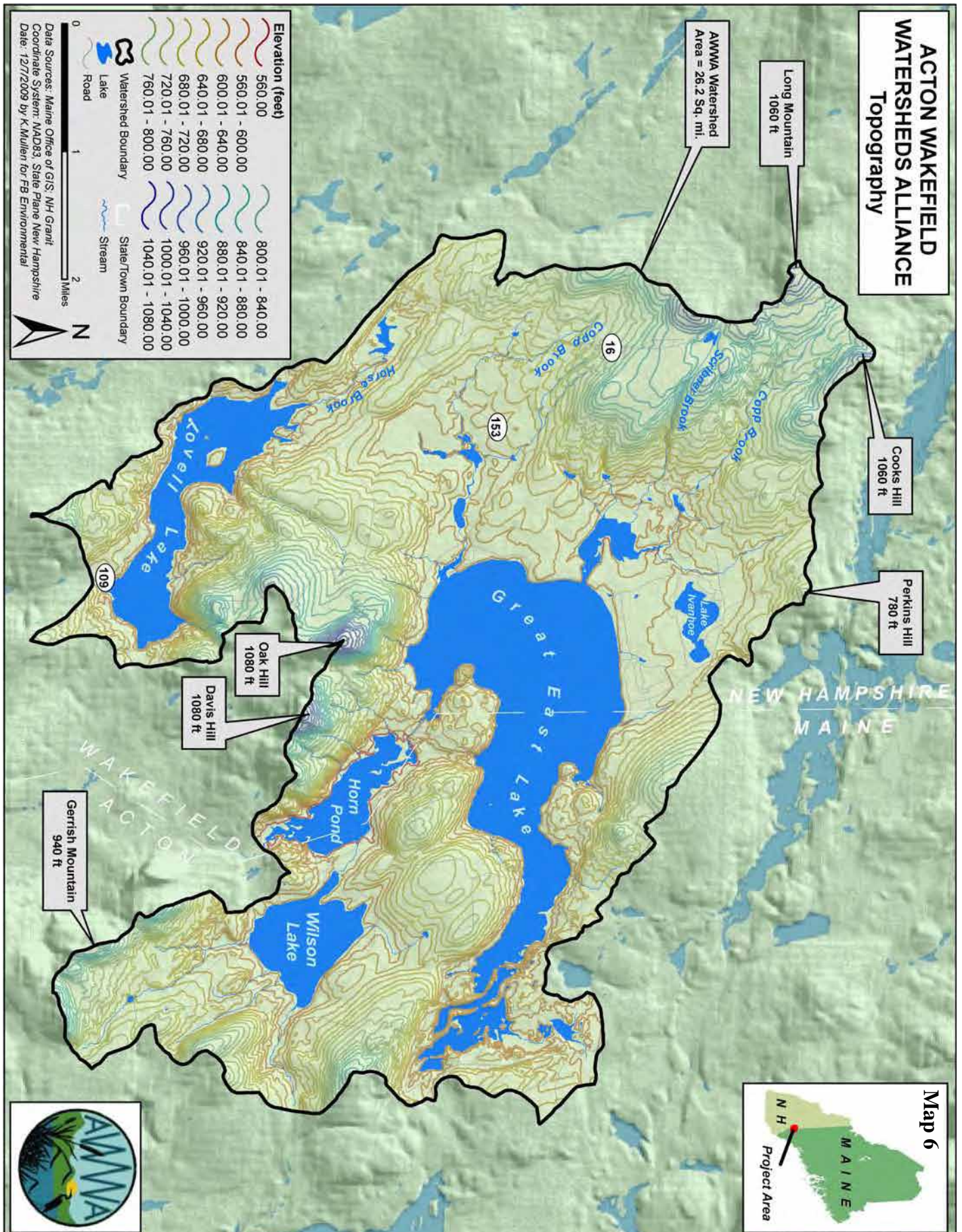


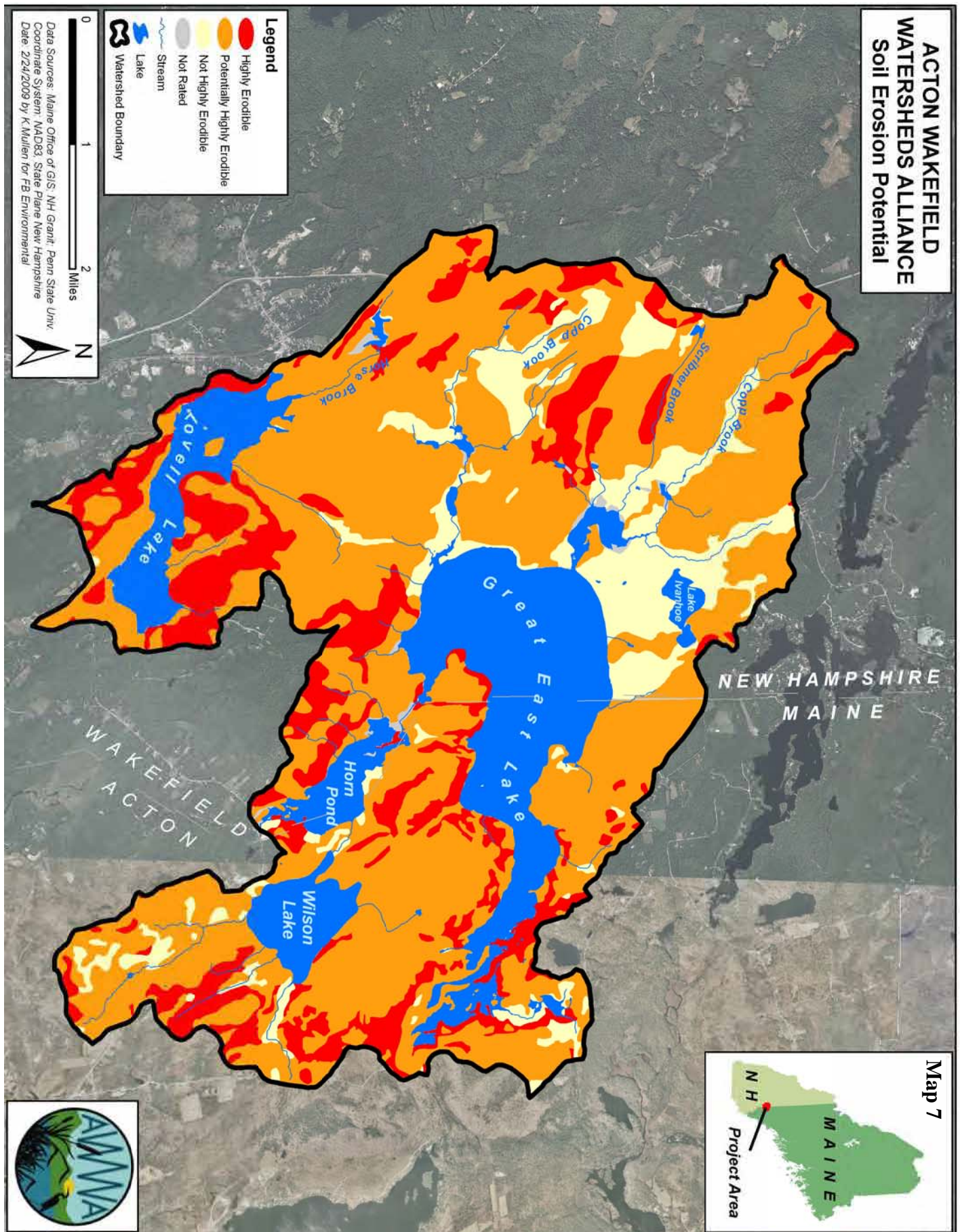


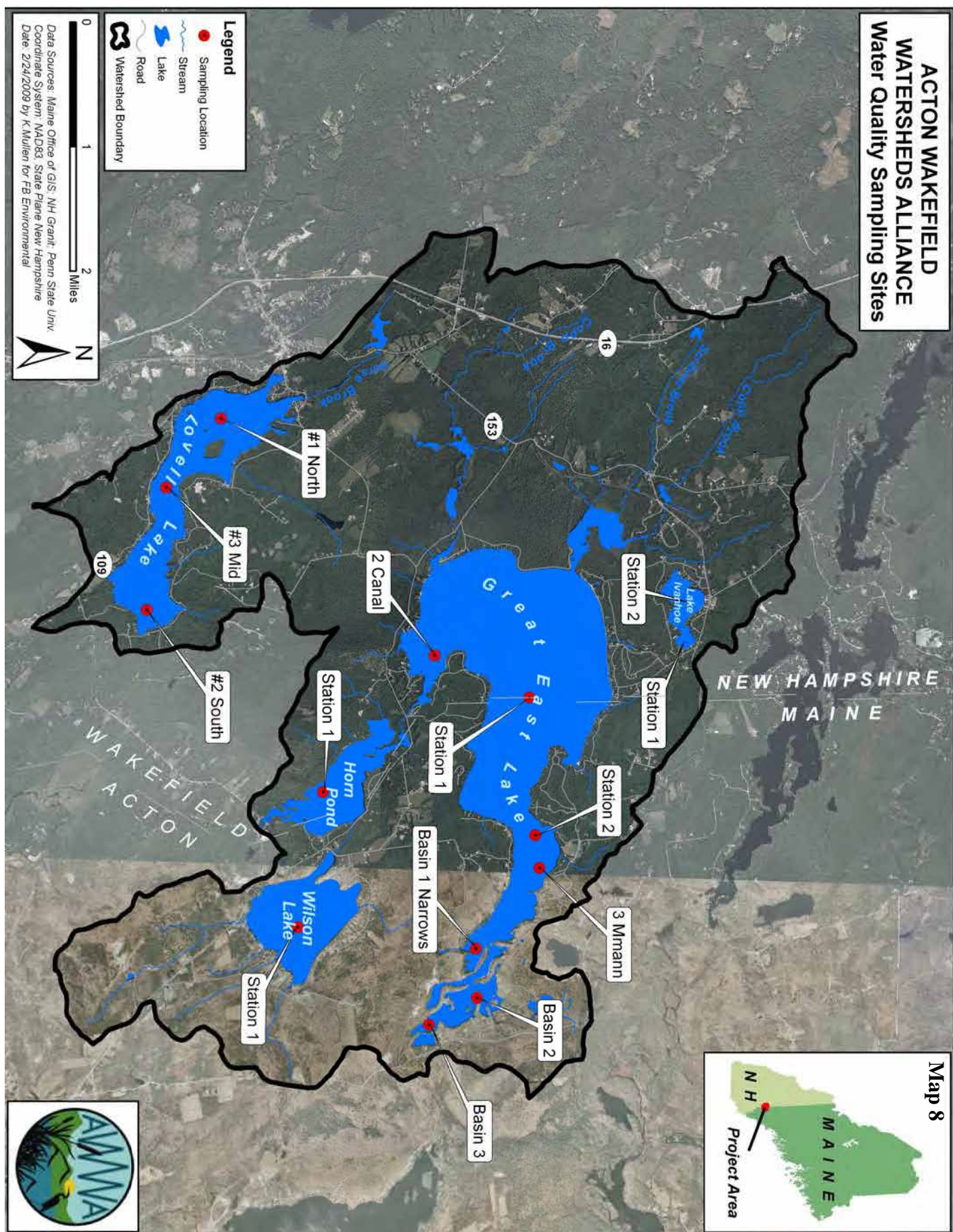


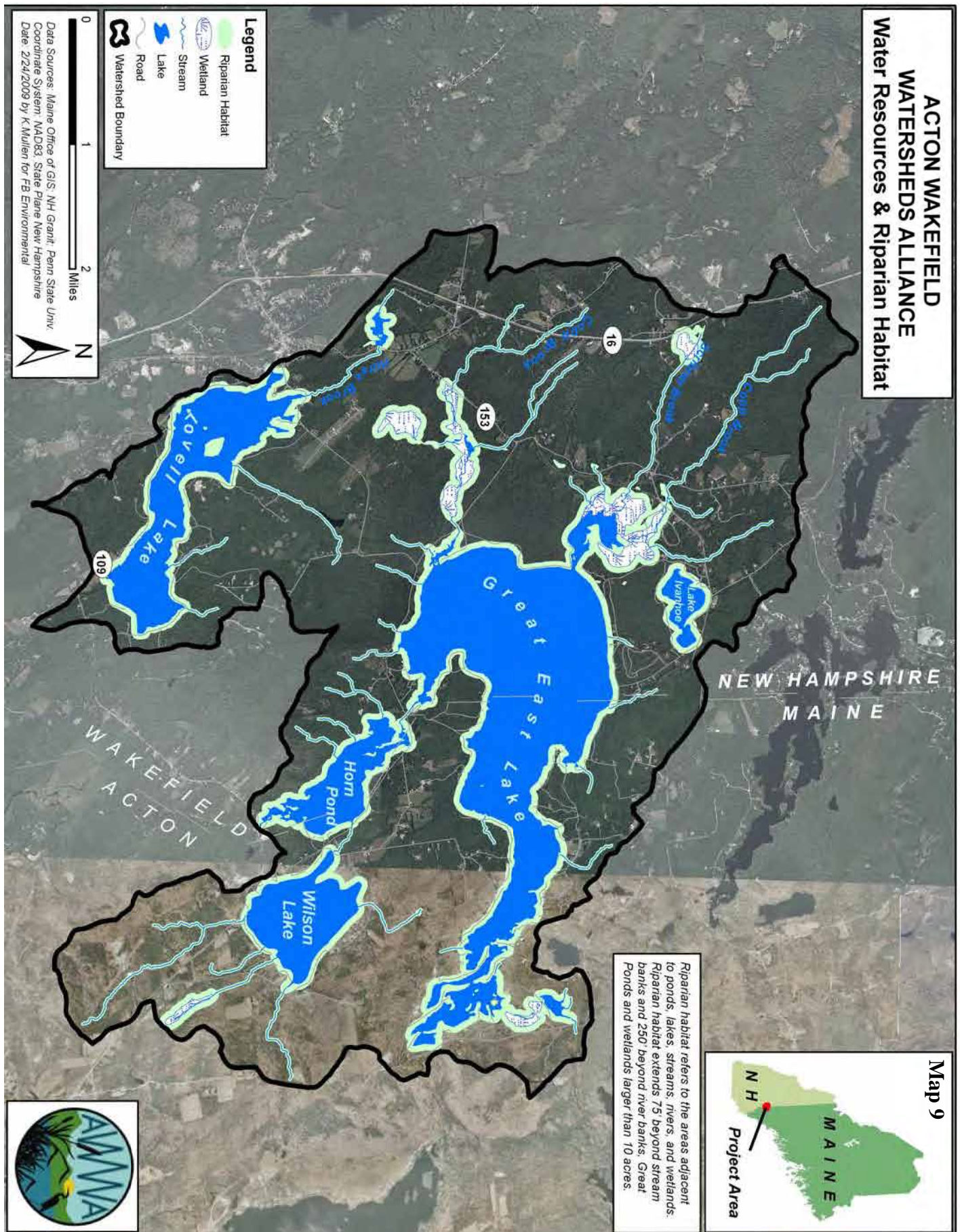


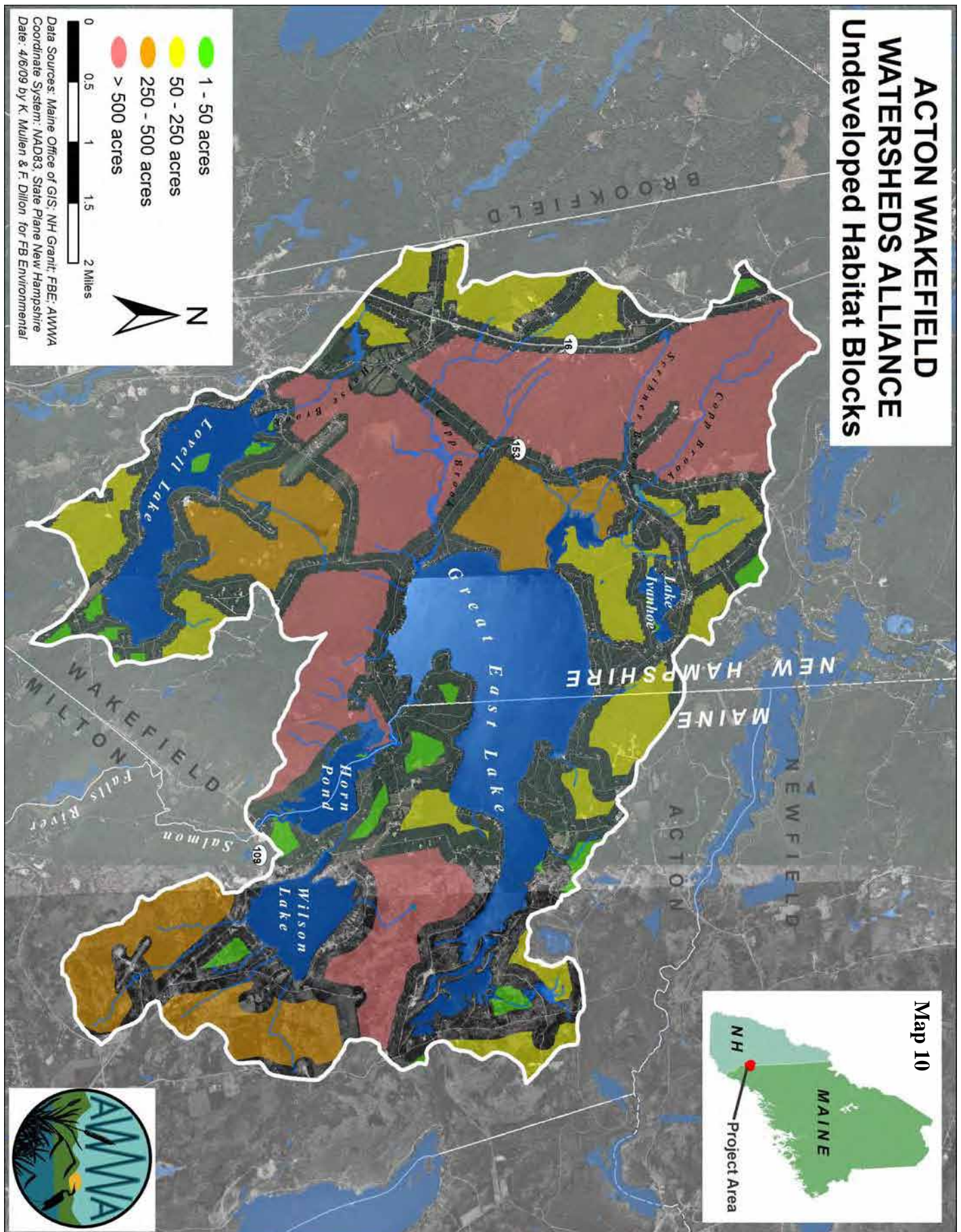


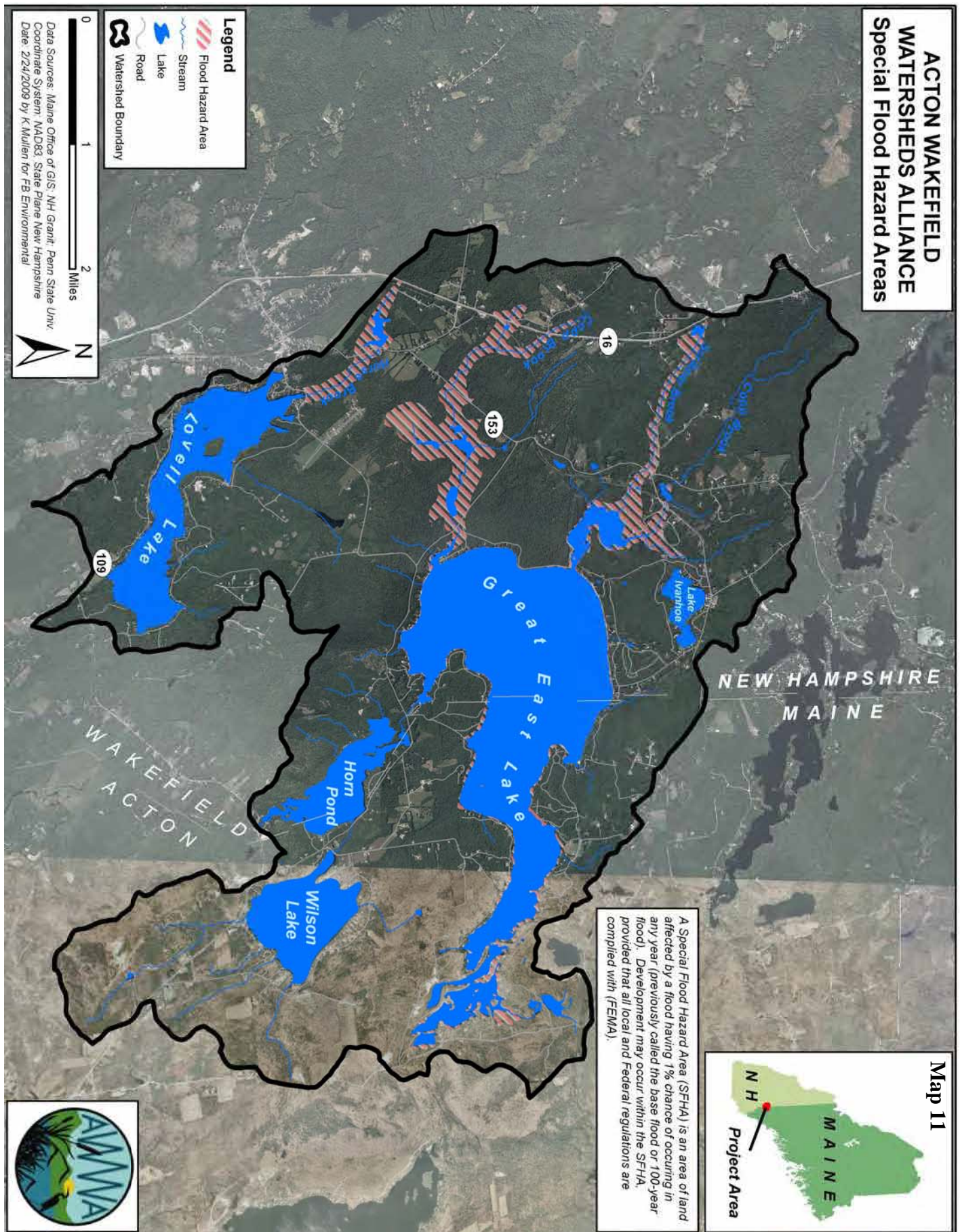












APPENDIX C:
Watershed Survey Summary Sheets

LAKE IVANHOE WATERSHED SURVEY SUMMARY FACT SHEET

BACKGROUND:

The Lake Ivanhoe Watershed (all the land that drains to Lake Ivanhoe) covers 455 acres (0.71 square miles) in Wakefield, New Hampshire . Lake Ivanhoe has 1.7 miles of shoreline.

Lake Ivanhoe's water quality has historically been classified as above average, according to the NH Department of Environmental Services (NH DES). Recently the lake has been classified as "potentially impaired" based on analysis of recently collected water quality parameters. Soil erosion is the single greatest source of pollution to Lake Ivanhoe.

- Soil contains phosphorus, a nutrient that helps plants like algae grow. When extra phosphorus enters a lake and causes excess algae to grow the lake can experience an algae bloom. Algae blooms make it undesirable for people to recreate on lakes.
- When algae living in a lake dies, it decomposes, depleting the oxygen level of the lake. Below certain oxygen levels animals living in the lake are unable to survive.
- Algae growth directly contributes to turbidity (cloudiness of water). Studies have shown that as water clarity decreases, property values also drop.



WATERSHED SURVEY:

In June 2009, a team of 46 volunteers and technical leaders fanned out around the Lake Ivanhoe and Great East Lake watersheds in 10 teams to identify areas of erosion that contribute pollution to the lakes. Technical leaders for the survey teams were from Acton Wakefield Watersheds Alliance, York County SWCD, NH DES, and Maine DEP .

The volunteers took careful notes using standardized data sheets. They also photographed the site for future reference. On each site where erosion was evident volunteers characterized the impact that the site was having on the lake, estimated the cost to remediate the problem and made BMP recommendations.

Volunteers and technical staff identified 25 sites that are impacting or have the potential to impact water quality of Lake Ivanhoe. They estimated that 3 of the sites have a potentially high impact on water quality, 13 had a moderate potential impact, and 9 sites are expected to have a low level of impact on water quality.



Volunteer photos of erosion sites documented during the survey.



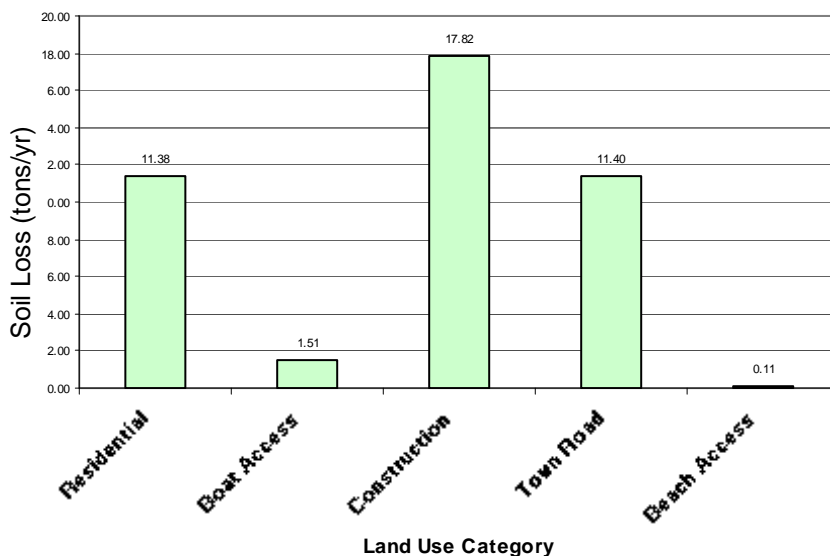
KEY SURVEY RESULTS:

- Residential properties accounted for 20 of the identified sites (80%) . Most of these sites have a low or medium impact on water quality and will be inexpensive to fix (less than \$500) using some simple best management practices, often easily fixed by the landowner. Currently these residential sites are contributing an estimated 11.4 tons of soil per year to the lake.
- Problems with Beach and Boat access areas accounted for 3 of the sites identified (12%).
- One town road and one logging road/ construction area were assessed to have high potential impact on the lake, contributing 11.4 and 17.82 tons of soil per year respectively. These sites were both assessed to have a high cost to repair and are likely to require technical expertise for adequate remediation.
- The estimated soil loss to the lake from erosion sites identified during the survey is 42.2 tons per year.

PROJECT PARTNERS:

Great East Lake Improvement Association, AWWA, York County Soil & Water Conservation District, NH Department of Environmental Services, and Maine Department of Environmental Protection

Soil Loss To Lake Estimates



Erosion sites were identified all around the watershed and on 5 different types of land uses and soil loss was estimated in each of these categories. Everyone has a role to play in protecting Lake Ivanhoe. The Town of Wakefield, waterfront property owners, road associations, and even people living far from the lake can all help reduce pollution entering the lake to protect this treasured resource.

NEXT STEPS:

- The information gathered from the watershed survey will be utilized in the creation of a watershed-based management plan for the Headwater Lakes of the Salmon Falls River .
- AWWA and the Round Pond Association will work together to apply for grants to help landowners, road associations, and the towns to fix some of the larger erosion problems identified in the survey.
- Landowners of identified sites will have the opportunity to meet with the AWWA Technical director and receive a site-specific remediation design as well as be considered as a YCC project host.
- Letters will be mailed to all landowners with identified erosion problems to encourage them to take action to fix their property and to provide them with access to the necessary resources.

FOR MORE INFORMATION:

A digital copy of the full survey report is available online at www.AWwatersheds.org. If you would like information about fixing erosion problems on your property or a copy of the Lake Ivanhoe Watershed Survey Report, contact:

David Giunta, President, Round Pond Association
(603) 522-3592
roundpond@ourlakehouse.net

Acton Wakefield Watersheds Alliance
info@awwatersheds.org
(603) 473-2500



Funding for this project was provided in part by a grant from the NH Department of Environmental Services with funding from the US Environmental Protection Agency under Section 319 of the Clean Water Act



GREAT EAST LAKE WATERSHED SURVEY SUMMARY FACT SHEET

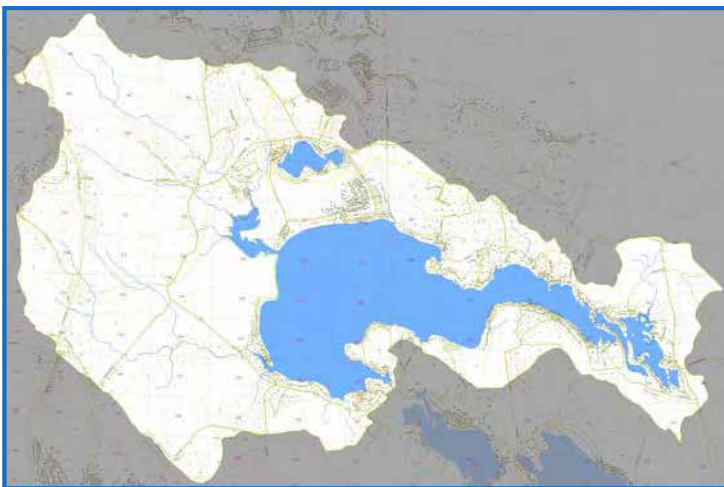
BACKGROUND:

The Great East Lake Watershed (all the land that drains to Great East Lake) covers 9,990 acres (15.6 square miles) in the towns of Wakefield, New Hampshire and Acton, Maine.

Great East Lake's water quality is above average, according to the NH Dept. of Environmental Services (DES) and Maine Department of Environmental Protection. Soil erosion is the single greatest source of pollution to Great East Lake.

- Soil contains phosphorus, a nutrient that helps plants like algae grow. When extra phosphorus enters a lake and causes excess algae to grow the lake can experience an algae bloom. Algae blooms make it undesirable for people to recreate on lakes.
- When algae living in a lake dies, it decomposes, depleting the oxygen level of the lake. Below certain oxygen levels animals living in the lake are unable to survive.
- Algae growth directly contributes to turbidity (cloudiness of water). Studies have shown that as water clarity decreases, property values also drop.

Great East Lake Watershed



WATERSHED SURVEY:

In June 2009, a team of 46 volunteers and technical leaders fanned out around the Great East and Lake Ivanhoe watersheds in 10 teams to identify areas of erosion that contribute pollution to the lakes. Technical leaders for the survey teams were from Acton Wakefield Watersheds Alliance, York County SWCD, NH DES, and Maine DEP.

The volunteers took careful notes when they identified a source of erosion using standardized data sheets. They also photographed the site for future reference. On each site where erosion was evident volunteers characterized the impact that the site was having on the lake, estimated the cost to remediate the problem and made BMP recommendations.

Volunteers and technical staff identified 177 sites that are impacting or have the potential to impact water quality.

Volunteer photos of erosion sites documented during the survey.



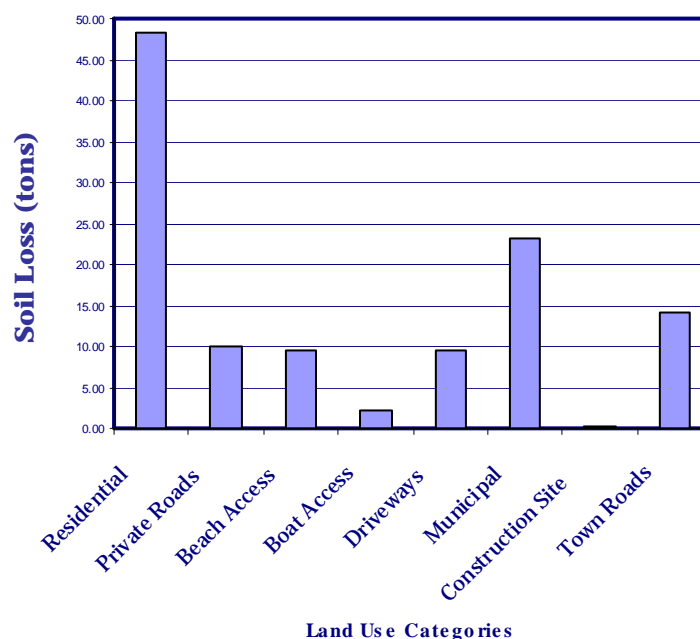
KEY SURVEY RESULTS:

- Residential properties accounted for 108 of the identified sites (62%) . Most of these sites have a low impact on water quality and will be inexpensive to fix (less than \$500) using some simple best management practices, often easily fixed by the landowner. Currently these residential sites are contributing an estimated 48.3 tons of soil per year to the lake.
- Private and state roads accounted for 29 of the sites identified (16%) . These sites have the potential to have a severe impact on the lake with higher associated costs (greater than \$2500) and often require technical experience to properly solve the erosion problems. In the Great East Lake watershed town and private roads currently add 24.1 tons of soil per year to the lake.
- The estimated soil loss to the lake from erosion sites identified during the survey is over 105 tons per year.

PROJECT PARTNERS:

Great East Lake Improvement Association, AWWA, York County Soil & Water Conservation District, NH Department of Environmental Services, and Maine Department of Environmental Protection

Soil Loss To Lake Estimates



Erosion sites were identified all around the watershed and on 9 different types of land uses and soil loss was estimated in 8 different land use categories. Everyone has a role to play in protecting Great East Lake. The Towns of Wakefield and Acton, waterfront property owners, road associations, and even people living far from the lake can all help reduce pollution entering the lake to protect this treasured resource.

NEXT STEPS:

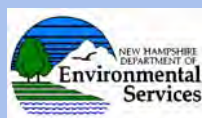
- The information gathered from the watershed survey will be utilized in the creation of a watershed-based management plan for the Headwater Lakes of the Salmon Falls River.
- AWWA and GELIA will work together to apply for grants to help landowners, road associations, and the towns to fix some of the larger erosion problems identified in the survey.
- Landowners of identified sites will have the opportunity to meet with the AWWA Technical director and receive a site-specific remediation design as well as be considered as a YCC project host.
- Letters will be mailed to all landowners with identified erosion problems to encourage them to take action to fix their property and to provide them with access to the necessary resources.

FOR MORE INFORMATION:

A digital copy of the full survey report is available online at www.awwatersheds.org. If you would like information about fixing erosion problems on your property or a copy of the Great East Lake Watershed Survey Report, contact:

Bess Smith, GELIA President
pres@greateastlake.org

Acton Wakefield Watersheds Alliance
info@awwatersheds.org
(603) 473-2500



Funding for this project was provided in part by a grant from the NH Department of Environmental Services with funding from the US Environmental Protection Agency under Section 319 of the Clean Water Act



photo courtesy of Saugus Photos Online

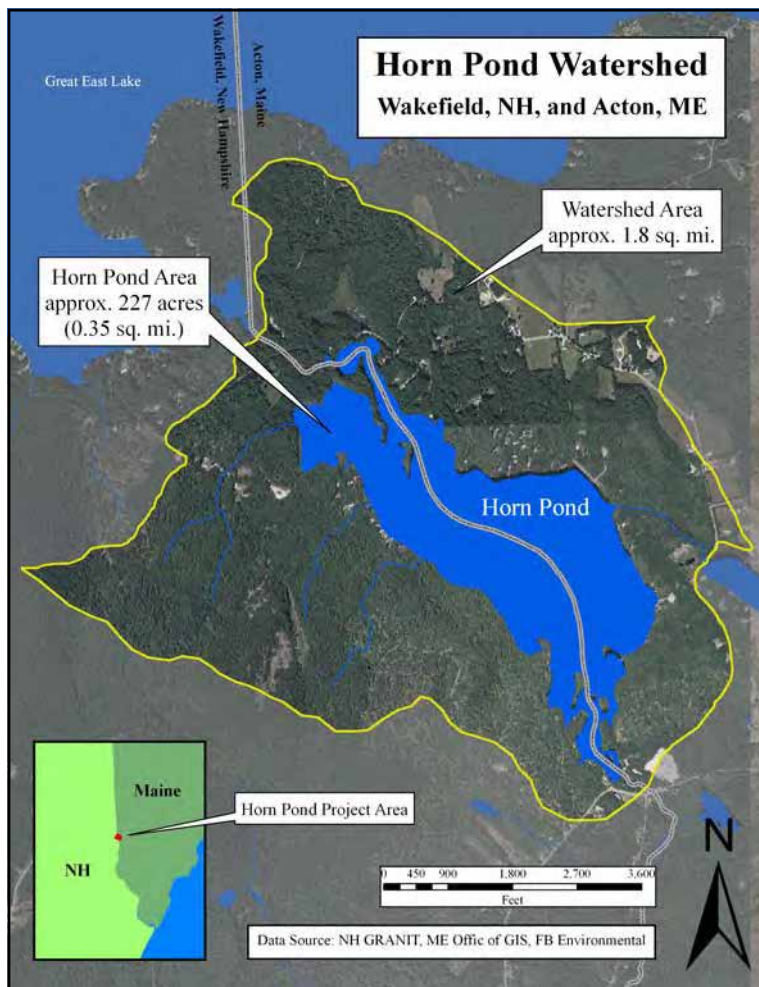
HORN POND WATERSHED SURVEY SUMMARY FACT SHEET

BACKGROUND:

The Horn Pond watershed (all the land that drains to Horn Pond) covers 1.8 square miles in the towns of Wakefield, NH, and Acton, ME.

Horn Pond's water quality is above average according to the NH Dept. of Environmental Services (DES) but it is threatened by polluted runoff. Soil erosion, in particular, is the single greatest source of pollution to Horn Pond.

- Soil contains the nutrient, phosphorus, which has the potential to promote algae blooms when it enters a lake in large quantities. As the algae die off, the water becomes depleted of oxygen through the breakdown process, and fish and animals are unable to survive.
- Algae blooms also turn water green and make a lake virtually unusable.
- Studies have shown that as water clarity decreases, property values also drop.



WATERSHED SURVEY:

In June 2008, a team of 20 local volunteers and technical staff from Acton Wakefield Watersheds Alliance, York County SWCD, NH DES, and Maine DEP conducted a survey of the watershed and identified 55 sites that are contributing polluted runoff to Horn Pond.

Teams documented polluted runoff sources from roads, properties, driveways, and shorelines using cameras and standardized field data sheets. Teams made recommendations to remediate each source using erosion control practices and rated impact and cost to fix.

Results and recommendations were compiled in the ***Horn Pond Watershed Survey Report***.

Examples of Identified Erosion Problems



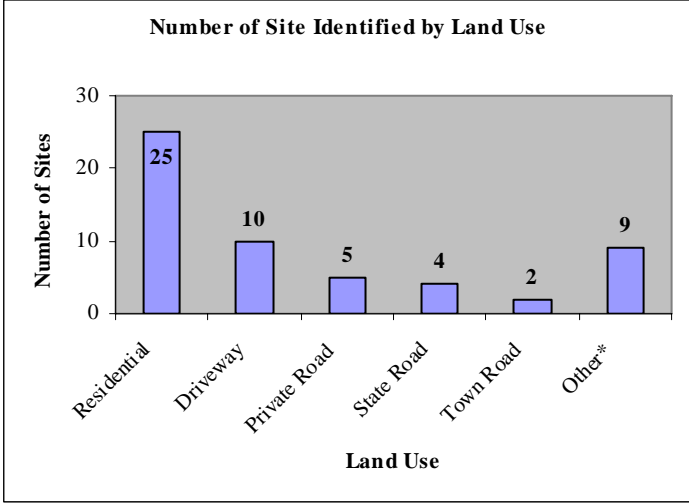
KEY SURVEY RESULTS:

Volunteers and technical staff identified 55 sites in the Horn Pond Watershed that are impacting or have the potential to impact water quality.

- 25 of the identified sites (45%) were found on residential properties. Most of these sites have a low impact on water quality and will be inexpensive to fix (less than \$500) with little technical expertise required. These tend to be simple fixes that can be done by the landowners themselves.
- 11 of the sites identified (24%) are associated with roads: State, town, and private. These sites tend to have a more severe impact on the lake with higher associated costs (greater than \$2500) and required technical knowledge. Also, the procedures involved with remediating these sites are more time and resource consuming.
- Canal Road and New Bridge Road pose serious problems for the lake. These paved roads produce a large amount of surface runoff during periods of precipitation. The roads are also pitched in such a way as to shed the majority of this runoff towards the lake. Winter sand, road salt, oil and gas, heavy metals, and other pollutants wash off the road and are carried into the lake, creating a water quality hazard. Canal Road drains directly into the Great East Lake Canal that flows into Horn Pond. The buffer between New Bridge Road and the lake is severely limited. In some areas only a few feet separate the two.

Project Partners:

Acton Wakefield Watersheds Alliance,
NH DES, York County SWCD, Maine DEP,
Town of Wakefield, NH, Town of Acton, ME



* Other includes: Construction Site (3), Boat Access (3), Trail or Path (2), Beach Access (1)

Erosion sites were identified all around the watershed and on 9 different types of land uses (see above). As such, everyone has a role to play in lake protection. The Towns of Wakefield and Acton, waterfront landowners, road associations, and even people living far from the lake can all help reduce lake pollution.

NEXT STEPS:

- The information gathered from the watershed survey will be utilized in the creation of a Watershed Based Management Plan for the Headwaters of the Salmon Falls River Watersheds.
- Residents of the Horn Pond Watershed will be encouraged to form a lake association to address concerns impacting the community. Lake associations are powerful tools that can promote effective solutions to the problems identified in this survey.
- The Acton Wakefield Watersheds Alliance will apply for grants to help landowners, road associations, and the town to fix some of the larger erosion problems identified in the survey.
- Letters will be mailed to all landowners with identified erosion problems to encourage them to take action to fix their property and to provide them with access to the necessary resources.
- Landowners of identified sites will have the opportunity to meet with the Technical Director and receive a site-specific remediation design as well as be considered as a YCC project host.

FOR MORE INFORMATION:

If you would like information about fixing erosion problems on your property or a copy of the Horn Pond Watershed Survey Report, contact:



Acton Wakefield Watersheds Alliance
www.awwatersheds.org
info@awwatersheds.org
(603) 473-2500



Funding for this project was provided in part by a grant from the NH Department of Environmental Services with funding from the US Environmental Protection Agency under Section 319 of the Clean Water Act



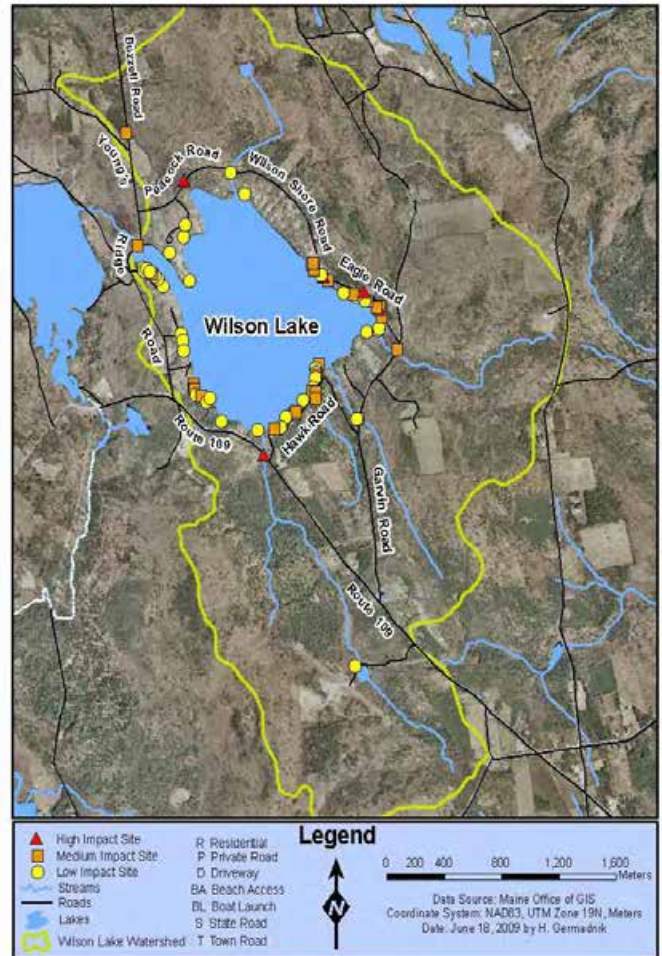
WILSON LAKE WATERSHED SURVEY SUMMARY FACT SHEET

BACKGROUND:

The Wilson Lake watershed (all the land that drains to Wilson Lake) covers 3.86 square miles in the Town of Acton, Maine.

According to the Maine Department of Environmental Protection (DEP), Wilson Lake's water quality is about average but low oxygen levels indicate that it is threatened by polluted runoff. Soil erosion, in particular, is the single greatest source of pollution to Wilson Lake.

- Soil contains the nutrient, phosphorus, which has the potential to promote algae blooms when it enters a lake in large quantities. As the algae die off, the water becomes depleted of oxygen through the breakdown process, and fish and animals are unable to survive.
- Algae blooms also turn water green and make a lake virtually unusable.
- Studies have shown that as water clarity decreases, property values also drop.



Sediment delta in Wilson Lake due to severe erosion on Eagle Road.

WATERSHED SURVEY:

In the Spring of 2009 a team of 32 local volunteers and technical staff from the Wilson Lake Association, York County SWCD, Acton Wakefield Watersheds Alliance, Maine DEP and New Hampshire DES conducted an survey of the watershed and identified 71 sites with soil erosion that are contributing polluted runoff to Wilson Lake.

Teams documented erosion problems on roads, properties, driveways and trails on standardized field data sheets. Teams made recommendations to remediate each source using erosion control practices and rated impact and cost to fix.

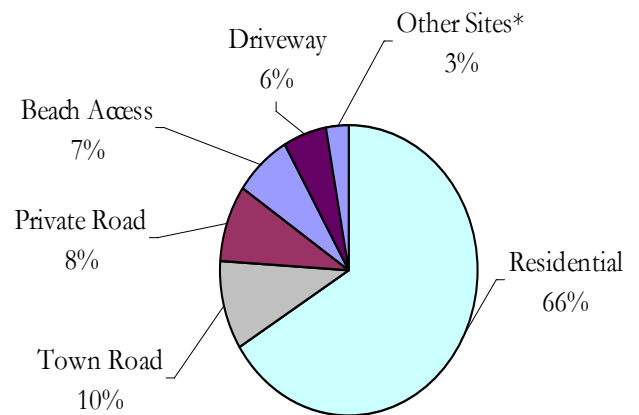
Results and recommendations were compiled in the ***Wilson Lake Watershed Survey Report***.

KEY SURVEY RESULTS:

Volunteers and technical staff identified 71 sites in the Wilson Lake Watershed that are impacting or have the potential to impact water quality.

- 47 of the identified sites (66%) were found in residential areas. These sites tend to have less severe erosion and can be fixed easily with low cost. Individual landowners can play a big role in helping address these problems.
- A significant percentage (25%) of the remaining erosion sites were associated with roads (town, private and state roads and driveways). These sites tend to be larger erosion problems with greater lake impacts.
- Erosion sites were identified all around the watershed and on seven different types of land uses. As such, everyone has a role to play in lake protection. The Town of Acton, property owners, business owners, road associations, lakefront landowners and even people living far from the lake can all take measures to reduce lake pollution.

Percentage of Sites by Land Use



*Other includes 1 state road and 1 boat launch.

Project Partners:

Wilson Lake Association
Maine Department of Environmental Protection
Acton Wakefield Watersheds Alliance
York County Soil and Water Conservation District
New Hampshire Department of Environmental Services

NEXT STEPS:

- Now that the watershed survey and report are complete, fixing the sites identified in this survey will require efforts by individuals, the Wilson Lake Association, road associations and municipal officials.
- York County SWCD, AWWA and Wilson Lake Association can use survey findings to apply for a DEP 319 grant to help landowners, road associations and towns fix some of the larger erosion problems identified in the survey. Property owners can also contact AWWA if they would like help from the Youth Conservation Corps.
- Letters will be mailed to all property owners with identified erosion problems. Hopefully, many of these people will take the initiative to start fixing the problems.

FOR MORE INFORMATION:

If you would like information about fixing erosion problems on your property or a copy of the Wilson Lake Watershed Survey Report, contact:

Wilson Lake Association

Jeanne Achille, Survey Coordinator
E-mail: jach28@gmail.com
Tel: (207) 477-0310

York County SWCD

Joe Anderson, Project Manager
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Acton Wakefield Watersheds Alliance

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Maine DEP

Wendy Garland
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Tel: (207) 822-6320



photo courtesy of www.lovelllake.org

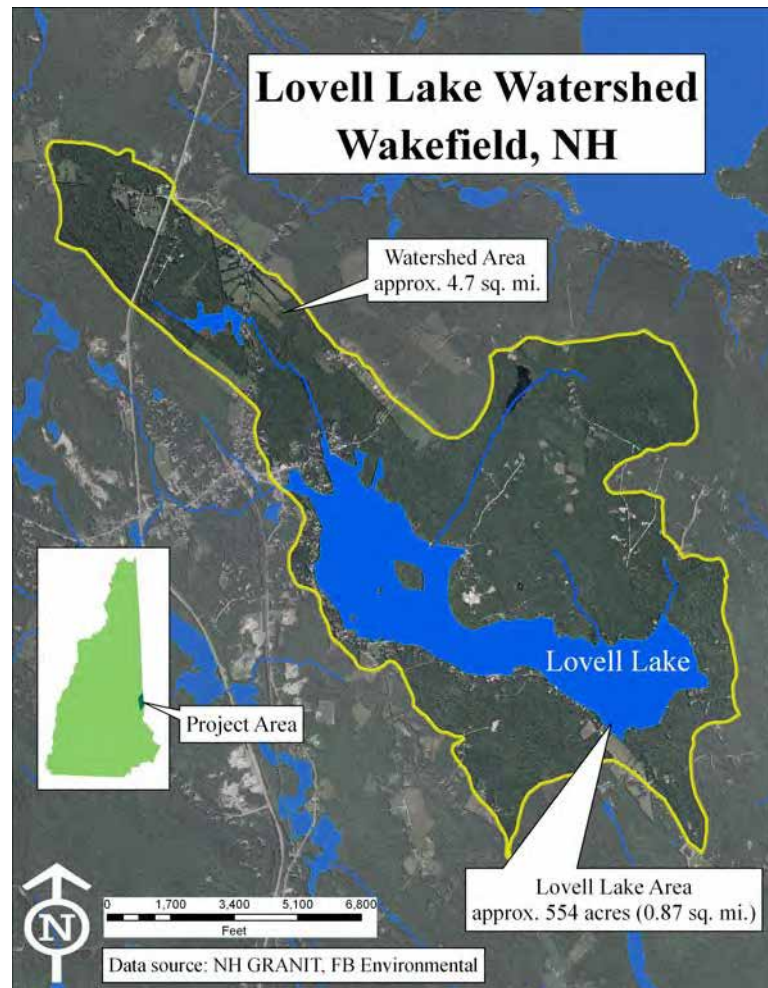
LOVELL LAKE WATERSHED SURVEY SUMMARY FACT SHEET

BACKGROUND:

The Lovell Lake watershed (all the land that drains to Lovell Lake) covers 4.7 square miles in the village of Sanbornville in the town of Wakefield.

Lovell Lake's water quality is above average, according to the NH Dept. of Environmental Services (DES), but it is threatened by polluted runoff. Soil erosion, in particular, is the single greatest source of pollution to Lovell Lake.

- Soil contains the nutrient phosphorus which has the potential to promote algae blooms when it enters a lake in large quantities. As the algae die off, the water becomes depleted of oxygen through the breakdown process, and fish and animals are unable to survive.
- Algae blooms also turn water green and make a lake virtually unusable.
- Studies have shown that as water clarity decreases, property values also drop.



WATERSHED SURVEY:

In September 2008, a team of 32 local volunteers and technical staff from Acton Wakefield Watersheds Alliance, York County SWCD, NH DES, and Maine DEP conducted a survey of the watershed and identified 161 sites that are contributing polluted runoff to Lovell Lake.

Teams documented polluted runoff sources from roads, properties, driveways, and shorelines using cameras and standardized field data sheets. Teams made recommendations to remediate each source using erosion control practices and rated the impact and cost to fix.

Results and recommendations were compiled in the ***Lovell Lake Watershed Survey Report***.



Examples of Identified Erosion Problems

KEY SURVEY RESULTS:

Volunteers and technical staff identified 161 sites in the Lovell Lake Watershed that are impacting or have the potential to impact water quality.

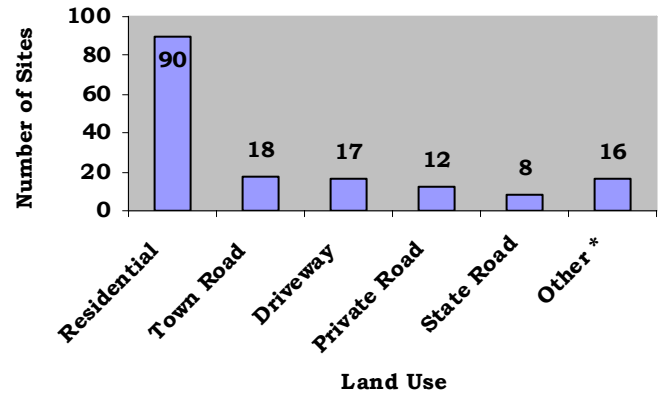
- 90 of the identified sites (57%) were found on residential properties. Most of these sites have a low impact on water quality and will be inexpensive to fix (less than \$500) with little technical expertise required. These tend to be simple fixes that can be done by the landowners themselves.
- 38 of the sites identified (24%) are associated with roads: State, town, and private. These sites tend to have a more severe impact on the lake with higher associated costs (greater than \$2500) and required technical knowledge. Also, the procedures involved with remediating these sites are more time and resource consuming.
- Route 109 poses a serious problem for the lake. This paved road produces a large amount of surface runoff during periods of precipitation. The road is also pitched in such a way as to shed the majority of this runoff towards the lake. Winter sand, road salt, oil and gas, heavy metals, and other pollutants wash off the road and are carried into the lake, creating a water quality hazard. The buffer between the road and the lake is severely limited. In some areas only a few feet separate the two.

Erosion sites were identified all around the watershed and on 8 different types of land uses (see above). As such, everyone has a role to play in lake protection. The Town of Wakefield, waterfront landowners, road associations, and even people living far from the lake can all help reduce lake pollution.

Project Partners:

Lovell Lake Association, Acton Wakefield Watersheds Alliance, NH DES, York County SWCD, Maine DEP, Town of Wakefield

Number of Sites Identified by Land Use



* Other includes: Beach Access (7), Boat Access (4), Commercial (3), and Municipal/Public (2)

NEXT STEPS:

- The information gathered from the watershed survey will be utilized in the creation of a Watershed Based Management Plan for the Headwaters of the Salmon Falls River .
- The Lovell Lake Association will work with the Acton Wakefield Watersheds Alliance to apply for grants to help landowners, road associations, and the town to fix some of the larger erosion problems identified in the survey.
- Letters will be mailed to all landowners with identified erosion problems to encourage them to take action to fix their property and to provide them with access to the necessary resources.
- Landowners of identified sites will have the opportunity to meet with the AWWA Technical Director and receive a site-specific remediation design as well as be considered as a YCC project host.
- Grants will be sought by the LLA and AWWA for assistance with remediation of larger projects.

FOR MORE INFORMATION:

If you would like information about fixing erosion problems on your property or a copy of the Lovell Lake Watershed Survey Report, contact:

Tim Sherrill
President, Lovell Lake Association
tsherrill@andovercos.com



Acton Wakefield Watersheds Alliance
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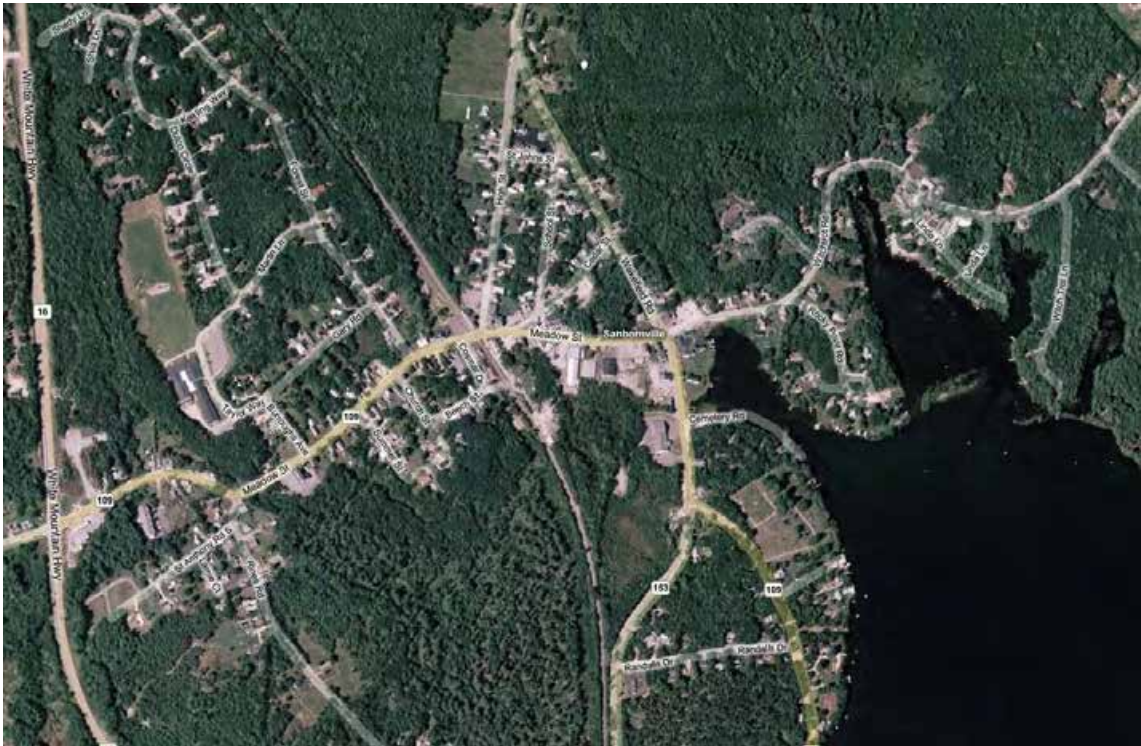


Funding for this project was provided in part by a grant from the NH Department of Environmental Services with funding from the US Environmental Protection Agency under Section 319 of the Clean Water Act

APPENDIX D: Municipal Ordinance Review

Acton Wakefield Watersheds Alliance Municipal Ordinance Review

Linking Development Rules to Water Quality Protection



March 2009



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1. INTRODUCTION

The border region between Acton, Maine and Wakefield, New Hampshire is host to a variety of relatively unspoiled natural resources. In particular, the exceptional water quality of the region's lakes has long been an attraction for people seeking rest, relaxation and recreation. As more people move to the area to enjoy its unique and special character, increasing development will likely place greater stress on lake water quality. This will primarily occur through polluted runoff, which originates from diffuse areas distributed across the landscape and is considered one of the leading threats to water quality in the United States. There are many potential types of activities and land uses that contribute polluted runoff to local water resources. These include construction sites, residential neighborhoods, commercial developments, and farm fields, among many others. Rainfall or snowmelt picks up pollutants – such as bacteria, nutrients and heavy metals – and carries them to nearby surface waters. The unfortunate result is often a decline in water quality.

The important efforts of the Acton Wakefield Watersheds Alliance (AWWA) and other affiliated lake associations have been critical for ensuring the long-term protection of the high quality waters in the AWWA region. However, in the absence of adequate land use controls on development, the potential exists for adverse impacts to the region's valuable water resources. Numerous studies have shown that the extent and type of development can degrade water quality. In particular, increases in **impervious cover** pose significant risks to aquatic ecosystems. Once the level of impervious cover in a developing watershed exceeds 10%, it is usually accompanied by a measureable decrease in water quality (CWP, 1998). Further increases in impervious cover continue this downward trend until it becomes difficult and costly to restore water quality to pre-development levels (Figure 1). The current extent of impervious cover in the AWWA region is less than 5%, well below the 10% threshold at which water quality begins to decline. However, poorly managed development can still have adverse impacts even at low impervious cover levels depending on how and where it occurs.

Impervious cover refers to any surface that will not allow water to soak into the ground. Examples include paved roads and driveways, parking lots and roofs.

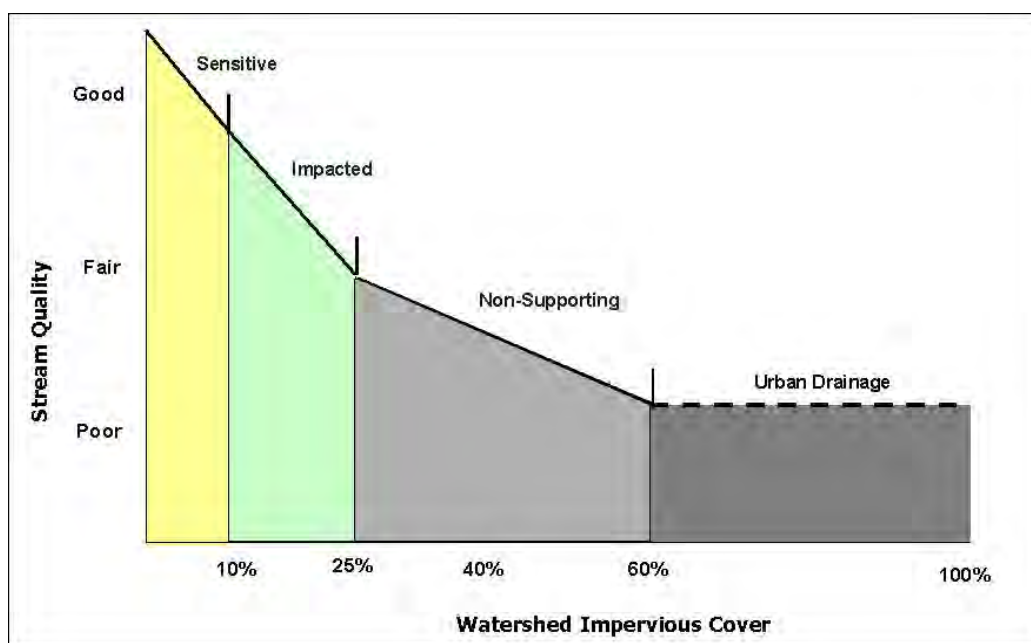


Figure 1. Relationship Between Stream Quality and Watershed Impervious Cover (Source: CWP, 2003).

The AWWA region has experienced considerable population growth over the last several decades (though increases in dwelling units have been more modest). From 1990-2005, Wakefield experienced the largest average annual and overall population growth rates – 3.4% and 56.5%, respectively – of all the communities in Strafford County (NHOEP, 2008). While Acton’s population increase from 1990-2000 was more modest compared to other York County communities (it had 9th highest growth rate of the 29 towns in the county), its average annual and overall growth rates were 2.2% and 24.2%, respectively (SMRPC, 2004). Given the AWWA region’s unique character and desirability as a residential and recreational destination, it is likely significant growth will continue to occur in Wakefield and Acton well into the future. Consequently, both communities should carefully consider the effects of current municipal land use regulations on local water resources.

2. METHODOLOGY

To help ensure that the AWWA region’s water resources continue to be of high quality, FB Environmental conducted a review of municipal land use ordinances for Acton and Wakefield to provide recommendations for how these documents could be better aligned with more sustainable development practices. Acton’s most recent Zoning Ordinance, Subdivision Regulations and Road Ordinance were included in the review as were Wakefield’s most recent Zoning Ordinance, Subdivision Regulations and Site Plan Regulations. The reviews were based on model development principles created by the Center for Watershed Protection (CWP, 1998). These principles promote the reduction of impervious cover, conservation of natural areas, and prevention of stormwater pollution while simultaneously preserving and enhancing the quality of life in local communities. The model principles are grouped into the following three primary types of “habitat” as a means of facilitating comparisons with other municipal land use ordinances:

- Transportation infrastructure (car habitat)
- Residential and commercial development (parcel habitat)
- Open spaces and natural areas (wildlife habitat)

The CWP’s Codes and Ordinance Worksheet (Appendix 1) was used to measure and compare local land use regulations for Acton and Wakefield against model development principles. The results of this comparison are presented below.

3. RESULTS / FINDINGS

The Codes and Ordinance Worksheet consists of 22 model development principles that are further subdivided into 66 site planning benchmarks (Appendix 1). Each benchmark measures a single site design practice and assigns a relative value or score depending on how closely local development regulations conform to the model ordinance. In some cases, determining scores for the ordinances was subject to interpretation since specific ordinance language could not be directly related to the model development principles. Additionally, while not all of the principles are entirely applicable to the rural nature of the AWWA region, they still provide a useful means for identifying opportunities for improving municipal land use regulations.

The highest possible overall score for the Codes and Ordinance Worksheet is 100 and the CWP generally recommends reforming local development rules if the score is less than 80. The overall scores for Acton and Wakefield are 71 and 64, respectively (Table 1, p. 3), suggesting there are considerable opportunities for improvement by both towns. A more detailed discussion of the scoring results for each of the three “habitat” types is provided immediately below. Completed worksheets for both communities are included in Appendix 2.

Table 1. Summary of Codes and Ordinance Worksheet scores for Acton and Wakefield

HABITAT TYPE	CWP Maximum	Acton's Score	Adequate	Needs Improvement	Wakefield's Score	Adequate	Needs Improvement
Transportation Infrastructure	40	21		√	15		√
Residential & Commercial Development	36	26		√	30		√
Open Spaces & Natural Areas	24	24	√		19		√
Totals:	100	71			64		

3.A. Transportation Infrastructure

This section of the worksheet focuses on the regulations specifying the size, shape and construction of roads, driveways and parking lots. The basic premises for optimizing the design of transportation infrastructure so that it does not adversely affect local water quality is to reduce impervious cover and effectively manage stormwater runoff. The maximum number of points allowed for this section is 40, although a few of the development principles are not very applicable to the AWWA region (e.g., queuing streets, mass transit and parking garages). Acton and Wakefield scored 21 and 15, respectively, which indicates considerable opportunity for improvement.

3.B. Residential and Commercial Development

This worksheet section addresses regulations that determine lot size and shape, housing density and overall neighborhood design. All of the development principles in the section are applicable to the AWWA region. As with transportation infrastructure, impervious cover reduction and stormwater management are the primary goals for local water quality protection along with open space preservation and protection. The maximum number of points allowed for this section is 36. Acton and Wakefield scored 26 and 30, respectively, indicating opportunities for improvement for both communities.

3.C. Open Spaces and Natural Areas

The preservation of wildlife habitat is the ultimate aim for this section of the worksheet. It seeks to assess how local land use regulations either promote (or hamper) efforts to protect natural areas and incorporate open spaces into new development projects. The primary means for providing this protection consist of maintaining adequate native vegetated buffers around shoreline and wetland areas, minimizing the extent of soil disturbance for new construction projects and preventing the discharge of untreated stormwater into sensitive aquatic habitats. The maximum number of points allowed for this section is 24. Acton and Wakefield scored 24 and 19, respectively, indicating that Acton's land use regulations are adequately protective of water quality from a natural areas perspective while Wakefield's regulations could benefit from some improvements.

4. RECOMMENDATIONS

The recommendations offered in this section should be viewed as the starting point to reforming municipal development rules as a means of providing improved protection to the AWWA region's water resources. They are intended to inform the public dialogue about which particular rules really need to be changed (or added) since considerable effort will be required to codify any potential changes. More research will likely be needed to determine how proposed changes to local land use rules may affect development costs, property values and public safety, among others.

It will be critical to involve key community members in this dialogue in order to strengthen municipal development rules. This includes participants from local government responsible for implementing land use rules, developers and real estate professionals, environmental groups and citizens, among others. A broad consensus will likely be needed to make any substantial changes and the process needed to achieve this

consensus could benefit from the assistance of an outside facilitator. Such a facilitator can ensure that all perspectives and views are included in the decision making process and can help guide the participants to action.

4.A. Transportation Infrastructure

Acton and Wakefield both scored well below the maximum of 40 points for this section of the Codes and Ordinance Worksheet (21 and 15, respectively). As such, both communities have numerous opportunities to strengthen their municipal development rules for enhanced protection of the AWWA region's water resources. Recommendations for each applicable model development principle are provided below.

Principle 1. Street Width: This development principle consists of two benchmarks, including minimum pavement width (4 points) and an allowance for queuing streets in municipal development rules (3 points). Both communities received 4 points for minimum pavement width since their land use rules allow for street widths of 20' or less. Narrower street widths will reduce the rate of increase in impervious cover for future development projects and thereby decrease potential impacts to local water quality. Neither community has provisions in their land use rules for queuing lanes and therefore received no points for the second benchmark of this design principle.

RECOMMENDATION 1: Acton and Wakefield both allow for minimum street widths of 20' and are therefore in keeping with this design principle. Both communities could consider establishing allowances or requirements for queuing lanes for new development projects (particularly for subdivisions).

Principle 2. Street Length: This development principle is intended to decrease the creation of impervious cover for new development projects and accounts for 1 point in the overall worksheet score. Neither community has provisions in their respective land use rules requiring or promoting the reduction of street lengths for new projects and therefore received no points for this development principle.

RECOMMENDATION 2: Acton and Wakefield should both consider establishing mechanisms that encourage or require the use of shorter street lengths in new development projects as a means of reducing potential impacts to water quality from increases in impervious cover.

Principle 3. Right-of-Way Widths: This development principle consists of two benchmarks, including minimum overall right-of-way width (3 points) and an allowance for the placement of utilities under pavement (1 point). Land use rules for both Acton and Wakefield do not allow for minimum right-of-way widths of 45' or less and therefore received no points for the first benchmark. Both communities do, however, allow for utilities to be placed under pavement and therefore received 1 point for the second benchmark.

RECOMMENDATION 3: Both communities should consider allowing narrower right-of-ways for new development projects. This could be accomplished by allowing for pavement width reductions (Principle 1), sidewalk width reductions, placing sidewalks on only one side of new streets, and by reducing border width requirements between sidewalks and streets. No further action is recommended for utility placement.

Principle 4. Street Cul-de-sac Design: This development principle consists of three benchmarks, including minimum allowable cul-de-sac radius (1 point); allowances for landscaped center islands (1 point); and allowances for alternative turnarounds (1 point). Acton's land use rules allow for a minimum radius of 38' for new cul-de-sacs and therefore earned 1 point for the first benchmark; Wakefield's land use rules exceed the minimum criteria established in the Codes and Ordinance Worksheet and therefore did not receive any

points. Both communities allow the center islands of cul-de-sacs to be landscaped and therefore received 1 point for the second benchmark. Acton allows for alternative turnarounds and therefore received 1 point for the third benchmark; Wakefield does not allow for alternative turnarounds and therefore received no points.

RECOMMENDATION 4: Wakefield should consider allowing for a reduction in cul-de-sac radius as a means of reducing impervious cover for new development projects. It should also consider allowing for alternative turnaround designs. Examples include T-shaped turnarounds, smaller radius turnarounds without center islands and loop roads.

Principle 5. Vegetated Open Channels: This development principle consists of two benchmarks, including curb and gutter requirements (2 points) and swale design criteria (2 points). The underlying premise for this principle is that paved streets generally produce stormwater runoff with higher pollutant loads than runoff from vegetated swales. Acton allows for new developments to be built without curbs and gutters provided the road shoulders will not be prone to erosion as a result. Therefore, it received 1 point for the first benchmark. Wakefield requires all new developments to be built with curbs and gutters and therefore received no points. Acton also has established design criteria for vegetated swales to convey stormwater and therefore received 1 point for the second benchmark. Wakefield has no such criteria and therefore received no points.

RECOMMENDATION 5: Wakefield should consider allowing new developments to be built without curbs or gutters and establishing vegetated swale design criteria for stormwater conveyance.

Principle 6. Parking Ratios: This development principle consists of four benchmarks including, minimum parking ratios for professional office buildings (1 point); minimum parking ratios for shopping centers (1 point); minimum parking requirement for single family homes (1 point); and maximum or median (rather than minimum) parking requirements (2 points). All of these benchmarks are intended to curb the construction of excess parking spaces as a means of minimizing impervious cover for future development projects.

Land use rules for Acton and Wakefield do not meet the minimum office building or shopping center parking ratios (<3 and <4.5, respectively) established by the Codes and Ordinance Worksheet and therefore received no points for either of these benchmarks. Both communities earned 1 point for allowing two or fewer parking spaces for single family homes. Neither community received any points for having maximum or median parking requirements.

RECOMMENDATION 6: When (and if) applicable, both communities should consider reducing parking ratios for professional office buildings and commercial shopping centers. Establishing maximum or median parking ratios (in lieu of minimum ratios) should also be considered by both communities.

Principle 7. Parking Codes: This development principle consists of four benchmarks, including promotion of shared parking areas (1 point); development of model shared parking agreements (1 point); allowance for reduced parking ratios with participation in shared parking agreements (1 point); and parking ratio reduction for connections to mass transit (also 1 point, though not very applicable for AWWA region). As with Principle 6, these practices are intended to minimize the extent of excess parking capacity built for new development projects.

Both communities promote the use of shared parking and therefore received 1 point for the first benchmark. Neither community has allowances for the use of shared parking agreements, reduced parking ratios for participating in shared parking agreements, nor reduced ratios for encouragement of mass transit use (which is not available in the AWWA region). Therefore, neither community received any points for these three benchmarks.

RECOMMENDATION 7: Both communities should consider allowing for shared parking agreements along with reduced parking ratios for participating in these agreements. The viability of mass transit for the AWWA region is questionable given the seasonality of residences and relatively low development densities (not enough commuters available to justify transit service).

Principle 8. Parking Lots: This development principle consists of four benchmarks, including minimum parking stall width (1 point); minimum parking stall length (1 point); percent allocation of parking lot for compact cars (1 point); and allowance for pervious materials for spillover parking areas (2 points). Both Acton and Wakefield earned 1 point for allowing minimum parking stall widths of 9'; however, neither community meets the minimum parking stall length of 18' established by the Codes and Ordinance Worksheet and therefore received no points for the second benchmark. Neither community requires parking lots to have 30% of the spaces set aside for compact cars and therefore received no points for this benchmark. Both communities received 1 point for allowing the use of pervious materials in spillover parking areas.

RECOMMENDATION 8: Both communities should consider reducing the requirements for parking stall length to 18' (or less). Both communities should also consider establishing a requirement for new parking lots to be constructed with 30% of the spaces set aside for compact cars.

Principle 9. Structured Parking: This development principle consists of establishing incentives for the construction of parking garages in lieu of surface parking lots and is not really applicable to the AWWA region given its relatively low development density and scarcity of commercial land uses. Consequently, neither community received the 1 point allowed for this principle.

RECOMMENDATION 9: This development principle does not apply well to the AWWA region and therefore no recommendation is warranted.

Principle 10. Parking Lot Runoff: This development principle consists of two benchmarks, including minimum percentage required for landscaping (2 points); and allowance for the use of stormwater BMPs (2 points). Both communities have provisions for both benchmarks in their land use rules and therefore received 2 points for each component.

RECOMMENDATION 10: Both communities may want to consider specifically promoting the use of Low Impact Development type BMPs for future development projects.

4.B. Residential and Commercial Development

Acton and Wakefield both scored below the maximum of 36 points for this section of the Codes and Ordinance Worksheet (26 and 30, respectively). Therefore, both communities have numerous opportunities to strengthen their development rules for enhanced protection of the AWWA region's water resources. Recommendations for each applicable model design principle are offered below.

Principle 11. Open Space Design: This development principle consists of five benchmarks, including allowance for open space / cluster design (3 points); establishing goals for land conservation and impervious cover reduction (1 point); extent of review requirements for open space design projects relative to conventional projects (1 point); allowance for open space / cluster projects to be a **by-right** form of development (1 point); and availability of flexible site design criteria in utilizing open space / cluster design options (2 points). All of these benchmarks are intended to promote smaller lot sizes as a means of reducing overall impervious cover (and stormwater runoff) for a particular development project. Indeed, one of the primary benefits of open space design relative to conventional development is impervious cover reduction (Figure 2). Additional benefits include decreased construction costs, conservation of natural areas, creation of community recreational space, and enhanced protection of local water resources. Land use rules for both communities address all the benchmarks of this development principle and therefore each received the maximum of 8 points allowed for it.

***By-right** open space development allows an open space plan that meets the requirements of the ordinance to go through the same permit and approval process as a conventional development. The by-right form of development prohibits denial of an open space plan in favor of a conventional plan assuming the open space plan meets the provisions of the ordinance (EPA, 2006).*

RECOMMENDATION 11: While ordinances for both communities allow for the creation of open space / cluster developments, both may want to consider actively promoting the use of open space projects to prospective developers for the numerous benefits they provide. Additionally, both towns may want to consider promoting infill development in their town centers, establishing designated growth areas for cluster development and identifying critical rural zones that limit development.

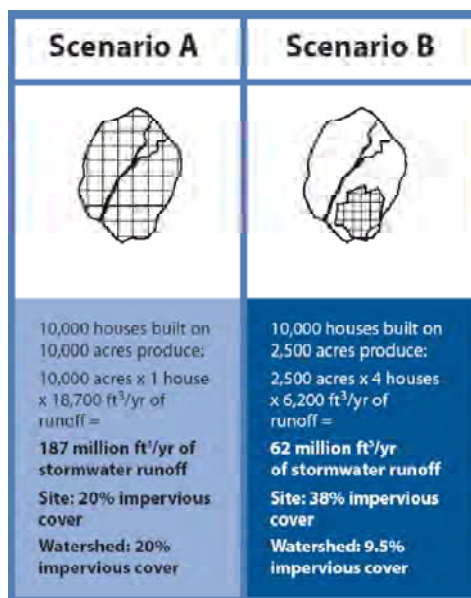


Figure 2. Effects of Development Density on Amounts of Impervious Cover and Stormwater Runoff Volumes (EPA, 2008).

Principle 12. Setbacks and Frontages: This development principle consists of five benchmarks and is primarily intended for developments with small lot sizes (~½ acre). These include an allowance for irregularly shaped lots (1 point); allowance for minimum front setback of 20' or less (1 point); allowance for minimum rear setback of 25' or less (1 point); allowance for minimum side setback of 8' or less (1 point); allowance for minimum frontage distance of less than 80' (2 points). The intent of this principle is to reduce setback distances as a means of decreasing road and driveway lengths in new developments.

Both Acton and Wakefield allow for irregularly shaped lots and each received 1 point for the first benchmark. Wakefield allows for minimum front setbacks of less than 20' and therefore received 1 point for this benchmark whereas Acton has no such allowance and received no points as a result. Both communities allow for minimum rear setbacks of less than 25' and therefore each received 1 point for the third benchmark. Neither community allows for minimum side setbacks of less than 8' and therefore received no points for this benchmark. Wakefield allows for a minimum frontage distance of less than 80' and therefore received 2 points for the final benchmark; Acton has no such allowance and received no points as a result.

RECOMMENDATION 12: Acton should consider allowing for minimum front setbacks of 20' or less, minimum side setbacks of 8' or less and minimum frontage distances of less than 80'. Wakefield should consider allowing for minimum side setbacks of 8' or less.

Principle 13. Sidewalk Design: This development principle consists of four benchmarks, including allowance for minimum width of 4' or less (2 points); allowance to provide sidewalks on only one side of the street (2 points); allowance to slope runoff to adjacent yards (1 point); and allowance for alternate pedestrian networks. The goals of this practice are to reduce the amount of impervious cover and direct stormwater runoff away from street and gutters to the pervious areas in new development projects (1 point).

Wakefield allows for a minimum sidewalk width of 4' or less and therefore received 2 points for the first benchmark; Acton does not allow for sidewalks this narrow and received no points as a result. Both communities allow for sidewalk placement on only one side of the street for new developments and therefore each received 2 points. Neither community has a provision allowing for sidewalks to be sloped to adjacent yards or pervious areas as a means of reducing stormwater runoff to streets or gutters and consequently neither received any points for the third benchmark. Both communities allow for alternate pedestrian networks (trails) and therefore received 1 point for the final benchmark.

RECOMMENDATION 13: Acton should consider allowing new developments to be built with minimum sidewalk widths of 4' or less. Both communities should consider provisions to allow sidewalks to be sloped to adjacent lawns or pervious areas to direct stormwater runoff away from streets or gutters.

Principle 14. Driveway Design: This development principle consists of four benchmarks, including allowance for minimum width of 9' or less (2 points); allowance for use of pervious materials (grass, gravel, porous pavement) for single family home driveways (2 points); allowance for use of "two track" driveway design (1 point); allowance for use of shared driveways in residential developments (1 point).

Neither community allows for driveways to be narrower than 9' and therefore received no points for this benchmark. Both communities allow driveways to be constructed with pervious materials and each received 2 points as a result. Neither community has provisions for the use of a "two track" driveway design.

RECOMMENDATION 14: Both communities should consider allowing driveways for new development or redevelopment projects to be built to a width of 9' or less while also creating provisions for the use of two track driveway designs as a means of reducing impervious cover.

Principle 15. Open Space Management: This development principle consists of five benchmarks, including allowance for establishing associations for the effective management of open spaces (2 points); requirement for consolidation of open spaces into larger units (1 point); requirement for minimum percentage of open space to be managed in natural condition (1 point); established definitions for allowable and prohibited uses for open spaces in residential developments (1 point); and allowance for management of open spaces by third party, land trust or conservation easement (1 point). The intent of this development principle is to ensure that designated open spaces are effectively managed and maintained while retaining as much open space as possible in a natural condition.

Both communities allow for the formation of associations as a means of effectively managing open spaces held in common and therefore both received 2 points for this benchmark. Acton has a requirement for the consolidation of open spaces into larger units and received 1 point for the second benchmark as a result. Wakefield has no such requirement and therefore received no points. Both communities have requirements or provisions for all of the remaining Open Space Management benchmarks and each received 3 points as a result.

RECOMMENDATION 15: Wakefield should consider establishing a requirement for the consolidation of open spaces into larger units as a means of protecting larger blocks of sensitive lands from development and enhancing wildlife habitat.

Principle 16. Rooftop Runoff: This development principle has two benchmarks, including allowance for discharge of rooftop runoff to adjacent yards or pervious areas (2 points); and allowance for site grading or drainage to provide temporary stormwater ponding in yards or on rooftops (2 points). The primary intent of this principle is to reduce the volume and intensity of stormwater runoff to paved areas and piped stormwater conveyance systems. Both communities have provisions in their development rules that allow for stormwater discharge from rooftops to yards or adjacent vegetated areas and temporary stormwater ponding for stormwater runoff reduction. Each town therefore received 4 points for this development principle.

RECOMMENDATION 16: Both communities meet the intent of this development principle. Therefore, no further action is recommended.

***ADDITIONAL RECOMMENDATION:** Phosphorus is one of the most significant limiting nutrients in freshwater ecosystems and can result in unsightly and harmful algal blooms when it reaches excessive levels. Therefore, communities with sensitive or high value water bodies like Acton and Wakefield may want to consider incorporating phosphorus control measures into their local land use rules. There are numerous examples throughout the country that could serve as useful models for the developing similar measures in the AWWA region.

4.C. Open Spaces and Natural Areas

Acton scored the maximum of 24 points allowed for this section of the Codes and Ordinance Worksheet; Wakefield scored 19 of 24 points indicating some opportunities to strengthen development rules for enhanced protection of the AWWA region's water resources. Recommendations for each applicable model design principle are provided below.

Principle 17. Buffer Systems: This development principle consists of three benchmarks, including provisions in land use rules to provide stream buffers within which minimal development occurs (2 points); if such provisions are in effect, buffer requirement of 75' or greater (1 point); and inclusion of expanded buffer for freshwater wetlands, steep slopes or the 100 year floodplain (1 point). The intent of this principle is to provide a variable width naturally vegetated system that provides enhanced protection for adjacent shorelines, wetlands and streams. Acton's land use rules contain provisions for each of these benchmarks and therefore received the maximum allowable score of 4 points. Wakefield's land use rules contain provisions for the first and third benchmarks and therefore received 3 points for this practice.

RECOMMENDATION 17: Wakefield should consider increasing the buffer requirement for all significant local water resources to at least 75'.

Principle 18. Buffer Maintenance: This development principle consists of three benchmarks, including requirements in the land use ordinance to maintain part of the buffer system with native vegetation (2 points); identification of allowable (or prohibited) uses within the buffer area (1 point); and identification of post-construction enforcement and education mechanisms (1 point). The main intent of this principle is to ensure the preservation or restoration of native vegetation throughout the entire development process. Acton's development rules address all of these benchmarks and therefore received a score of 4 points. Wakefield does not have a requirement for the maintenance of native vegetation but does address the second and third benchmarks and therefore received 2 points.

RECOMMENDATION 18: For new or redevelopment projects, Wakefield should consider requiring that a portion of shoreline, wetland and stream buffers consists of native vegetation to provide for enhanced water quality protection.

Principle 19. Clearing and Grading: This development principle consists of two benchmarks, including requirements or encouragement in land use rules for preservation of natural vegetation at residential development sites (2 points); and allowance for reserve septic field areas to remain vegetated until they are needed for future use (1 point). The intent of this principle is to conserve as much of a development site in its natural state as possible thereby retaining most of the natural hydrologic characteristics. Clearing should be generally limited to the immediate area around the building footprint while allowing for construction access and setbacks to provide for adequate safety (Figure 3). Both communities address both benchmarks in their development rules and therefore each received 3 points for this development principle.

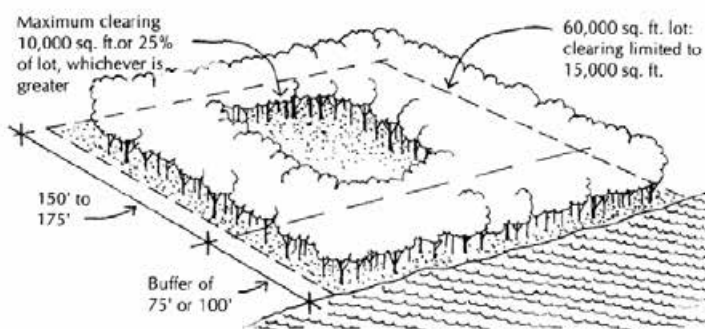


Figure 3. Example of Limits on Clearing for Shoreline Lot (Schueler, 2001 - drawing by Brian Kent)

RECOMMENDATION 19: Both communities meet the intent of this development principle. Therefore, no further action is recommended.

Principle 20. Tree Conservation: This development principle consists of two benchmarks, including requirements to preserve some of the forest or specimen trees at residential development sites (2 points); and requirements to adequately show limits of disturbance on construction plans to prevent clearing of natural vegetation during construction (1 point). As with the previous development principles in this section of the Codes and Ordinance assessment, the intent of this principle is to preserve existing natural vegetation and encourage the use of native plants for revegetation projects. Both communities have provisions in their development rules that address both of these benchmarks and therefore each received 3 points.

RECOMMENDATION 20: Both communities meet the intent of this development principle. Therefore, no further action is recommended.

Principle 21. Land Conservation Incentives: This development principle consists of two benchmarks, including the use of incentives to developers or landowners for the conservation of non-regulated land (2 points); and flexibility for developers to meet regulatory or conservation requirements (2 points). The intent of this development principle is to promote the conservation of vegetated buffers around significant water resources. Both communities provide incentives for land conservation and therefore each received 2 points for this benchmark. Acton allows for some flexibility in its land use rules for developers to meet regulatory or conservation requirements and therefore received 2 points for this benchmark. Wakefield does not allow for this flexibility and received no points as a result.

RECOMMENDATION 21: Wakefield should consider allowing developers some flexibility in meeting regulatory or conservation requirements. Examples include density compensation, buffer averaging, transferable development rights and off-site mitigation, among others.

Principle 22. Stormwater Outfalls: This development principle consists of four benchmarks, including requirements to treat stormwater before discharge to significant water resources (2 points); use of effective design criteria for stormwater BMPs (1 point); prohibition for discharge of untreated stormwater to jurisdictional wetland (1 point); and restriction or prohibition for development within 100 year floodplain (2 points). The intent of this design practice is to prevent the discharge of untreated stormwater to significant water resources (Figure 4). Both communities have provisions in their land use rules for all the benchmarks and therefore received 6 points allowed for this development principle.



Figure 4. A Stormwater Outfall Discharging Untreated Runoff to a Stream (Photo: FB Environmental)

RECOMMENDATION 22: Both communities meet the intent of this development principle. Therefore, no further action is recommended.

5. CONCLUSIONS

Development rules for Acton and Wakefield already have substantial protections in place for the AWWA region's valuable water resources. However, as indicated by the preceding assessment, both communities could benefit from further protections – particularly given the high likelihood that the area will continue to grow well into the future. The quality of the AWWA region's water resources is currently exceptional. Unfortunately, there are far too many examples of previously "clean" lakes in Maine and New Hampshire that have experienced the slow and barely perceptible impacts from surrounding development followed by significant declines in water quality. In conducting a review of municipal ordinances (and developing a Watershed Management Plan), AWWA has taken proactive and meaningful steps to ensure that its lakes do not suffer a similar fate. The information contained in this report should help inform local decision makers on how to effectively manage growth and development so the clarity and beauty of the AWWA region's lakes can be preserved in perpetuity for future generations. Ensuring that municipal staff have the resources needed to provide adequate oversight of development practices under improved land use rules will also be of critical importance.

As of this writing (March 2009), the Town of Acton is reviewing their municipal ordinances and Comprehensive Plan for improvements. These improvements will be incorporated into the local land use regulations and presented to the public for a vote in June 2009. It is hoped that this ordinance review is consistent with and provides support for the efforts currently underway in the Town of Acton.

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Appendix 1: Center for Watershed Protection Code and Ordinance Worksheet


CODE AND ORDINANCE WORKSHEET

About the Adobe Acrobat Form

Note: Acrobat Reader will not save the information entered into a form. Saving changes is only possible with a full version of Acrobat.

- The blue fields indicate that an answer is required.
- The gray fields are for notes and are not required, but highly recommended.
- The green fields will automatically summarize the points – no input is needed here.

To fill out a form:

1. Select the hand tool .
2. Position the pointer inside a form field, and click. The I-beam pointer allows you to type text. If your pointer appears as a pointing finger, you can select an item from a list (i.e., YES or NO).
3. After entering text or making a selection, press Tab to accept the form field change and go to the next or previous field.
4. Once you have filled in the appropriate form fields, do both of the following:
 - Choose File > Export > Form Data to save the form data in a separate FDF file. Type a filename and click save.
 - Print the form so that you have a hard copy for your records.

And Most Importantly...

Send CWP a copy! Let us know how you did!

The Code and Ordinance Worksheet allows an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development occurs in your community. You are guided through a systematic comparison of your local development rules against the model development principles. Institutional frameworks, regulatory structures and incentive programs are included in this review. The worksheet consists of a series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks derived from the model development principles.

The worksheet is intended to guide you through the first two steps of a local site planning roundtable.

Step 1: Find out what the Development Rules are in your community.

Step 2: See how your rules stack up to the Model Development Principles.

The homework done in these first two steps helps to identify which development rules are potential candidates for change.

PREPARING TO COMPLETE THE CODE AND ORDINANCE WORKSHEET

Two tasks need to be performed before you begin in the worksheet. First, you must identify all the development rules that apply in your community. Second, you must identify the local, state, and federal authorities that actually administer or enforce the development rules within your community. Both tasks require a large investment of time. The development process is usually shaped by a complex labyrinth of regulations, criteria, and authorities. A team approach may be helpful. You may wish to enlist the help of a local plan reviewer, land planner, land use attorney, or civil engineer. Their real-world experience with the development process is often very useful in completing the worksheet.

Identify the Development Rules

Gather the key documents that contain the development rules in your community. A list of potential documents to look for is provided in Table 1. Keep in mind that the information you may want on a particular development rule is not always found in code or regulation, and maybe hidden in supporting design manuals, review checklists, guidance document or construction specifications. In most cases, this will require an extensive search. Few communities include all of their rules in a single document. Be prepared to contact state and federal, as well as local agencies to obtain copies of the needed documents.

Table 1: Key Local Documents that will be Needed to Complete the COW
Zoning Ordinance
Subdivision Codes
Street Standards or Road Design Manual
Parking Requirements
Building and Fire Regulations/Standards
Stormwater Management or Drainage Criteria
Buffer or Floodplain Regulations
Environmental Regulations
Tree Protection or Landscaping Ordinance
Erosion and Sediment Control Ordinances
Public Fire Defense Masterplans
Grading Ordinance

Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local agencies or authorities are actually responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable. Table 2 provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, some road design, and stormwater).

USING THE WORKSHEET: HOW DO YOUR RULES STACK UP TO THE MODEL DEVELOPMENT PRINCIPLES?

Completing the Worksheet

Once you have located the documents that outline your development rules and identified the authorities responsible for development in your community, you are ready for the next step. You can now use the worksheet to compare your development rules to the model development principles. The worksheet is presented at the end of this chapter. The worksheet presents seventy-seven site planning benchmarks. The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. You should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule. The questions require either a yes or no response or specific numeric criteria. If your development rule agrees with the site planning benchmark, you are awarded points.

Calculating Your Score

A place is provided on each page of the worksheet to keep track of your running score. In addition, the worksheet is subdivided into three categories:

- Residential Streets and Parking Lots (Principles No. 1 - 10)
- Lot Development (Principles No. 11 - 16)
- Conservation of Natural Areas (Principles No. 17 - 22).

For each category, you are asked to subtotal your score. This **“Time to Assess”** allows you to consider which development rules are most in line with the site planning benchmarks and what rules are potential candidates for change.

The total number of points possible for all of the site planning benchmarks is 100. Your overall score provides a general indication of your community's ability to support environmentally sensitive development. As a general rule, if your overall score is lower than 80, then it may be advisable to systematically reform your local development rules. A score sheet is provided at end of the Code and Ordinance Worksheet to assist you in determining where your community's score places in respect to the Model Development Principles. Once you have completed the worksheet, go back and review your responses. Determine if there are specific areas that need improvement (e.g., development rules that govern road design) or if your development rules are generally pretty good. This review is key to implementation of better development: assessment of your current development rules and identification of impediments to innovative site design. This review also directly leads into the next step: a site planning roundtable process conducted at the local government level. The primary tasks of a local roundtable are to systematically review existing development rules and then determine if changes can or should be made. By providing a much-needed framework for overcoming barriers to better development, the site planning roundtable can serve as an important tool for local change.

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community

Development Responsibility		State/Federal	County	Town
Sets road standards	Agency:			
	Contact Name:			
	Phone No.:			
Review/approves subdivision plans	Agency:			
	Contact Name:			
	Phone No.:			
Establishes zoning ordinances	Agency:			
	Contact Name:			
	Phone No.:			
Establishes subdivision ordinances	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/establishes stormwater management or drainage criteria	Agency:			
	Contact Name:			
	Phone No.:			
Provides fire protection and fire protection code enforcement	Agency:			
	Contact Name:			
	Phone No.:			
Oversees buffer ordinance	Agency:			
	Contact Name:			
	Phone No.:			
Oversees wetland protection	Agency:			
	Contact Name:			
	Phone No.:			
Establishes grading requirements or oversees erosion and sediment control program	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/approves septic systems	Agency:			
	Contact Name:			
	Phone No.:			
Review/approves utility plans (e.g., water and sewer)	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/approves forest conservation/ tree protection plans	Agency:			
	Contact Name:			
	Phone No.:			

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)? _____ feet

If your answer is between **18-22 feet**, give yourself **4 points**

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

YES/ NO

If your answer is **YES**, give yourself **3 points**

Notes on Street Width (include source documentation such as name of document, section and page #):

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Street Length (include source documentation such as name of document, section and page #):

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

_____ feet

If your answer is **less than 45 feet**, give yourself **3 points**

Does the code allow utilities to be placed under the paved section of the ROW?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on ROW Width (include source documentation such as name of document, section and page #):

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

_____ feet

If your answer is **less than 35 feet**, give yourself **3 points**

If your answer is **36 feet to 45 feet**, give yourself **1 point**

Can a landscaped island be created within the cul-de-sac?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

YES/ NO

If your answer is **NO**, give yourself **2 points**

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

_____ spaces

If your answer is **less than 3.0 spaces**, give yourself **1 point**

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

_____ spaces

If your answer is **4.5 spaces or less**, give yourself **1 point**

What is the minimum required parking ratio for single family homes (per home)?

_____ spaces

If your answer is **less than or equal to 2.0 spaces**, give yourself **1 point**

Are your parking requirements set as maximum or median (rather than minimum) requirements?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

7. Parking Codes

Is the use of shared parking arrangements promoted?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Are model shared parking agreements provided?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Are parking ratios reduced if shared parking arrangements are in place?

YES/ NO

If your answer is **YES**, give yourself **1 point**

If mass transit is provided nearby, is the parking ratio reduced?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Parking Codes (include source documentation such as name of document, section and page #):

8. Parking Lots

What is the minimum stall width for a standard parking space?

_____ feet

If your answer is **9 feet or less**, give yourself **1 point**

What is the minimum stall length for a standard parking space?

_____ feet

If your answer is **18 feet or less**, give yourself **1 point**

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Can pervious materials be used for spillover parking areas?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

Time to Assess: Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of **40** points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 ____ + Subtotal Page 6 ____ + Subtotal Page 7 ____ =

0

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

YES/ NO

*If your answer is **YES**, give yourself **3** points*

*If your answer is **NO**, skip to question No. 12*

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

YES/ NO

*If your answer is **YES**, give yourself **1** point*

Are the submittal or review requirements for open space design greater than those for conventional development?

YES/ NO

*If your answer is **NO**, give yourself **1** point*

Is open space or cluster design a by-right form of development?

YES/ NO

*If your answer is **YES**, give yourself **1** point*

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)

YES/ NO

*If your answer is **YES**, give yourself **2** points*

Notes on Open Space Design (include source documentation such as name of document, section and page #):

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

YES/ NO

If your answer is **YES**, give yourself **1 point**

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

_____ feet

If your answer is **20 feet or less**, give yourself **1 point**

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

_____ feet

If your answer is **25 feet or less**, give yourself **1 point**

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

_____ feet

If your answer is **8 feet or less**, give yourself **1 points**

What is the minimum frontage distance for a one half (½) acre residential lot?

_____ feet

If your answer is **less than 80 feet**, give yourself **2 points**

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

_____ feet

If your answer is **4 feet or less**, give yourself **2 points**

Are sidewalks always required on both sides of residential streets?

YES/ NO

If your answer is **NO**, give yourself **2 points**

Are sidewalks generally sloped so they drain to the front yard rather than the street?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Sidewalks (include source documentation such as name of document, section and page #):

14. Driveways

What is the minimum driveway width specified in the community?

_____ feet

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2 points**

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Can a "two track" design be used at single family driveways?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Are shared driveways permitted in residential developments?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Are open space areas required to be consolidated into larger units?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Does a minimum percentage of open space have to be managed in a natural condition?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Are allowable and unallowable uses for open space in residential developments defined?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Can open space be managed by a third party using land trusts or conservation easements?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

Time to Assess: Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 ____ + Subtotal Page 9 ____ + Subtotal Page 10 ____ =

0

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

YES/ NO

If your answer is **YES**, give yourself **2** points

If so, what is the minimum buffer width?

feet

If your answer is **75 feet or more**, give yourself **1** point

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

YES/ NO

If your answer is **YES**, give yourself **1** point

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

YES/ NO

If your answer is **YES**, give yourself **2** points

Does the stream buffer ordinance outline allowable uses?

YES/ NO

If your answer is **YES**, give yourself **1** point

Does the ordinance specify enforcement and education mechanisms?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Do reserve septic field areas need to be cleared of trees at the time of development?

YES/ NO

If your answer is **NO**, give yourself **1 point**

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Are there effective design criteria for stormwater best management practices (BMPs)?

YES/ NO

If your answer is **YES**, give yourself **1 point**

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?

YES/ NO

If your answer is **NO**, give yourself **1 point**

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

YES/ NO

If your answer is **YES**, give yourself **2 points**

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet

Subtotal Page 13

0

Time to Assess: Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 ____ + Subtotal Page 12 ____ + Subtotal Page 13 ____ =

0

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each **Time to Assess**

Principles 1 - 10 (Page 8)

Principles 11 - 16 (Page 11)

Principles 17 - 22 (Page 13)

0

TOTAL

0

SCORING (A total of **100** points are available):

Your Community's Score

90- 100	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 - 89	Your local development rules are pretty good, but could use some tweaking in some areas.
79 - 70	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 - 69	Development rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
less than 60	Your development rules definitely are not environmentally friendly. Serious reform of the development rules is needed.

Appendix 2: Municipal Ordinance Review Results (following pages)

AWWA Region Municipal Ordinance Review - March 2009		Acton, Maine			
		Requirement	Points	Source	Section
Transportation Infrastructure					
1. Street width	Min. pavement width 18-22"	20 ft	4	Road Ordinance	G.1.a
	Queueing streets allowed (N/A?)	No	0	Subdivision Ordinance	10.15.1.A.9.c
2. Street length	Standards promoting length reduction	No	0	Road Ordinance	G.1.a
3. Right-of-way	Min. allowed width less than 45'	50 ft	0	Road Ordinance	G.1.a
	Pavement over utilities allowed	Yes	1	Road Ordinance	G.1.b.2
4. Cul-de-Sacs	Min. radius allowed <35' or 36'-45'	38 ft	1	Subdivision Ordinance	10.15.1.B.2.l
	Landscaped center island allowed	Yes	1		
	Alternative turnarounds allowed	Yes	1	Road Ordinance	G.1.a.2
5. Vegetated open channels	Curb & gutters required for most streets	No	2	Subdivision Ordinance	10.15.1.B.2.h.i
	Established swale design criteria	Yes	2	Zoning Ordinance	5.2.f.6 & 7
6. Parking ratios	Min. for office building (<3 per 1000 sq ft)	>3	0	Zoning Ordinance	5.11.2.h
	Min. for comm. centers (<4.5 per 1000 sq ft)	6	0	Zoning Ordinance	5.11.2.f
	Min. for 1 family homes (2 or less per home)	2	1	Zoning Ordinance	5.11.2.a
	Max. or median space requirement	No	0	Zoning Ordinance	5.11.2
7. Parking codes	Shared parking promoted	Yes	1		
	Model shared parking agreements	No	0		
	Ratios reduced w/shared parking	No	0		
	Ratios reduced w/mass transit (N/A?)	No	0		
8. Parking lots	Min. stall width 9' or less	9 ft	1	Zoning Ordinance	6.6.4.7.6.3
	Min. stall length 18' or less	24 ft	0	Zoning Ordinance	6.6.4.7.6.3
	30% spaces for compact cars	No	0		
	Pervious materials allowed	Yes	2		
9. Structured parking	Incentives for parking garages (N/A?)	No	0	Zoning Ordinance	5.11.4
10. Parking lot runoff	Min. % required to be landscaped	Yes	2	Zoning Ordinance	5.6.2.D
	Allowance for other stormwater BMPs	Yes	2	Zoning Ordinance	5.6.2.D
Residential and Commercial Development					
11. Open space design	Open space/cluster design allowed	Yes	3	Subdivision Ordinance	10.13
	Goal for land conservation / IC reduction	Yes	1		
	Review requirements > conventional dev.	No	1		
	By-right form of development	Yes	1		
	Flexible site design criteria	Yes	2	Subdivision Ordinance	10.13.B.3
12. Setbacks and frontages	Irregular lot shapes allowed	Yes	1	Zoning Ordinance	2.5.3
	Min. front setback 20' or less	75 ft	0	Zoning Ordinance	4.2.5.2.c
	Min. rear setback 25' or less	25 ft	1	Zoning Ordinance	4.2.5.2.c
	Min. side setback 8' or less	25 ft	0	Zoning Ordinance	4.2.5.2.c
	Min. frontage distance 80' or less	250 ft	0	Zoning Ordinance	4.2.5.1
13. Sidewalks	Min. width 4' or less	5 ft	0	Road Ordinance	G.1.a
	Required both sides	No	2	Road Ordinance	G.1.a.4
	Slope runoff to yard	No	0		
	Alternate pedestrian networks allowed	Yes	1		
14. Driveways	Min. width allowed (1 lane=<9'; 2 lanes= <18')	12 to 16 ft	0		
	Use pervious materials allowed	Yes	2	Zoning Ordinance	6.6.4.7.6.2
	Use of "two track" design allowed	No	0		
	Shared driveways allowed	Yes	1		
15. Open space management	Associations for open space management	Yes	2	Subdivision Ordinance	10.6.E.4 & 5
	Requirement for open space consolidation	Yes	1		
	Req. for min. % open space to be natural	Yes	1	Subdivision Ordinance	10.6.B.4
	Allowable uses for open spaces defined	Yes	1	Subdivision Ordinance	10.6.B
	Management by third party allowed	Yes	1	Subdivision Ordinance	10.6.E.2
16. Rooftop runoff	Discharge to yard allowed	Yes	2		
	Temporary yard ponding allowed	Yes	2	Zoning Ordinance	6.6.4.7.8.1
Open Spaces and Natural Areas					
17. Buffer Systems	Stream buffer ordinance	Yes	2	Zoning Ordinance	4.1.2.6
	Min. width 75' or greater	75 ft	1	Zoning Ordinance	4.1.2.7
	Includes wetland, slopes, floodplain	Yes	1		
18. Buffer maintenance	Requirement for retaining native vegetation	Yes	2	Zoning Ordinance	6.6.4.7.9
	Allowable uses defined	Yes	1	Zoning Ordinance	5.16.2
	Enforcement and education specified	Yes	1	Zoning Ordinance	6.6.4.2
19. Clearing and grading	Requirement to preserve natural vegetation	Yes	2	Zoning Ordinance	5.6.2.R & S
	Requirement to clear future septic fields	Yes	1		
20. Tree conservation	Requirement to preserve tree stand	Yes	2	Subdivision Ordinance	10.6.A.3
	Plans required to show conservation	Yes	1	Zoning Ordinance	5.16
21. Land conservation incentives	Non-regulated land conservation incentives	Yes	2		
	Flexible conservation requirements	Yes	2	Subdivision Ordinance	10.6.B.8
22. Stormwater outfalls	Requirement to treat before discharge	Yes	2	Zoning Ordinance	5.17.1
	Effective design criteria for BMPs	Yes	1	Zoning Ordinance	5.2.f.6
	Direct untreated discharge to wetland	No	1	Zoning Ordinance	5.17.1
	100-year floodplain restrictions	No	2	Subdivision Ordinance	1.2.M
		TOTAL:	71		

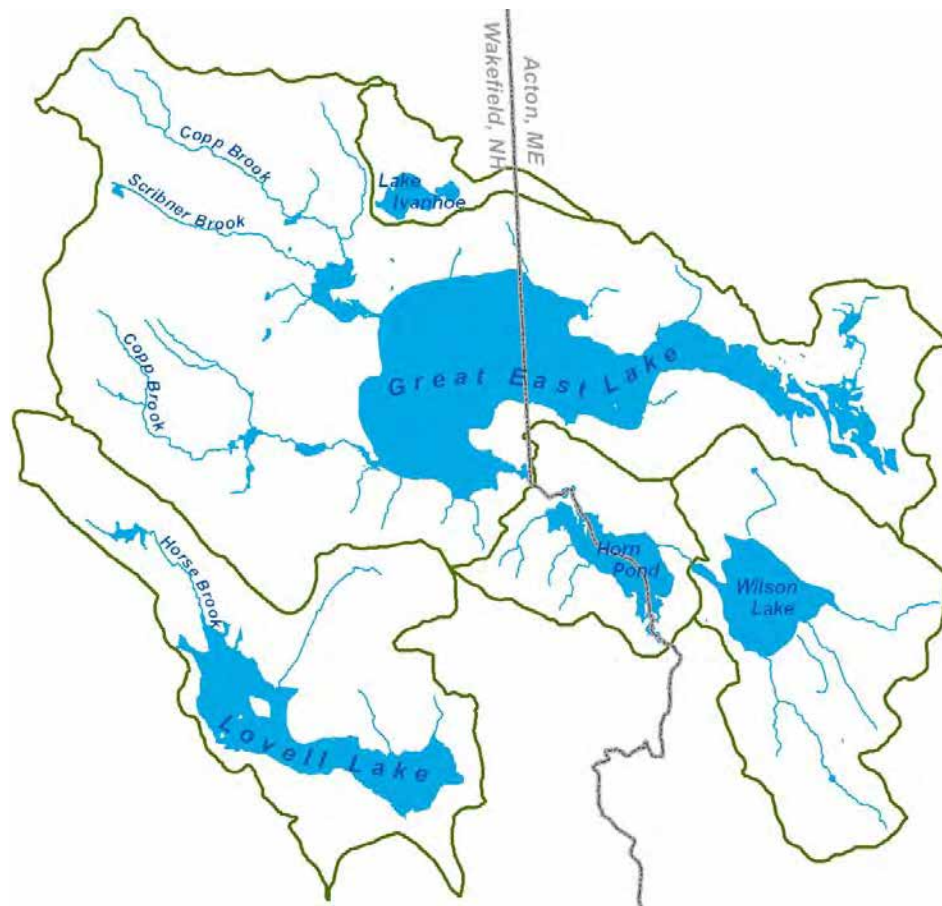
AWWA Region Municipal Ordinance Review - March 2009		Wakefield, New Hampshire			
		Requirement	Points	Source	Section
Transportation Infrastructure					
1. Street width	Min. pavement width 18-22"	20 ft	4		
	Queueing streets allowed (N/A?)	No	0		
2. Street length	Standards promoting length reduction	No	0		
3. Right-of-way	Min. allowed width less than 45'	50 ft	0	Subdivision Ordinance	3.11.B.2
	Pavement over utilities allowed	Yes	1		
4. Cul-de-Sacs	Min. radius allowed <35' or 36'-45'	65 ft	0	Subdivision Ordinance	3.11.B.13
	Landscaped center island allowed	Yes	1	Subdivision Ordinance	3.11.B.14
	Alternative turnarounds allowed	No	0		
5. Vegetated open channels	Curb & gutters required for most streets	Yes	0	CEO	
	Established swale design criteria	No	0	Site Plan Regulations	3.15.c
6. Parking ratios	Min. for office building (<3 per 1000 sq ft)	4 spaces	0	Site Plan Regulations	3.17.B
	Min. for comm. centers (<4.5 per 1000 sq ft)	5 spaces	0		
	Min. for 1 family homes (2 or less per home)	2 spaces	1	Zoning Ordinance	12.C.7
	Max. or median space requirement	No	0		
7. Parking codes	Shared parking promoted	Yes	1	Zoning Ordinance	12.C.4b
	Model shared parking agreements	No	0		
	Ratios reduced w/shared parking	No	0	Site Plan Regulations	3.14.F
	Ratios reduced w/mass transit (N/A?)	No	0		
8. Parking lots	Min. stall width 9' or less	9 ft	1	Site Plan Regulations	3.17.G
	Min. stall length 18' or less	20 ft	0		
	30% spaces for compact cars	No	0		
	Pervious materials allowed	Yes	2	Site Plan Regulations	3.17.N
9. Structured parking	Incentives for parking garages (N/A?)	No	0		
10. Parking lot runoff	Min. % required to be landscaped	Yes	2	Site Plan Regulations	3.19.A.1
	Allowance for other stormwater BMPs	Yes	2	Site Plan Regulations	3.19.A.2
Residential and Commercial Development					
11. Open space design	Open space/cluster design allowed	Yes	3	Zoning Ordinance	12.A
	Goal for land conservation / IC reduction	Yes	1	Zoning Ordinance	12.A.11 & 12
	Review requirements > conventional dev.	No	1	Zoning Ordinance	12.A
	By-right form of development	Yes	1	Zoning Ordinance	12.C.1
	Flexible site design criteria	Yes	2		
12. Setbacks and frontages	Irregular lot shapes allowed	Yes	1	Site Plan Regulations	3.2.3
	Min. front setback 20' or less	20 ft	1	Site Plan Regulations	3.11.B.24
	Min. rear setback 25' or less	10 ft	1	Zoning Ordinance	Table 2
	Min. side setback 8' or less	20 ft	0	Zoning Ordinance	Table 2
	Min. frontage distance 80' or less	75 ft	2	Zoning Ordinance	Table 3
13. Sidewalks	Min. width 4' or less	4 ft	2	Subdivision Ordinance	3.11.A.10.a
	Required both sides	No	2	Subdivision Ordinance	3.11.A.10.a
	Slope runoff to yard	No	0	Subdivision Ordinance	3.11.A.10.a
	Alternate pedestrian networks allowed	Yes	1		
14. Driveways	Min. width allowed (1 lane=<9'; 2 lanes= <18')	12 to 16 ft	0	CEO	
	Use pervious materials allowed	Yes	2	Zoning Ordinance	12.C.4c
	Use of "two track" design allowed	No	0		
	Shared driveways allowed	Yes	1	Zoning Ordinance	12.C.4b
15. Open space management	Associations for open space management	Yes	2	Zoning Ordinance	12.F & 12.G
	Requirement for open space consolidation	No	0	Zoning Ordinance	12.2
	Req. for min. % open space to be natural	Yes	1	Zoning Ordinance	12.C.13
	Allowable uses for open spaces defined	Yes	1	Zoning Ordinance	12.C.13
	Management by third party allowed	Yes	1	Zoning Ordinance	12.C.14
16. Rooftop runoff	Discharge to yard allowed	Yes	2	Subdivision Ordinance	3.13.B & B.4
	Temporary yard ponding allowed	Yes	2	Subdivision Ordinance	3.13.B & B.5
Open Spaces and Natural Areas					
17. Buffer Systems	Stream buffer ordinance	Yes	2	Zoning Ordinance	12.13.c
	Min. width 75' or greater	20 ft	0	Zoning Ordinance	15.A
	Includes wetland, slopes, floodplain	Yes	1	Zoning Ordinance	12.c.13
18. Buffer maintenance	Requirement for retaining native vegetation	No	0		
	Allowable uses defined	Yes	1	Zoning Ordinance	15.A
	Enforcement and education specified	Yes	1	Subdivision Ordinance	2.27.A & B
19. Clearing and grading	Requirement to preserve natural vegetation	Yes	2	Subdivision Ordinance	1.04
	Requirement to clear future septic fields	No	1		
20. Tree conservation	Requirement to preserve tree stand	Yes	2	Subdivision Ordinance	3.20
	Plans required to show conservation	Yes	1		
21. Land conservation incentives	Non-regulated land conservation incentives	Yes	2	Design Standards	3.00
	Flexible conservation requirements	No	0		
22. Stormwater outfalls	Requirement to treat before discharge	Yes	2	Subdivision Ordinance	3.13.B
	Effective design criteria for BMPs	Yes	1	Subdivision Ordinance	3.16.B
	Direct untreated discharge to wetland	No	1		
	100-year floodplain restrictions	Yes	2	Zoning Ordinance	11.H.2.a & H.2.b
		TOTAL:	64		

APPENDIX E: Buildout Analysis

Acton Wakefield Watersheds Alliance

Buildout Analysis

Acton, ME & Wakefield, NH



September 2009

Prepared by:

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- Tricia Rouleau, FB Environmental Associates
- Linda Schier, Acton Wakefield Watersheds Alliance

1. Introduction

FB Environmental (FBE) performed a buildout analysis for the Acton Wakefield Watersheds Alliance (AWWA), within the towns of Acton, Maine and Wakefield, New Hampshire. The high quality waters of the AWWA region form the headwaters of the Salmon Falls River. Waterbodies in the Acton and Wakefield watersheds include Great East Lake, Horn Pond, Lake Ivanhoe, Lovell Lake, Wilson Lake and all their tributaries. The AWWA buildout analysis results provide estimates of the number of potential lots and the number of new units the watershed towns may see developed at some point in the future. Full 'Buildout' refers to the time and circumstances whereby, based on a set of restrictions (e.g. environmental constraints and current zoning), no more building growth may occur, or the point at which lots have been subdivided to the minimum size allowed and there is no more 'developable' land.

Performing a buildout analysis shows a locality what land is available for development, how much development can occur and at what densities. Localities can use the analysis as a snapshot, worse-case scenario tool for planning. The buildout analysis is also a valuable tool to help model potential impacts from future development on water and other natural resources. The Geographic Information System (GIS) based buildout analyses for the Acton and Wakefield watersheds were conducted using ESRI ArcGIS 9.2 and CommunityViz.

What is CommunityViz?

CommunityViz is a GIS-based decision-support tool designed to help planners and resource managers visualize, analyze, and communicate about important land-use decisions. While there are many components to CommunityViz, for the purposes of this study two tools were utilized: The 'Buildout Wizard' was used to calculate the development capacity of the watershed land (numerically and spatially), and the 'Time Scope Analysis' tool was used to visualize how development might occur over time.

Using these tools, this study explores several basic questions about the future of the Acton and Wakefield watersheds:

- How much 'developable land' is there in the watershed?
- How much new development can theoretically occur in the watershed, based on current zoning and other constraints? (*Buildout Analysis*)
- At its current growth rate, how will the watershed's appearance potentially change over time? (*Time Scope Analysis*)

2. Methodology

The AWWA buildout analysis was performed following these general steps:

- 1) Collect information on existing conditions in the watershed: existing buildings, zoning, and growth rates.
- 2) Collect GIS data and development constraints layers.
- 3) Based on constraints layers, determine where development may occur.
- 4) Analyze watershed buildout potential using Buildout Wizard.
- 5) Determine how development might occur over time using the Time scope Analysis tool.
- 6) Present results in tables and maps.

Existing Conditions

Existing Buildings

The location and number of existing buildings in the Wakefield watershed area was determined using high resolution digital orthophotographs produced from aerial photos collected in the spring of 2003 by the National Agriculture Imagery Program (NAIP), and downloaded from New Hampshire's Statewide Geographic Information System Clearinghouse, NH GRANIT. Aerials from the websites <http://maps.live.com> and <http://earth.google.com/> were then used to pinpoint more recent development in the AWWA watershed. Using these images, a new GIS layer was created, with a point representing each existing building (700 buildings total). A determination of existing buildings in the entire Town of Acton was conducted by the Southern Maine Regional Planning Commission (SMRC) using similar methods. FBE utilized the resulting GIS layer to determine the number of existing buildings within the watersheds of interest in the Town of Acton (617 buildings total).

Zoning

Crucial to a buildout analysis is the feasibility of modeling zoning requirements. Certain zoning requirements are too site-specific to be able to incorporate into the analysis. With that in mind, this analysis made use of the following caveats in the determination of buildout zoning restrictions:

- Future lots will be made the smallest size allowable for the zoning district, taking into account minimum lot size and minimum buildable area.
- Potential unit types are not specified.
- Road and shoreland frontage requirements are not specified.

Zoning information utilized in the AWWA buildout analysis is shown below in Table 1. This information represents restrictions that apply only in the sections of each town that fall within the watershed boundary. In addition to the zoning restrictions listed below, each watershed town also follows the minimum Shoreland Zoning restrictions required in Maine and New Hampshire (see 'Development Constraints' below)

Table 1: Acton and Wakefield Watershed Zoning Restrictions

<u>Zone</u>	<u>Building Setbacks</u>	<u>Road Setbacks</u>	<u>Min. Lot Size</u>	<u>Lot Coverage</u>	<u>Right-of-Ways</u>	<u>Building Size Restrictions</u>
ACTON						
Commercial C	side – 50 ft, rear – 50 ft	75 ft	3 ac	Max 20% (Residential Uses)	50 ft	NA
Village	side – 25 ft, rear – 25 ft	75 ft	2 ac (< 2 ac with approval)	Max 20% (Residential Uses)	50 ft	NA
Transitional	side – 25 ft, rear – 25 ft	75 ft	2 ac	Max 20% (Residential Uses)	50 ft	NA
Rural	side – 25 ft, rear – 25 ft	75 ft	3 ac	Max 20% (Residential Uses)	50 ft	NA
Critical Rural	side – 25 ft, rear – 25 ft	75 ft	5 ac	Max 20% (Residential Uses)	50 ft	NA
WAKEFIELD						
Residential I	side – 20 ft, rear – 10 ft	20 ft	1 ac	NA	50 ft	Min. Living Area - 1,150 ft ² , Max. Height – 35 ft
Residential II	side – 20 ft, rear – 10 ft	20 ft	1 ac	NA	50 ft	Min. Living Area - 1,150 ft ² , Max. Height – 35 ft
Residential III – Rural	side – 50 ft, rear – 10 ft	50 ft	3 ac	NA	50 ft	Min. Living Area - 1,150 ft ² , Max. Height – 35 ft
Business & Commercial	side – 20 ft, rear – 10 ft	20 ft	20,000 ft ²	NA	50 ft	Max. Height – 35 ft
Village/ Residential	side – 20 ft, rear – 10 ft	20 ft	20,000 ft ²	NA	50 ft	Min. Living Area - 1,150 ft ² , Max. Height – 35 ft
Agricultural	side – 20 ft, rear – 15 ft	50 ft	5 ac	NA	50 ft	Min. Living Area - 1,150 ft ² , Max. Height – 35 ft

Population Growth Rates

The AWWA region has experienced considerable population growth over the last several decades (though increases in dwelling units have been more modest). From 1990-2005, Wakefield experienced the largest average annual and overall population growth rates – 3.4% and 56.5%, respectively – of all the communities in Strafford County (NHOEP, 2008). While Acton's population increase from 1990-2000 was more modest compared to other York County communities (it had 9th highest growth rate of the 29 towns in the county), its average annual and overall growth rates were 2.2% and 24.2%, respectively (SMRPC, 2004). Given the AWWA region's unique character and desirability as a residential and recreational destination, it is likely significant growth will continue to occur in Wakefield and Acton well into the future. Consequently, both communities should carefully consider

the effects of current municipal land use regulations on local water resources. The annual growth estimates presented above (3.4% for Wakefield and 2.2% for Acton) were used in the Time Scope Analysis (p. 10).

Development Constraints

Constraints to development in a buildout analysis are those areas that are considered undevelopable, or areas where no future buildings may be built. To determine where development may occur in the watershed, buildout calculations deduct land due to physical constraints to development including environmental restrictions (e.g. soils, slopes, wetlands), zoning restrictions (e.g. shoreland zoning, street ROWs and building setbacks), and practical design considerations (e.g. lot layout inefficiencies). Existing buildings may also reduce the available capacity for new development.

Below is a list of GIS data used to model development constraints in the Acton and Wakefield watersheds:

- 1) Conservation Land
- 2) Steep slopes (>20%)
- 3) NWI wetlands
- 4) Existing buildings
- 5) Hydric soils
- 6) Highly erodible soils
- 7) Street ROW (50 ft.)
- 8) Unbuildable parcels (*parcels with an existing building and less than double the minimum lot size (i.e. lots that cannot be subdivided)*)
- 9) Shoreland zoning:
 - a. *Resource Protection restrictions –*
 - i. Acton Only: Areas within 250 feet of the upland edge of freshwater wetlands, salt marshes and salt meadows, and wetlands associated with great ponds and rivers, which are rated "moderate" or "high" value waterfowl and wading bird habitat, including nesting and feeding areas. (*ME Office of GIS "shorezone_iwwh" layer*)
 - ii. Both Towns: 100 year floodplain as designated on the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps or Flood Hazard Boundary Maps. (*ME Office of GIS "FIRM" layer*)
 - iii. Acton Only: Areas of 2 or more contiguous acres with sustained slopes of 20% or greater. (*This does not apply within the Acton shoreland zone, but steep slopes in the rest of the watershed were used as a constraint layer (#2.)*)
 - b. *Building setbacks outside of the Resource Protection Zone –*
 - i. Acton Only: 100 feet from the normal high-water line of great ponds classified GPA and rivers that flow to great ponds classified GPA, and 75 feet from the normal high-water line of other water bodies, tributary streams, or the upland edge of a wetland. (*75 foot buffer around all streams and wetlands, and 100 foot buffer around great ponds and associated rivers.*)

- ii. Wakefield Only: 50 feet from the normal high-water line of waterbodies, and 30 feet from the upland edge of a wetland. *(50 foot buffer around all waterbodies, and 30 foot buffer around wetlands.)*

Buildout Assumptions

To determine how many units can be built on the available buildable land in the watershed, various density and other design factors are considered, based on the zoning requirements for each town. The assumptions specified below refer to methods used in the Wakefield portion of the buildout analysis. A separate buildout for Town of Acton was completed by the Southern Maine Regional Planning Commission (SMRPC), using similar methods based on the zoning restrictions outlined in Table 1 above. FB Environmental utilized the results of the SMRPC analysis to extrapolate results for the Acton portion of the AWWA watershed. For simplification purposes, some assumptions used in the analysis, such as road setbacks and street right-of-ways (ROWS) are based on the average requirements for all zones in the town. The minimum lot size requirements are based on each zone's specific requirements.

- **Building setbacks** were estimated based on the average front and rear setback specified in Wakefield's zoning ordinance (15 feet between structures). Setbacks are measured from building center points in Community Viz. To account for this, building footprints need to be estimated to avoid building overlap. The dimensions of the minimum building footprint, roughly based on Wakefield zoning rules, were estimated to be 30 feet x 30 feet. This number was then divided by two (15 feet), and the "Minimum Separation Distance" used in Community Viz was 30 feet ($15 + 15 = 30$) (Lingeman & Bradt, 2008).
- **Minimum lot size requirements** used were based on requirements for each zone, as specified in Table 1.
- **Street ROWs** were estimated to be 50 feet, based on zoning requirements. A 15 foot building footprint factor was then added. Therefore, the total ROW entered into CommunityViz was 65 feet.
- **Efficiency factors** adjust density values to reflect common density losses. They are entered as a percentage where 100% means complete efficiency (no density lost), and 0% means no buildings will be estimated for that land-use. In the AWWA buildout, an 80% EF was used, based on recommendations in the CommunityViz manual (Placeways, LLC, 2007).

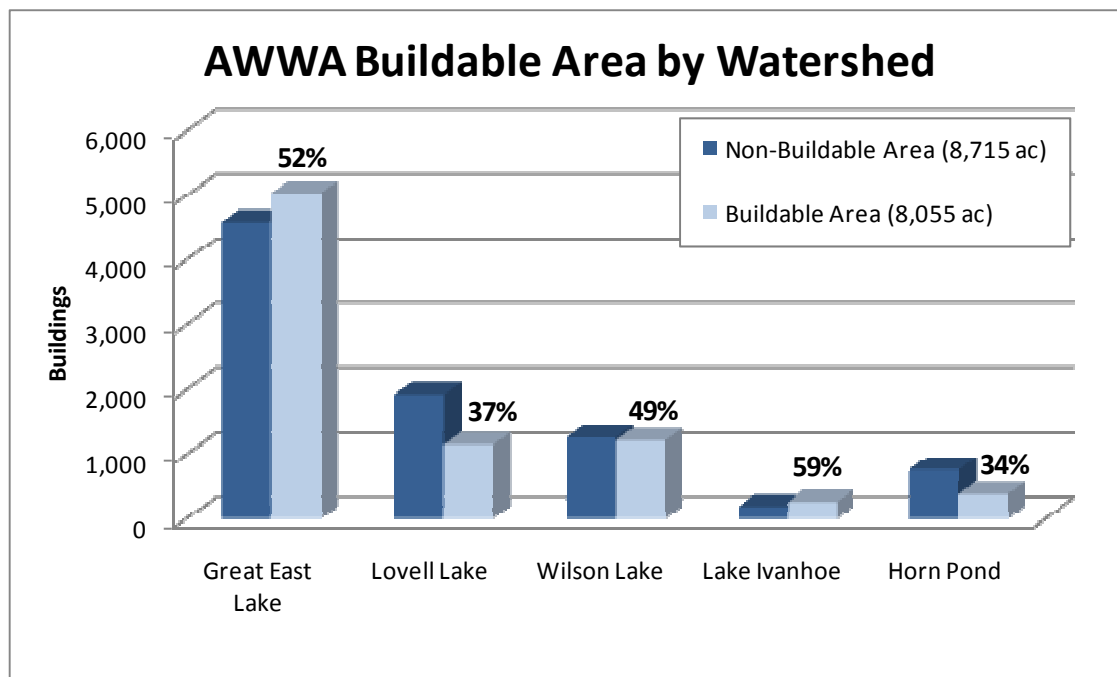
3. Acton and Wakefield Watersheds Buildout Results

Buildout Results

Table 2: Acton and Wakefield Buildable Area by Watershed

Watershed	Total Area (acres)	Buildable Area (acres)	Percent Buildable Area
ACTON			
Great East Lake	2,799	937	33%
Horn Pond	555	213	38%
Lake Ivanhoe	49	41	84%
Wilson Lake	2,479	1,216	49%
<i>Acton Totals</i>	<i>5,882</i>	<i>2,407</i>	<i>41%</i>
WAKEFIELD			
Great East Lake	6,821	4,101	60%
Horn Pond	584	169	29%
Lake Ivanhoe	407	227	56%
Lovell Lake	3,076	1,151	37%
<i>Wakefield Totals</i>	<i>10,888</i>	<i>5,648</i>	<i>52%</i>
Grand Totals	16,770	8,055	48%

Figure 1: Acton and Wakefield Buildable vs. Non-Buildable Area by Watershed



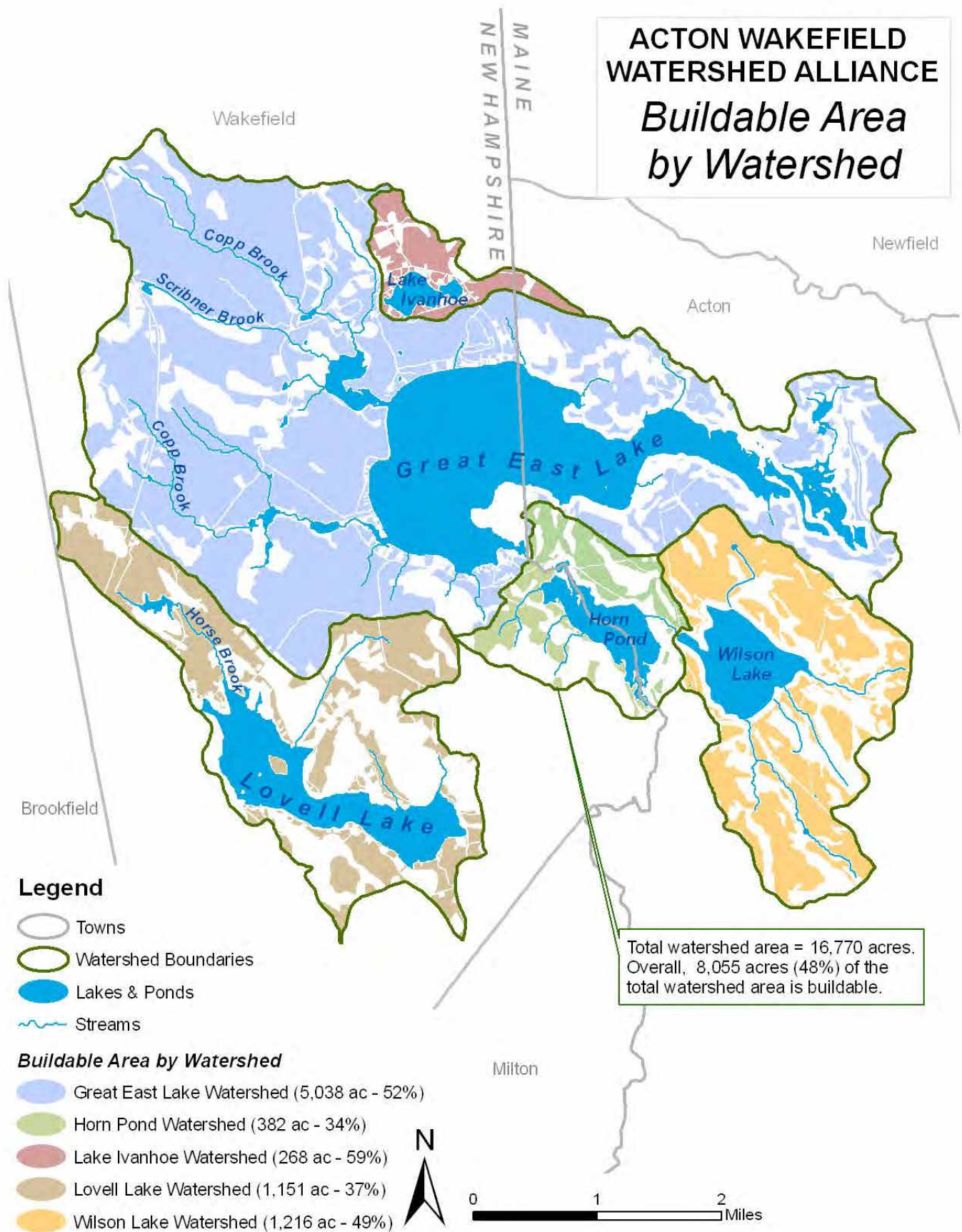


Figure 2: Acton and Wakefield Watersheds Buildable Area Map

Table 3: Acton and Wakefield Full Buildout Results, by Watershed

Watershed	Buildout Units	Existing Units	Total
ACTON			
Great East Lake	218	338	556
Horn Pond	53	93	146
Lake Ivanhoe	12	2	14
Wilson Lake	365	184	549
<i>Acton Totals</i>	<i>648</i>	<i>617</i>	<i>1265</i>
WAKEFIELD			
Great East Lake	1,347	327	1,674
Horn Pond	86	17	103
Lake Ivanhoe	197	55	252
Lovell Lake	644	301	945
<i>Wakefield Totals</i>	<i>2,274</i>	<i>700</i>	<i>2974</i>
Grand Totals	2,922	1,317	4,239

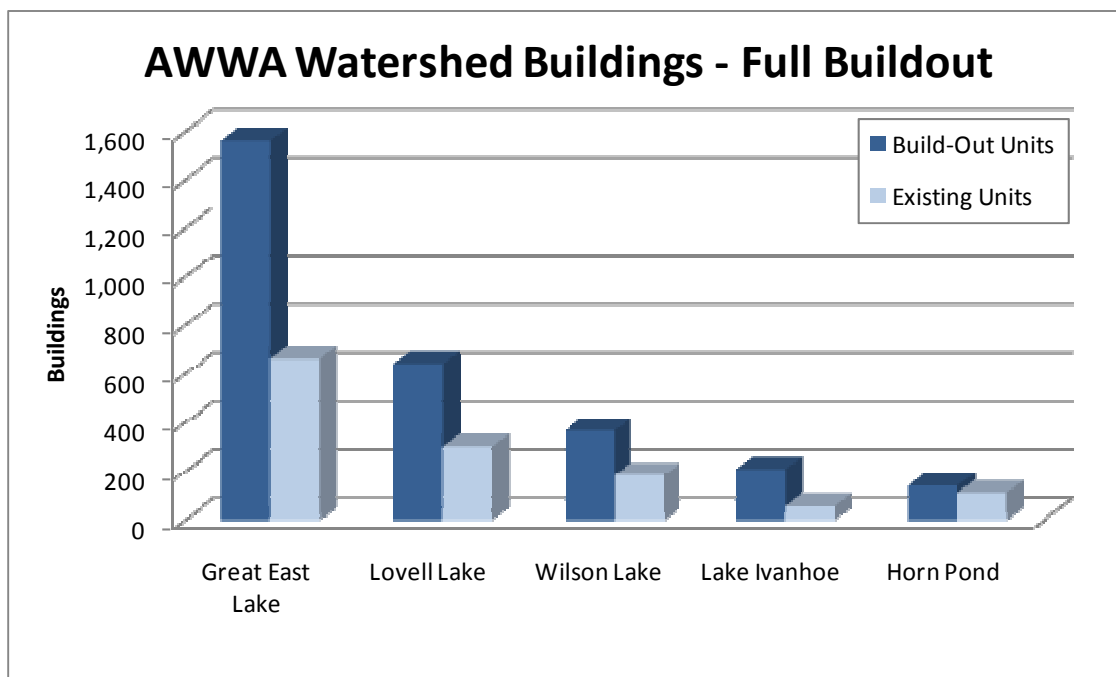
Figure 3: Acton and Wakefield Full Buildout Results, by Watershed

Table 4: Acton and Wakefield Full Buildout Results, by Zoning District

Zoning District	Buildout Units
ACTON	
Commercial C	6
Critical Rural	41
Rural	588
Transition	11
Village	2
<i>Existing Buildings</i>	<i>617</i>
<i>Acton Totals</i>	<i>1,265</i>
WAKEFIELD	
Business & Commercial	116
Residential I	145
Residential II	661
Residential III - Rural	956
Village	16
Agricultural	356
Historic	24
<i>Existing Buildings</i>	<i>700</i>
<i>Wakefield Totals</i>	<i>2,974</i>
Grand Totals	4,239

Discussion

Based on the development restraints and zoning requirements outlined earlier, there are an estimated 4,152 acres of developable land in the AWWA watershed (25% of the total watershed area). Buildout results estimate that this developable area, under current zoning, can accommodate an additional 4,239 buildings, or approximately 200% more than the current number of existing buildings in the watershed. At full buildout, population would increase by over 9,000 people, residential water use would increase by over 500 million gallons per year, and residential energy use would increase by over 400,000 BTUs per year (based on a CommunityViz 'Common Impacts' analysis).

Although the exact amount of additional development may vary based on the amount of land protected as open space, zoning and other regulations, and socioeconomic factors, the buildout analysis indicates that significant additional development could occur in the watershed. This buildout analysis reinforces the idea that comprehensive watershed scale planning is needed to address future development impacts.

Time scope Analysis Results

The time scope analysis estimates are based on a projected per-year population growth rate of 2.2% for Acton and 3.4% for Wakefield (p. 3). (This information is based on currently available projections, but long-term growth

rates may vary.) If this growth rate remains consistent, which may be unlikely, full buildout would not occur watershed-wide until the year 2054. On an individual town basis, full buildout in the Town of Acton will occur in 2041 (Table 5), and in 2054 in the Town of Wakefield (Table 6). The analysis assumes development will occur on parcels closest to existing roads first. (Note: An additional 20 buildings were added at the start of the analysis to help account for any houses that may have been missed in the existing buildings count.)

Table 5: Time-Scope Analysis Results for the Town of Acton (assuming a 2.2% annual growth rate)

Buildout Date	Total New Buildings	Total Buildings (Incl. Existing)
2015	99	716
2020	182	799
2025	275	892
2030	379	996
2035	495	1,112
2040	624	1,241
2041	648	1,265

Table 6: Time-Scope Analysis Results for the Town of Wakefield (assuming a 3.4% annual growth rate)

Buildout Date	Total New Buildings	Total Buildings (Incl. Existing)
2015	164	864
2020	319	1,019
2025	501	1,201
2030	717	1,417
2035	973	1,673
2040	1,273	1,973
2045	1,630	2,330
2050	2,051	2,751
2054	2,274	2,974

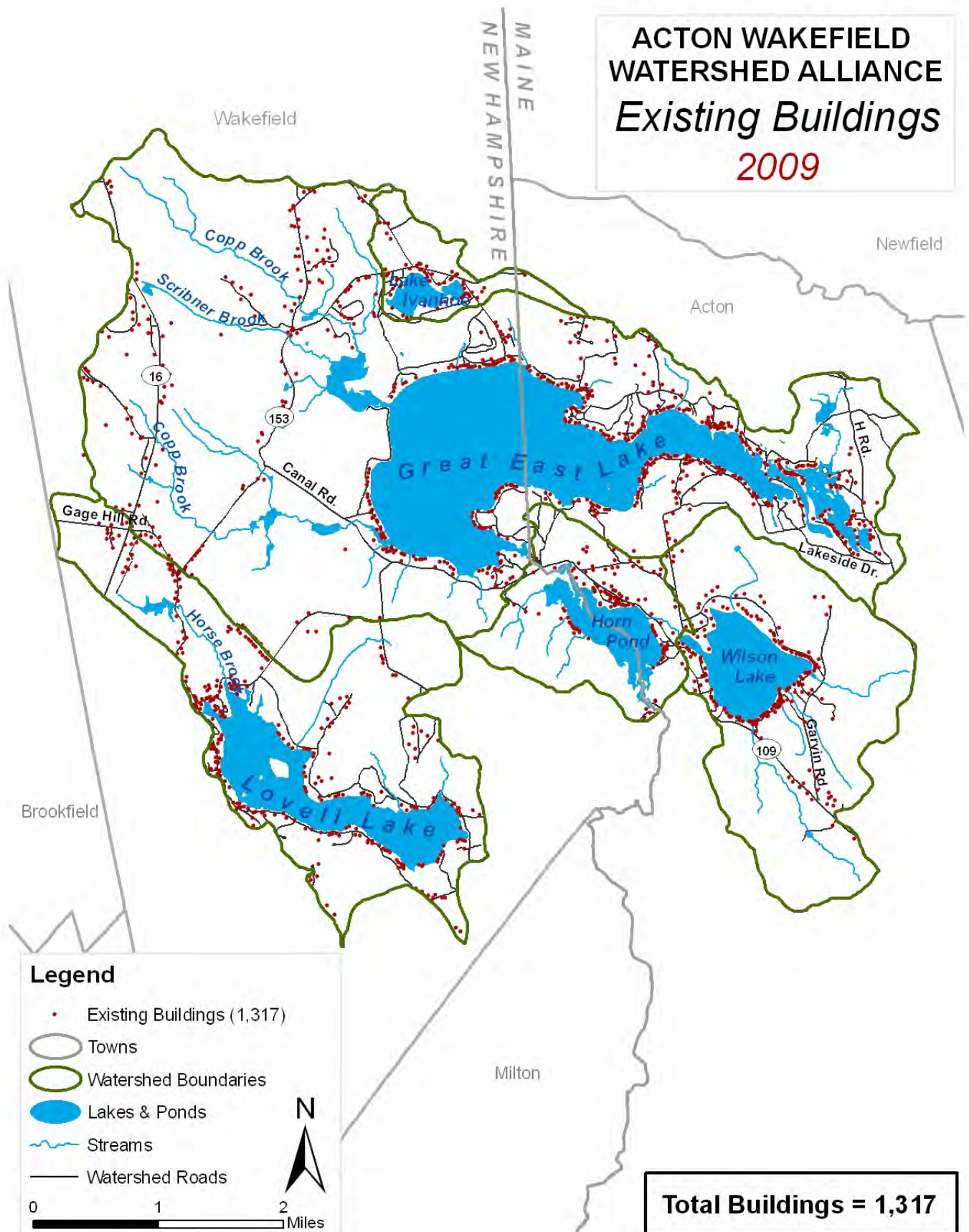


Figure 4: AWWA Existing Buildings Map

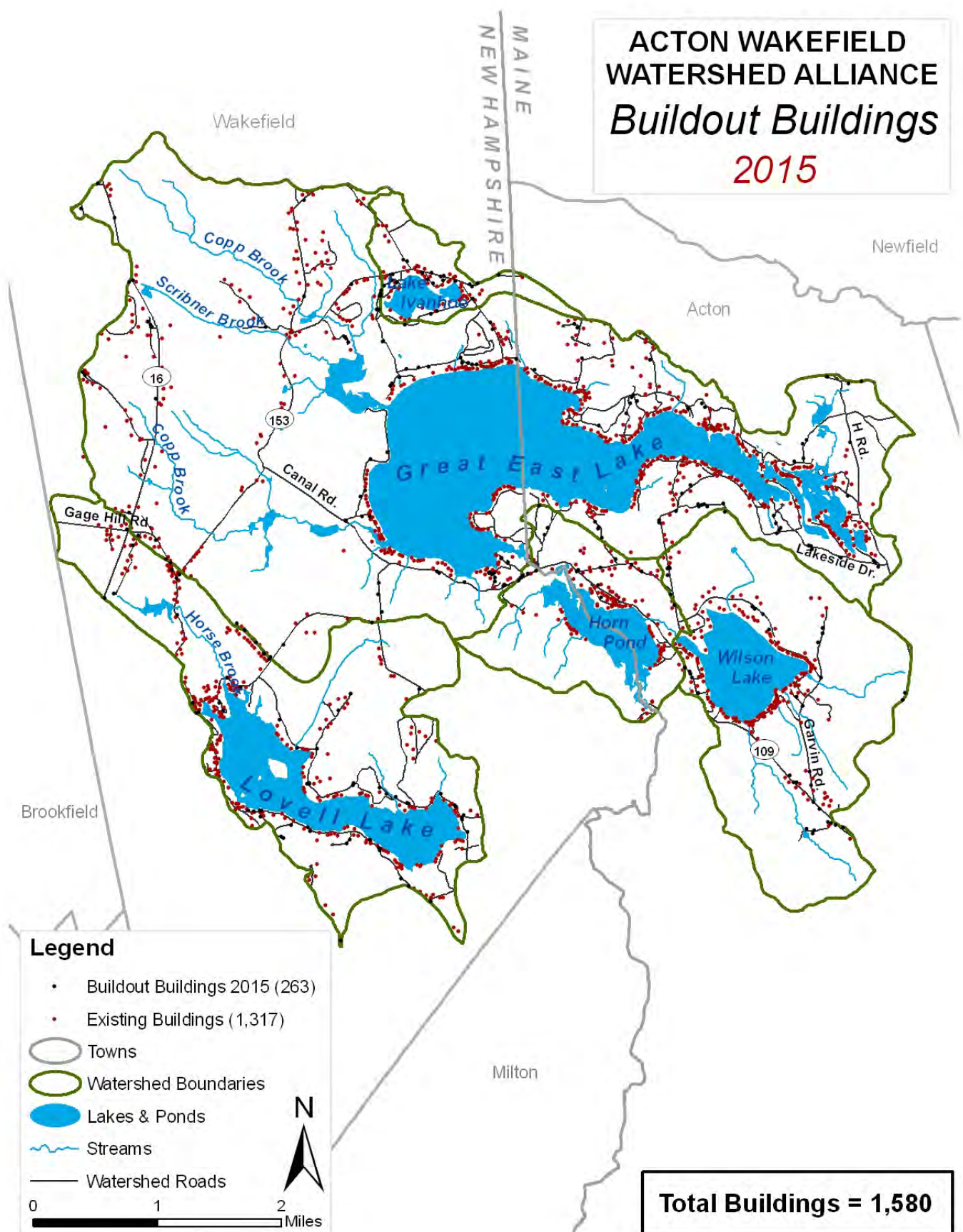


Figure 5: AWWA Buildout Year 2015 Map

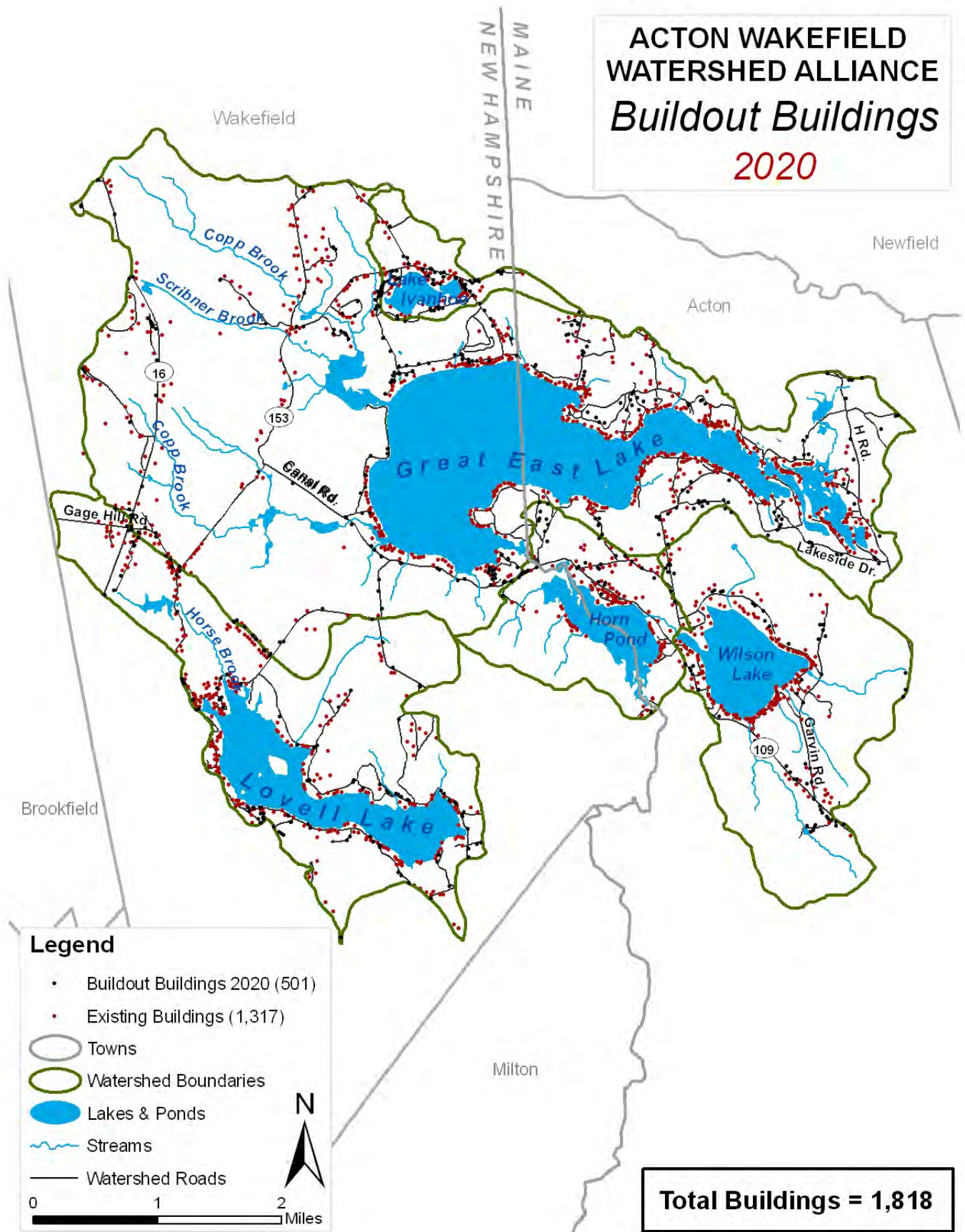


Figure 6: AWWA Buildout Year 2020 Map

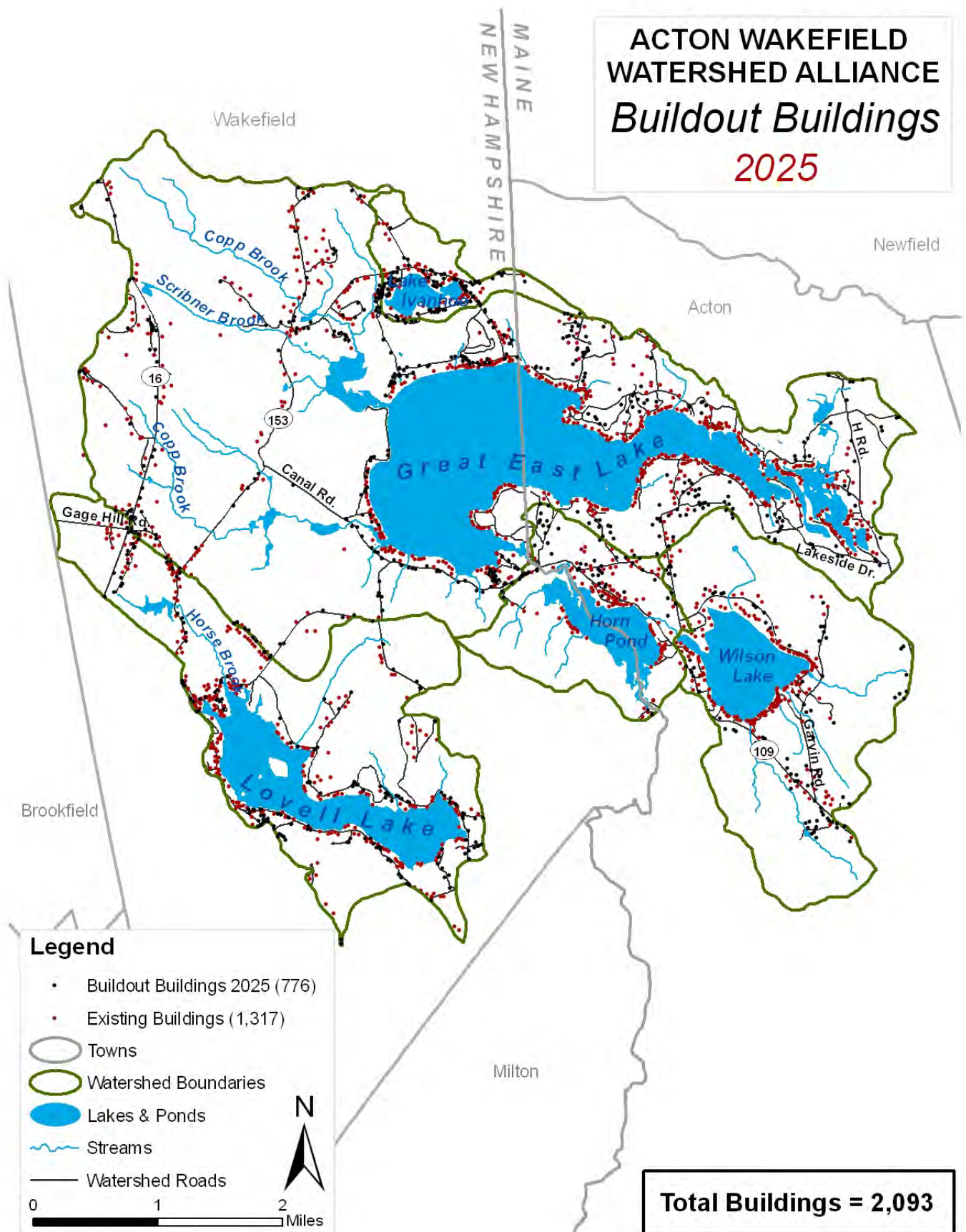


Figure 7: AWWA Buildout Year 2025 Map

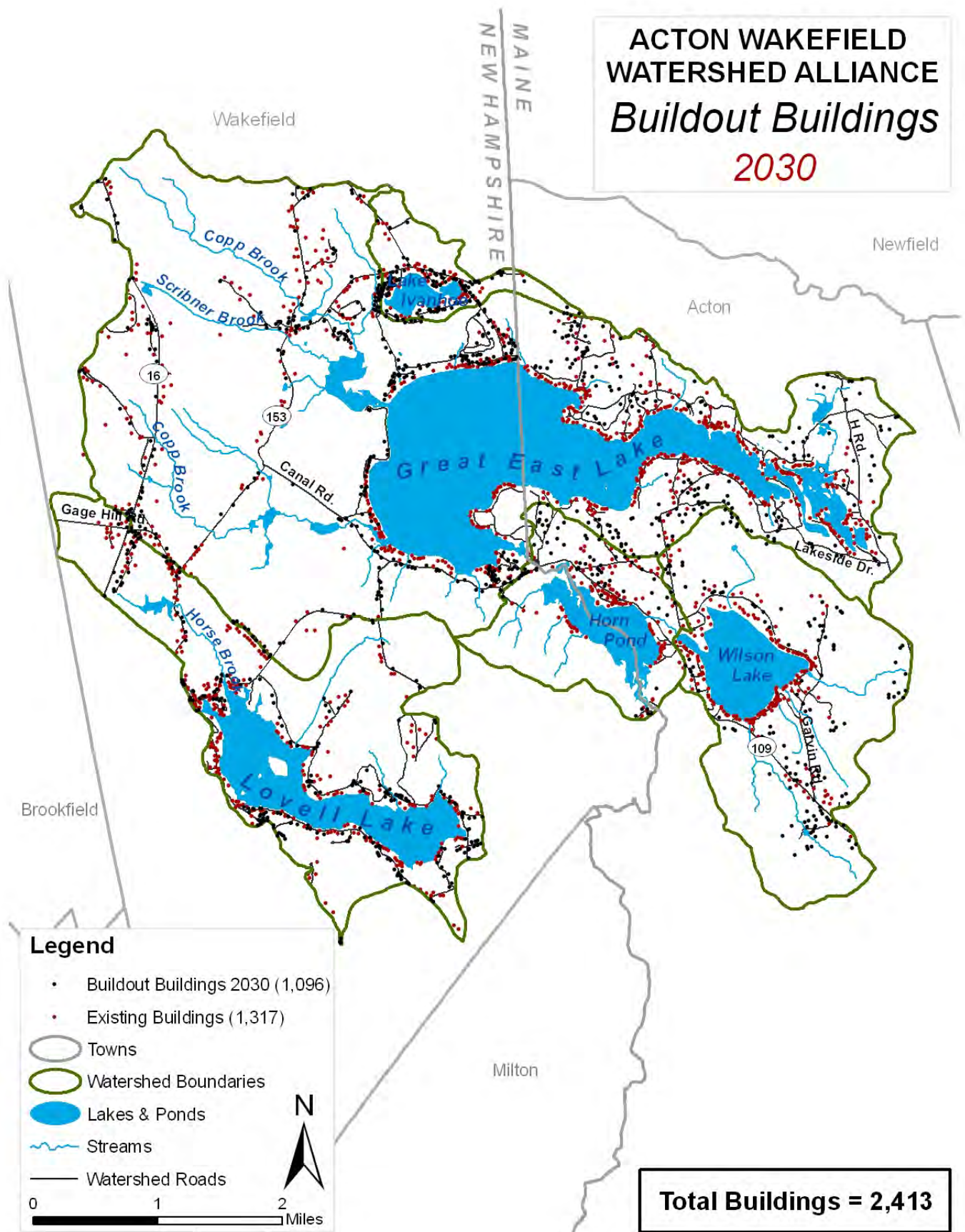


Figure 8: AWWA Buildout Year 2030 Map

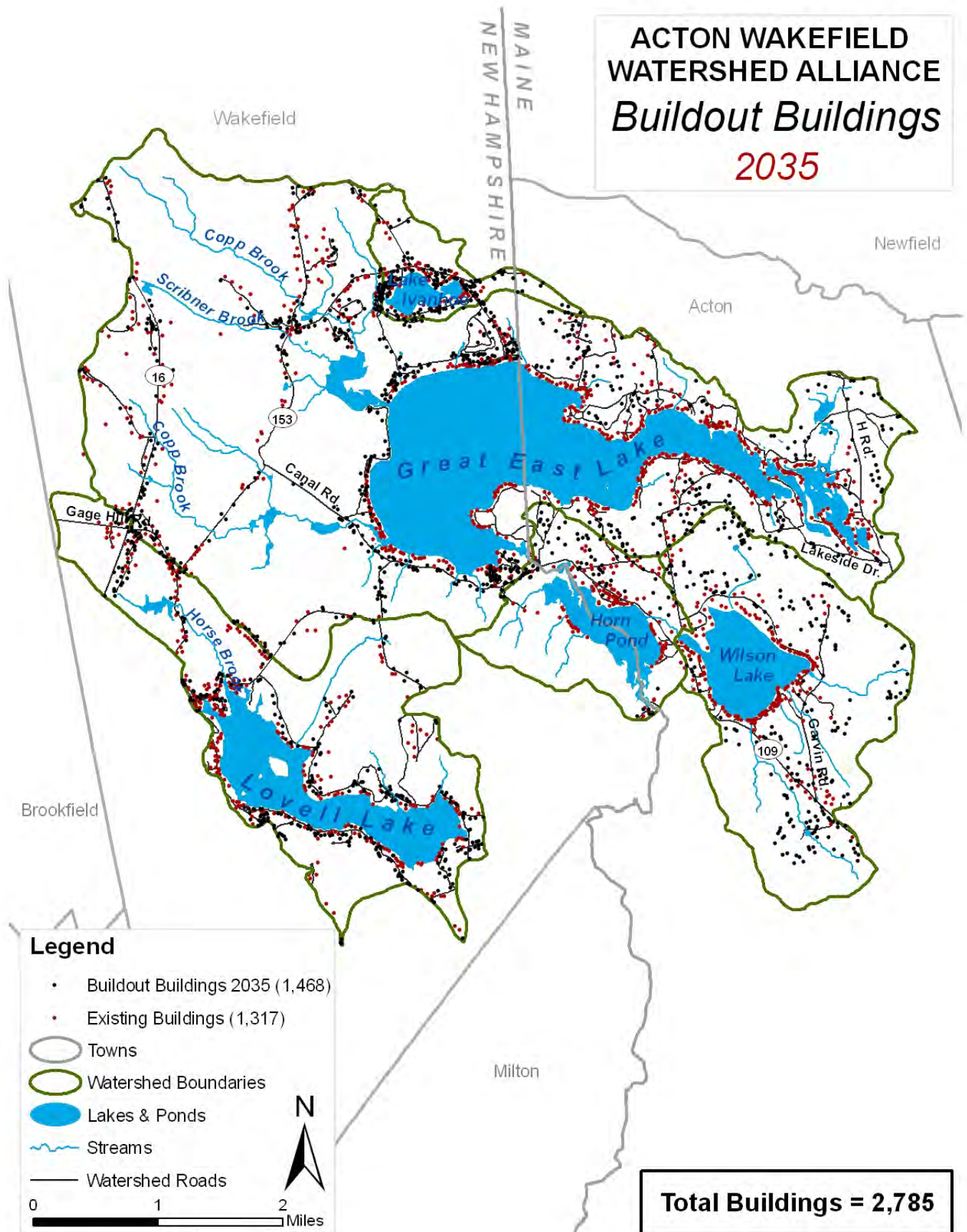


Figure 9: AWWA Buildout Year 2035 Map.

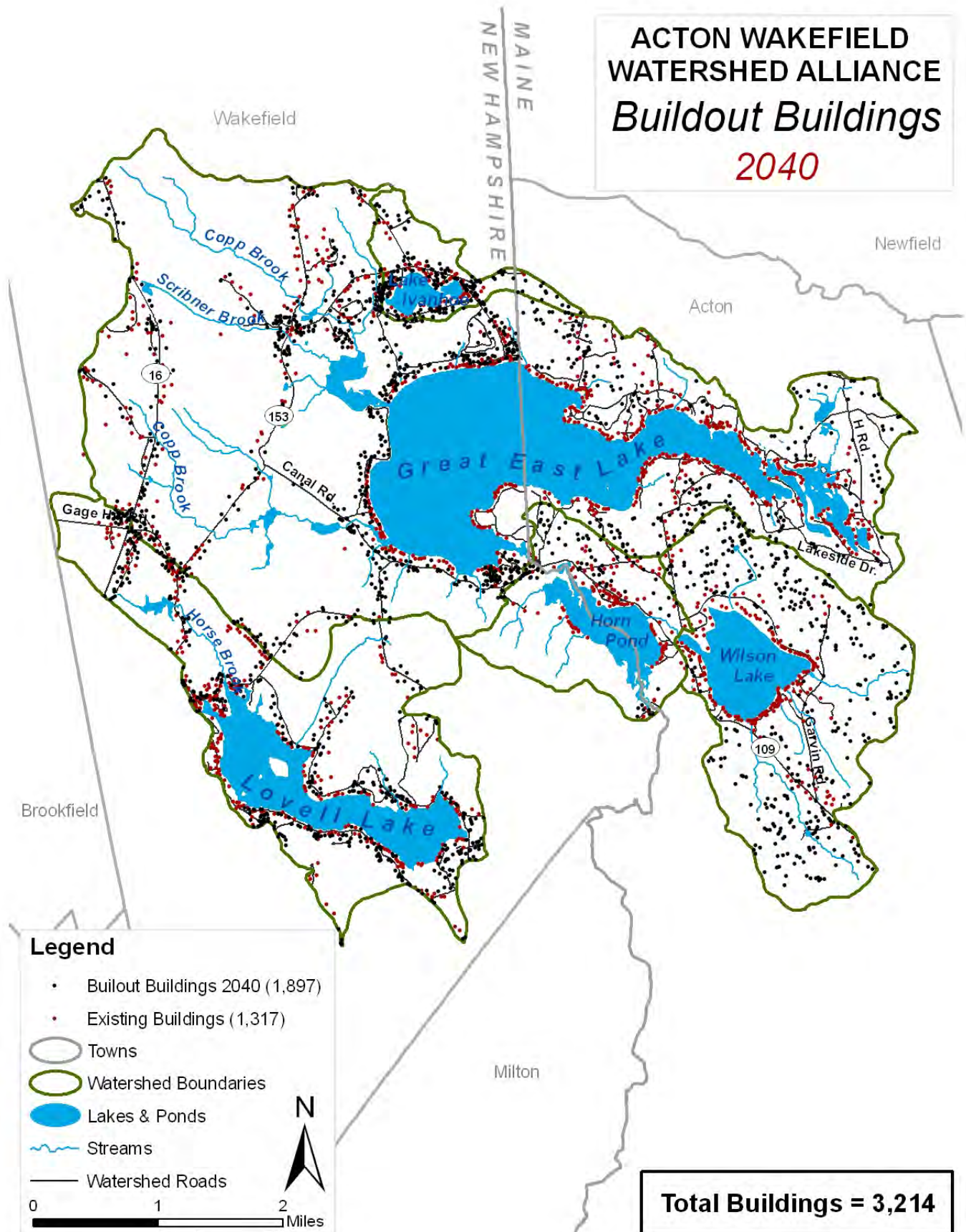


Figure 10: AWWA Buildout Year 2040 Map

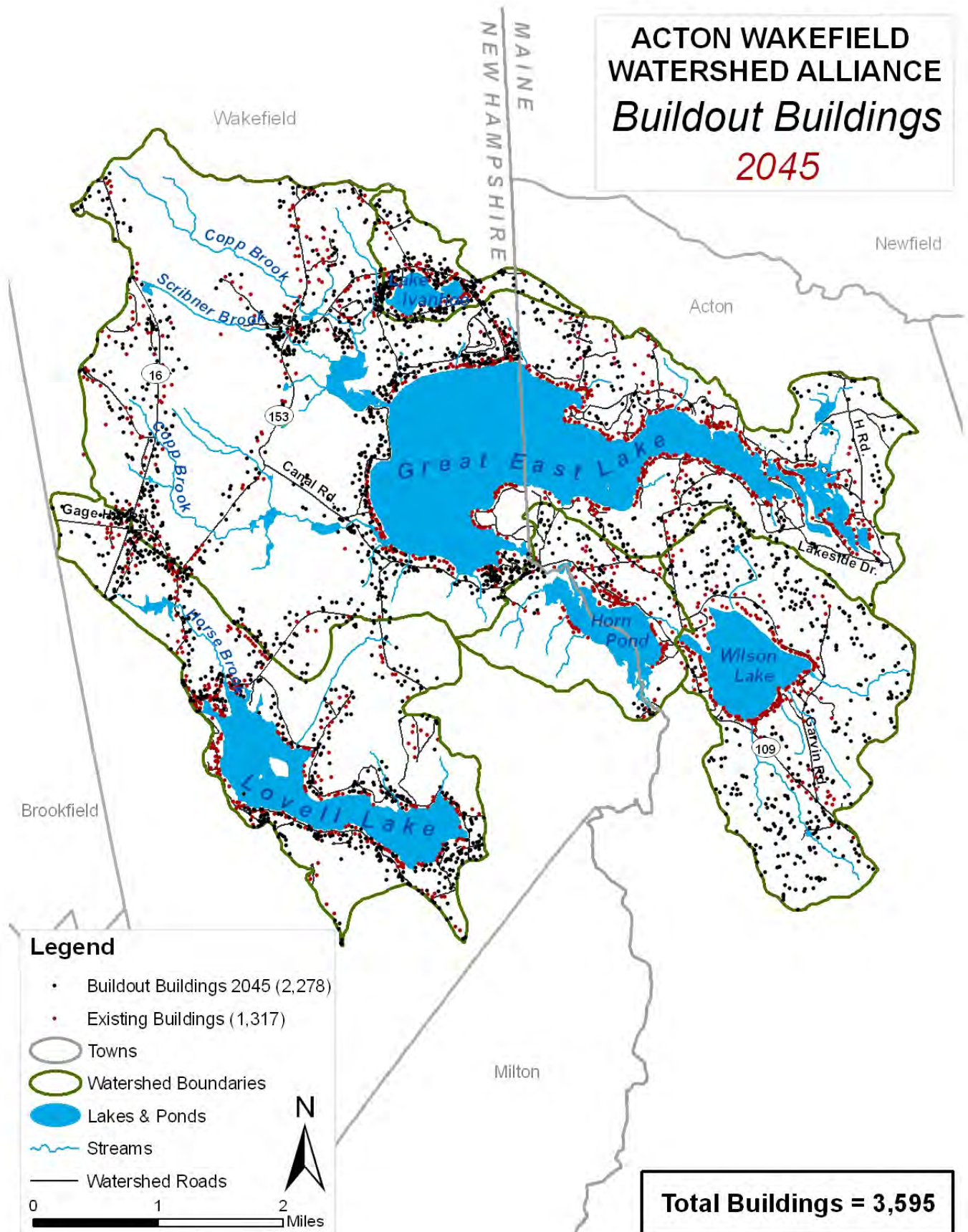


Figure 11: AWWA Buildout Year 2045 Map

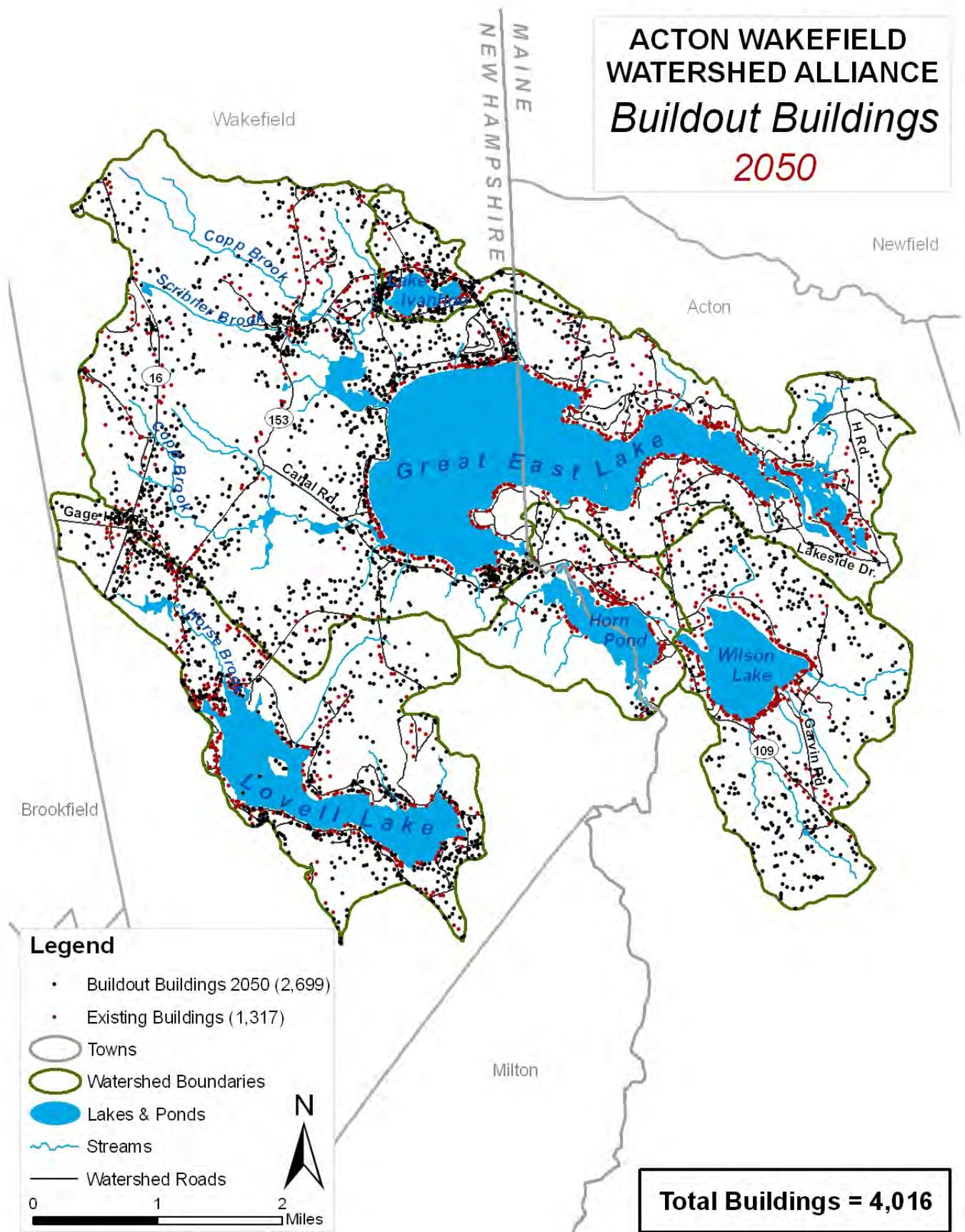


Figure 12: AWWA Buildout Year 2050 Map

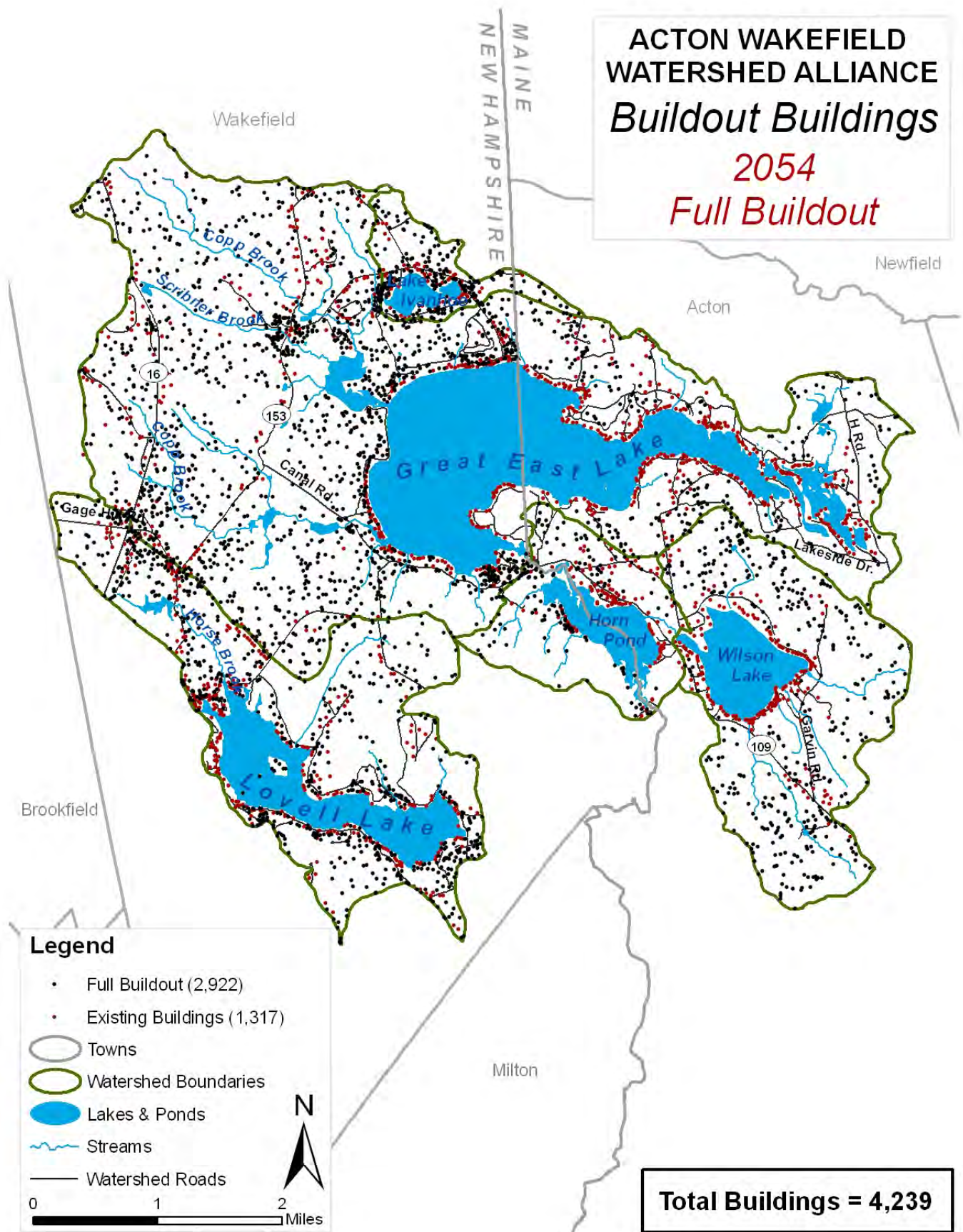


Figure 13: AWWA Full Buildout Map

Buildout Phosphorus Load Estimate

An increase in watershed development could lead to more phosphorus (P) entering AWWA waterbodies from the surrounding watershed each year. Phosphorus serves to “fertilize” the lake and decreases water clarity. Excess phosphorus can also harm fish habitat and lead to nuisance algae blooms. A spreadsheet was used to estimate the additional annual phosphorus load that could result from buildout in the AWWA watershed. Based on recommendations from Maine DEP, the analysis was based on 30% of total buildout, or 2,193 new units, rather than on full buildout. In the Town of Acton, 30% buildout (194 units) would occur around the year 2021, while 30% buildout in the Town of Wakefield (682 units) would occur in approximately 2030. Table 7 and Figures 14 and 15 below illustrate the extent of 30% buildout in the Acton and Wakefield watersheds.

Table 7: Acton and Wakefield 30% Buildout Results, by Watershed

Subwatershed	Buildout Units	Existing Units	Total
ACTON			
Great East Lake	98	338	436
Horn Pond	28	93	121
Lake Ivanhoe	1	2	3
Wilson Lake	67	184	251
<i>Acton Totals</i>	<i>194</i>	<i>617</i>	<i>811</i>
WAKEFIELD			
Great East Lake	384	327	711
Horn Pond	10	17	27
Lake Ivanhoe	59	55	114
Lovell Lake	229	301	530
<i>Wakefield Totals</i>	<i>682</i>	<i>700</i>	<i>1382</i>
Grand Totals	876	1,317	2,193

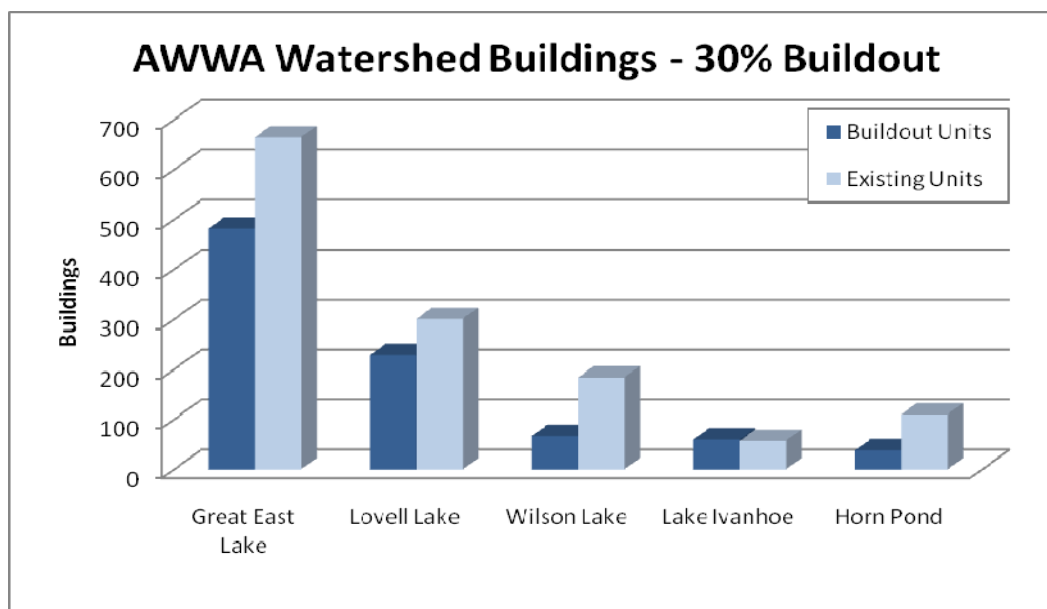


Figure 14: Acton and Wakefield 30% Buildout Results, by Watershed

Phosphorus load analyses were conducted for two scenarios:

1. The first analysis estimates phosphorus loads at 30% buildout.
2. The second analysis estimates phosphorus loads at 30% buildout, assuming that all new development incorporates phosphorus reduction BMPs.

Final phosphorus loading numbers were calculated in a spreadsheet, using estimated export coefficients for residential properties, agriculture, roadways, and other types of development (including commercial development, parks and cemeteries, and forest land, among others). The following methods were used to estimate P loads at 30% buildout:

- For each new building, it was assumed that the total developed area (including house, driveway, lawn, and any accessory buildings) covers 20% of the minimum lot size. This estimate is based on the 20% maximum lot coverage estimate. Minimum lot sizes for individual development zones in each town were used (see Table 1).
- The buildout unit locations were buffered to create a developed area covering 20% of the minimum lot size. This layer was then compared to existing land uses to determine what types of land uses the new lots were created on. The new area for each land use type was then recalculated and adjusted accordingly on the spreadsheet.
- The first scenario uses a phosphorus export coefficient of 0.5 kg P/ha/year for all new residential development. This is the same coefficient used in similar analyses in Maine.
- The second scenario uses a lower export coefficient of 0.056 kg P/ha/year for all new residential development. This assumes that phosphorus reduction measures have been applied on all new development. The coefficient for this scenario is based on the per acre phosphorus allocations for the watersheds within the Town of Acton as outlined in *Phosphorus Control in Lake Watersheds: A Technical Guide for Evaluating New Development* (MDEP, 2008). Because no similar data was available for Wakefield, the Acton coefficient was used in Wakefield. The final coefficient represents the allocation for the Horn Pond watershed, the highest allocation among the Acton watersheds.

Under existing conditions, the annual phosphorus load delivered to the AWWA waterbodies from the surrounding watershed is estimated to be 1,245 kg P/year (2,744 lbs/year, Table 8). According to analysis results, under 30% buildout, the annual phosphorus load delivered to the AWWA waterbodies from the surrounding watershed would increase to 1,330 kg P/year (2,932 lbs/acre, Table 9). This is 86 more kg (190 lbs) of P per year than under current conditions. Under ideal conditions, if phosphorus reduction measures were in place on all newly developed parcels, this estimate would be reduced to an near 1,248 kg P/year (2,751 lbs/acre), 3 kg more than under existing conditions.

Table 8: AWWA Watershed Phosphorus Loading Under Existing Conditions

LAND USE CLASS	Total Area Acres	Land Area %	TP Coeff. Avg. kg/TP/ha	TP Export Load kg TP	TP Export %
ACTON					
<u>Developed Land</u>					
Hayland/Pasture	405	7%	0.64	105	25%
Low Density Development	181	3%	0.50	37	9%
Medium Density Development	89	2%	1.00	36	8%
High Density Development	100	2%	1.40	57	13%
Parks/Cemetaries	49	1%	0.80	16	4%
Septic Systems	-	-	-	72	17%
<u>Non-Developed Land</u>					
Unmanaged Forest	3,887	66%	0.04	25	6%
Surface Water (Atmospheric)	1,170	20%	0.16	76	18%
Acton Totals:	5,880	100%		423	100%
WAKEFIELD					
<u>Developed Land</u>					
Hayland/Pasture	1,036	10%	0.64	268	33%
Low Density Development	881	8%	0.50	178	22%
Medium Density Development	349	3%	1.00	141	17%
High Density Development	28	0.3%	1.40	16	2%
Parks/Cemetaries	7	0.1%	0.80	2	0.3%
Septic Systems	-	-	-	77	9%
<u>Non-Developed Land</u>					
Scrub Shrub	15	0.1%	0.15	0.9	0.1%
Unmanaged Forest	6,468	60%	0.04	44	5%
Surface Water (Atmospheric)	2,102	19%	0.11	94	11%
Wakefield Totals:	10,886	100%		822	100%
COMBINED TOTALS	16,766			1,245	

***Conversion factors:** 1kg/hectare = 0.89 lbs/acre; 1kg = 2.2lbs

Table 9: AWWA Watershed Additional Phosphorus Loading Under 30% Buildout

		30% Buildout Estimated P Load (kg P/year)	
	<u>Estimated New Units</u>	<u>Without</u> Phosphorus Reduction Measures	<u>With</u> Phosphorus Reduction Measures
Acton	194	24	1
Wakefield	682	62	2
Total Additional P:		86	3

***Conversion factors:** 1kg/hectare = 0.89 lbs/acre; 1kg = 2.2lbs

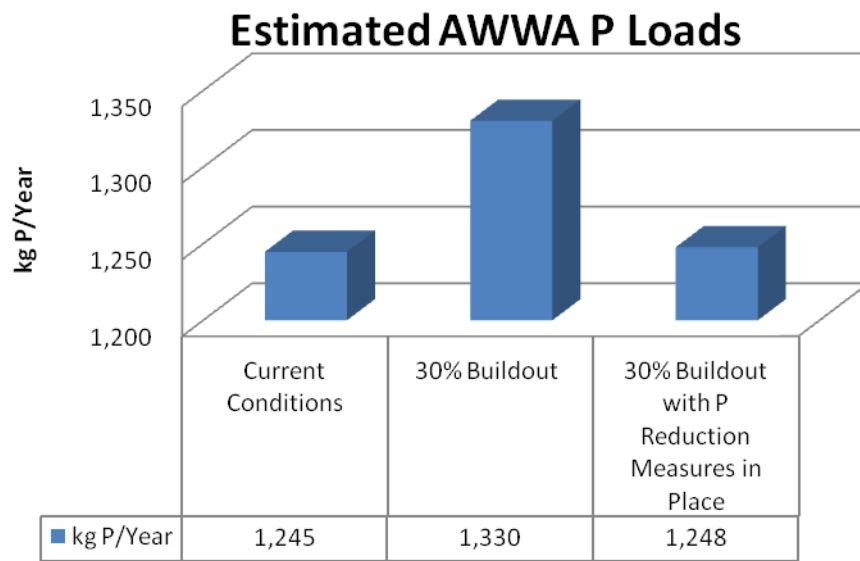


Figure 15: AWWA Phosphorus Loads Under Existing and Future Conditions

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APPENDIX F: Lake Fact Sheets

Lake Fact Sheet

Lake Ivanhoe



LAKE FACTS

Watershed: Wakefield, NH

Counties: Carroll

Midas Number: N/A

Mean Depth: 12 feet (3.7 m)

Max Depth: 20 feet (6.1 m)

Surface Area: 68 acres (0.12 mi²)

Volume: 992,000 m³

Perimeter: 8,858 feet

Flushing Rate: 0.90 flushes/year

Avg. Transparency: 5.1 meters (19 ft)

Watershed Area: 455 acres (0.71 mi²)

Drains to: Great East Lake

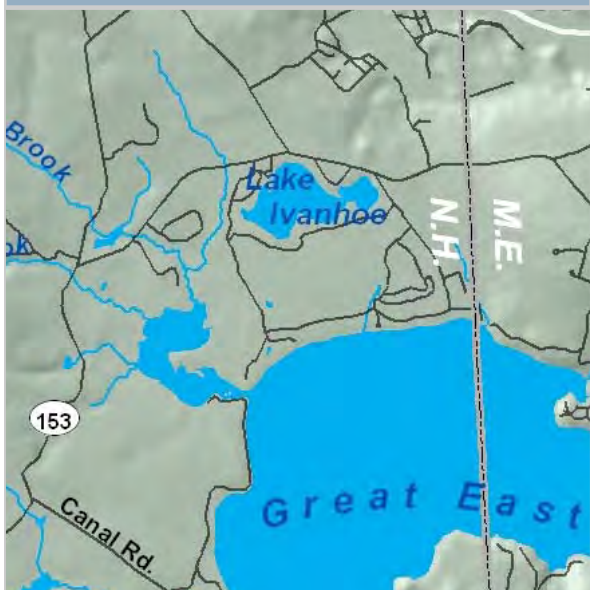
Major Drainage Basin: Salmon Falls River

Lake Ivanhoe, originally known as Round Pond, sits between Acton Ridge Road and Round Pond Road near Wakefield, New Hampshire's eastern border with Maine. The lakeshore is developed with numerous homes and camps, as well as a campground on Acton Ridge Road. Historically, a small stream drained the lake at its western end, crossing Wansor Road, and then south through a small area of forest and into Great East Lake. Local residents report that the stream outlet was filled in years ago during a construction project, and that water flowing out of Lake Ivanhoe is currently flowing over land toward Great East Lake causing serious flooding problems including flooding of septic systems. Great East Lake, to the south, forms the headwaters of the Salmon Falls River, the natural borderline between the two states which empties into the tidal waters of the Piscataqua River in Portsmouth, New Hampshire.

The water quality of Lake Ivanhoe is classified as "Potentially Impaired" based on recent analysis of measured water quality parameters. Lake Ivanhoe is potentially impaired because its in-lake phosphorus concentration exceeds the water quality standard for oligotrophic lakes in NH (< 8 ppb) as well as for chlorophyll-a (< 3.3 ppb). NH DES will determine whether Lake Ivanhoe should be listed as a federally impaired waterbody. Reducing in-lake phosphorus by 0.8 ppb will enable Lake Ivanhoe to once again be considered a high quality waterbody.

The Lake Ivanhoe direct watershed covers 0.71 square miles (455 acres). The lake is threatened by polluted runoff from development in the surrounding watershed and along its well developed shoreline. Soil erosion, in particular, is the single greatest source of pollution to Lake Ivanhoe. Soil contains the nutrient phosphorus, which has the potential to promote algae blooms when it enters a lake in large quantities. As the algae die off, the water becomes depleted of oxygen, affecting fish and animals who depend on the lake water.

In the spring of 2009, in an effort to address this concern, a team of local volunteers and technical staff from the Great East Lake Improvement Association, Acton Wakefield Watersheds Alliance, York County SWCD, NHDES, and Maine DEP conducted a survey of the watershed and identified sites that are contributing polluted runoff to Lake Ivanhoe. Teams documented polluted runoff sources from roads, properties, driveways, and shorelines using cameras and standardized field data sheets. Survey results and remediation recommendations were compiled in the *Lake Ivanhoe Watershed Survey Report* (Appendix C).



Current Water Quality Trends - LAKE IVANHOE

Water Quality Information

Water quality monitoring data for Lake Ivanhoe has been collected since 1981. This includes 16 years of secchi disk transparencies, 17 years of total phosphorus (TP) data (including 2 years of epicore samples), 16 years of chlorophyll *a* (Chl-*a*) and color data, and 14 years of dissolved oxygen (DO) profiles. The UNH Lay Lakes Monitoring Program (LLMP) and Center for Freshwater Biology (CFB), and NH Department of Environmental Services (NHDES) have collaborated in the collection of lake data to collect water quality data for Lake Ivanhoe in order to evaluate present water quality, track algae blooms, and determine water quality trends.

According to NH Lake Nutrient Criteria, Lake Ivanhoe is considered “Potentially Impaired”. This is because the median phosphorus concentration is at the tipping point (8 ppb) between a high quality lake (<8 ppb) and the lower classification (>8 and <12ppb), and the Chl-*a* value exceeds the state standard (<3.3 ppb).

Lake Ivanhoe has a relatively low flushing rate (0.9 flushes/year) which can make it sensitive to pollution. The average Maine and NH lake flushes 1 to 1.5 times per year. Phosphorus loading reductions have been recommended for Lake Ivanhoe to halt future water quality declines.

Sampling Locations



Lake Ivanhoe has two sampling locations. Station 2 (deep hole) is located in the large, western basin of the lake, and Station 1 is located within the smaller eastern basin.

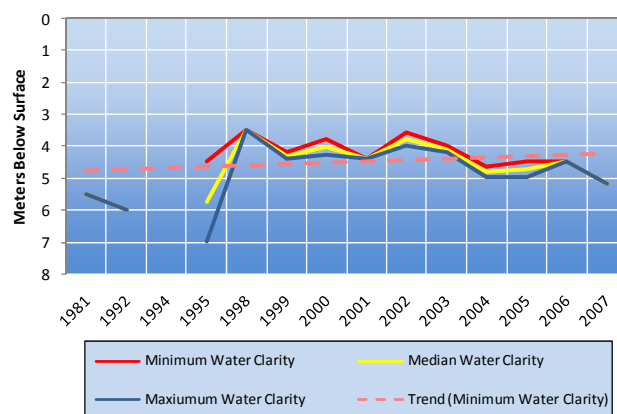
Water Clarity

Secchi Disk Transparency (SDT) is a quick, simple, inexpensive, and accurate method for determining the clarity of a lake. Factors that limit the depth of clarity include algae, zooplankton, water color, and silt. Generally, as algal populations increase, SDT readings decrease. SDT readings have been conducted in Lake Ivanhoe for over 16 years at Station 2, with a mean annual SDT of 4.8 m (15.7 ft) at Station 2, and 5.1 m (16.7 ft) at Station 1.

Sampling Results for Station 2 (1981-2008)

Sampling Parameter	Station 2
Mean Color (SPU)	15.2
Median EpiCore P (ppb)	8.0
Mean Secchi (m)	4.7
Mean Chl-a (ppb)	3.4

Lake Ivanhoe (Station 2) Historical Water Clarity



Dissolved Oxygen

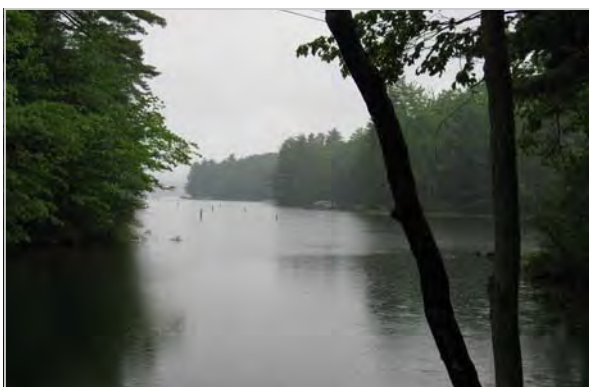
Dissolved oxygen (DO) in the lake is critical to the survival of all plants and animals, and is therefore an indicator of water quality and the level of life a lake can support. DO levels below 5 parts per million stress certain cold water fish, and a persistent loss of oxygen may eliminate or reduce habitat for sensitive cold water species. Low DO at the bottom of the lake is of particular concern because it can result in the release of phosphorus from bottom sediments- leading to increased algal production. Historic and more recent profiles confirm that Lake Ivanhoe is not stratified. Therefore, the potential for TP to be released from bottom sediments and become available to algae in the water column (internal loading) is low.

Total Phosphorus

Phosphorus is an essential element for plant growth, yet is found in limited amounts in lake systems. Therefore, small increases in phosphorus in Lake Ivanhoe can lead to substantial increases in algal growth Lake Ivanhoe over the period from 1981 to 2007 for Station 1 is 2 – 24 parts per billion (ppb) with a median of 8 ppb. A reduction of 0.8 ppb of total phosphorus is recommended for this lake.

Lake Fact Sheet

Great East Lake



LAKE FACTS

Watershed: Acton, ME & Wakefield, NH

Counties: York (ME) & Carroll (NH)

Midas Number: 3922

Mean Depth: 35 feet (11 m)

Max Depth: 102 feet (31 m)

Surface Area: 1,707 acres (2.7 mi²)

Volume: 75,589,500 m³

Perimeter: 95,144 feet

Flushing Rate: 0.3 flushes/year

Avg. Transparency: 9.2 meters (30.2 ft)

Watershed Area: 9,939 acres (15.53 mi²)

Drains to: Horn Pond

Major Drainage Basin: Salmon Falls River



Great East Lake lies on the Maine and New Hampshire border with 763 acres (45%) of its 1,707 acre surface area in Acton, Maine and 944 acres (55%) in Wakefield, New Hampshire.

The outlet of Great East Lake flows over a dam and through an 800 foot canal where it enters Horn Pond near Canal Road. Great East Lake forms the headwaters of the Salmon Falls River, the natural borderline between the two states which empties into the tidal waters of the Piscataqua River in Portsmouth, New Hampshire. Copp Brook and Scribner Brook feed into Great East Lake from the north-west as well as some smaller tributaries including JoDo Brook.

With nearly 18 miles of shoreline, Great East Lake is the largest of the Salmon Falls Headwater Lakes. The lake is regarded as a high quality waterbody, known for its natural beauty and abundance of wildlife. Great East Lake is managed for both coldwater and warmwater fisheries. The extensive rocky, gravelly shoreline serves as an excellent spawning and nursery habitat for smallmouth bass. The lake is home to 21 species of fish, two species of crayfish, and one species of freshwater mussel.

Numerous camps and residences dot the perimeter of Great East Lake. A town-owned boat launch is located on the north side of the lake, and a state-owned boat launch, located adjacent to the outlet off Canal Road, provides boat access. Great East Lake dam, operated by the NH Department of Environmental Services (NH DES), is located at the southeast end of the lake near the Maine-New Hampshire border in Wakefield. Water levels are maintained at full capacity during the summer, with seasonal fall drawdown to three feet below full lake level beginning in October.

The Great East Lake direct watershed covers 15.53 square miles (9,939 acres). The direct watershed area for Great East Lake is the largest of all of the five target AWWA subwatersheds, and therefore has a strong influence on downstream water quality. A watershed survey was conducted in the Great East Watershed in the Spring of 2009. Results of this survey are summarized in Appendix C.

Water Quality Information

The Maine Department of Environmental Protection (Maine DEP), the Maine Volunteer Lake Monitoring Program (VLMP), the UNH Lay Lakes Monitoring Program (LLMP) and Center for Freshwater Biology (CFB), and the NH Department of Environmental Services (NHDES) have collaborated in the collection of lake data to collect water quality

Current Water Quality Trends - GREAT EAST LAKE

data for Great East Lake in order to evaluate present water quality, track algae blooms, and determine water quality trends.

Water quality monitoring data for Great East Lake has been collected since 1974. This includes 29 years of secchi disk transparencies, 23 years of total phosphorus (TP) data (including 21 years of epicore samples), 20 years of chlorophyll-a, (Chl-a) data 20 years of color data, and 7 years of dissolved oxygen profiles.

Great East Lake is on the cusp of an “outstanding” and “good” classification in Maine, and qualifies as a high quality waterbody in New Hampshire. Outstanding lakes exhibit average secchi disk transparency (SDT) greater than 9.1 meters (30 feet), have very low algae levels (Chl-a of <2 ppb) and have very low phosphorus concentrations (2 to 5 ppb). These lakes are rare and unique resources, which are particularly sensitive to small increases in phosphorus concentrations. As such, management actions are needed to limit future phosphorus increases in Great East Lake.

The ultimate goal for Great East Lake is maintain or improve existing water quality by limiting future inputs of phosphorus from the watershed. This can be accomplished by controlling non-point source pollution (e.g. soil erosion) from existing development and restricting phosphorus loading from new development through watershed-wide planning efforts.

Sampling Locations



Great East Lake has four regular sampling locations: Station 1 (Center Hole) located in the deepest area of the lake; Station 2 (Canal); Station 3 (Maine Mann); and Basin 2. Two additional sites, Basin 3 and Basin 1 (Narrows) are sampled occasionally.

Water Clarity

Secchi Disk Transparency (SDT) is a quick, simple, inexpensive, and accurate method for determining the clarity of a lake. Factors that limit the depth of clarity include algae,

Sampling Results for Station 1 (1974-2008)

Sampling Parameter	Station 1
Mean Color (SPU)	13.8
Median EpiCore P (ppb)	6.4
Mean Secchi (m)	9.2
Mean Chl-a (ppb)	1.2

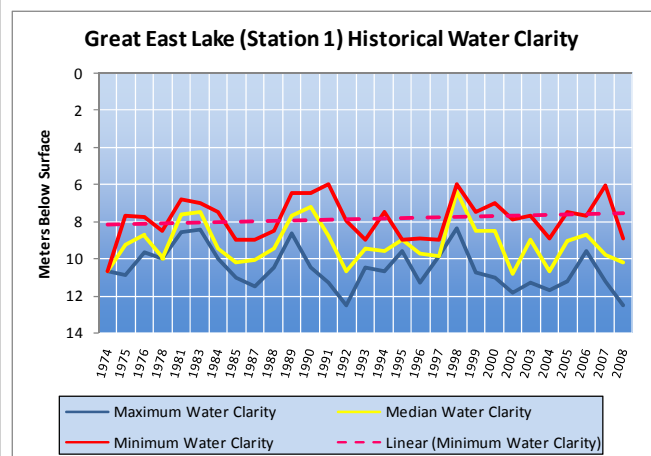
zooplankton, water color, and silt. Generally, as algal populations increase, SDT readings decrease. SDT readings have been conducted over 29 years at Station 1, with an average SDT reading of 9.2 m (30.2 ft). There is some evidence to suggest this lake may be changing over time toward reduced minimum transparency and higher TP.

Dissolved Oxygen (DO)

Dissolved oxygen (DO) in the lake is critical to the survival of all plants and animals, and is therefore an indicator of water quality and the level of life a lake can support. DO levels below 5 parts per million stress certain cold water fish, and a persistent loss of oxygen may eliminate or reduce habitat for sensitive cold water species. Historic profiles show little DO depletion in deep areas of Great East Lake.

Total Phosphorus (TP)

The range of water column TP for Great East Lake from 1976 to 2008 for Station 1 is 0.9 – 17.8 parts per billion (ppb) with a median of 6.4 ppb. High quality lakes with low flushing rates, such as Great East, may be particularly sensitive to small increases in phosphorus, making management measures to limit phosphorus inputs from the watershed particularly important. The existing in-lake TP concentration should be maintained or improved.



Lake Fact Sheet

Horn Pond



LAKE FACTS

Watershed: Acton, ME & Wakefield, NH

Counties: York (ME) & Carroll (NH)

Midas Number: 3924

Mean Depth: 13 feet (3.9 m)

Max Depth: 31 feet (9.4 m)

Surface Area: 227 acres (0.35 mi²)

Volume: 3,155,000 m³

Perimeter: 25,544 feet

Flushing Rate: 8.2 flushes/year

Avg. Transparency: 6.6 meters (21.7 ft)

Watershed Area: 1,139 acres (1.78 mi²)

Upstream Waterbodies: Great East Lake, Wilson Lake

Major Drainage Basin: Salmon Falls River



Horn Pond lies on the Maine and New Hampshire border with 119 acres (52%) of its 227 acre surface area in Acton, Maine and 108 acres (48%) in Wakefield, New Hampshire. The lake is both spring-fed and fed by outflow from Great East Lake to the north, and Wilson Lake to the east. Wilson Lake flows into Horn Pond via a wide rushing stream that flows through a large culvert under New Bridge Road on the eastern shore. The outlet for Great East Lake enters south of Canal Road. Horn Pond is natural pond raised by a dam on the Salmon Falls River. The Salmon Falls River forms a natural borderline between Maine and New Hampshire and eventually empties into the tidal waters of the Piscataqua River in Portsmouth, New Hampshire.

Horn Pond is currently considered “Potentially Non-supporting” according to the State of NH revised water quality standards for oligotrophic lakes. Oligotrophic lakes are characterized as being nutrient-poor, having rocky substrates and shorelines, deeper water, limited algae and aquatic plant growth, and an abundance of dissolved oxygen, even in deep water. This profusion of dissolved oxygen is crucial for productive fish habitat and is exemplified by the abundance of fish in the lake. Horn Pond is managed for both coldwater and warmwater fisheries.

The Horn Pond direct watershed covers 1.78 square miles (1,139 acres). Although Horn Pond’s water quality is good, the lake is threatened by polluted runoff from development in the surrounding watershed and along its well developed shoreline. Soil erosion, in particular, is the single greatest source of pollution to Horn Pond. Soil contains the nutrient phosphorus, which has the potential to promote algae blooms when it enters a lake in large quantities. As the algae die off, the water becomes depleted of oxygen, affecting fish and animals who depend on the lake water.

In June 2008, in an effort to address this concern, a team of 20 local volunteers and technical staff from Acton Wakefield Watersheds Alliance, York County SWCD, NHDES, and Maine DEP conducted a survey of the watershed and identified 55 sites that are contributing polluted runoff to Horn Pond. Teams documented polluted runoff sources from roads, properties, driveways, and shorelines using cameras and standardized field data sheets. Survey results and remediation recommendations were compiled in the *Horn Pond Watershed Survey Report*, and summarized in Appendix C).

Current Water Quality Trends - HORN POND

Water Quality Information

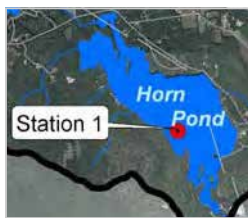
Water quality monitoring data for Horn Pond has been collected since 1982. This includes 11 years of secchi disk transparencies (SDT), 7 years of total phosphorus data (including 2 years of epicore samples), 2 years of chlorophyll-a, (Chl-a) data, 7 years of color data, and 5 years of dissolved oxygen profiles. The Maine Department of Environmental Protection (Maine DEP), the Maine Volunteer Lake Monitoring Program (VLMP), the UNH Lay Lakes Monitoring Program (LLMP) and Center for Freshwater Biology (CFB), and NH Department of Environmental Services (NHDES) have collaborated in the collection of lake data to collect water quality data for Horn Pond in order to evaluate present water quality, track algae blooms, and determine water quality trends.

The water quality of Horn Pond is considered to be good by Maine standards, based on measures of SDT, TP, and Chl-a, and potentially non-supporting by NH standards based on the median TP concentration. The potential for nuisance algal blooms on Horn Pond is low. Water flushes through the Horn Pond 8.2 times/year, much more frequently than the average Maine or New Hampshire lake which flushes 1 to 1.5 times per year.

The ultimate goal for Horn Pond is to maintain the current in-lake TP concentration of 8.0 ppb to prevent future water quality declines in Horn Pond. This can be accomplished by preventing soil erosion and stormwater runoff from existing development, and restricting phosphorus loading from new development.

Sampling Locations

Horn Pond has one regular sampling location, Station 1, located in the deepest area of the lake near the western shore. Station 1 is located on the Wakefield, NH side of Horn Pond.

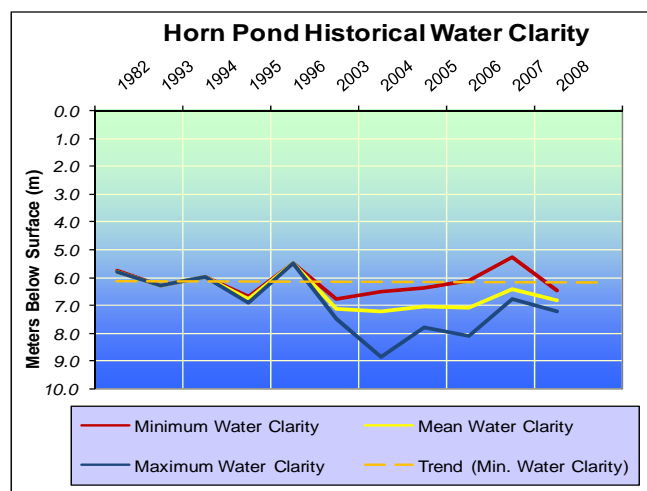


Water Clarity

Secchi Disk Transparency (SDT) is a quick, simple, inexpensive, and accurate method for determining the clarity of a lake. Factors that limit the depth of clarity include algae, zooplankton, water color, and silt. Generally, as algal populations increase, SDT readings decrease. SDT readings have been conducted in Horn Pond for over 29 years at Station 1, with an average annual SDT of 6.6 m (21.7 ft).

Sampling Results for Station 1 (1982-2008)

Sampling Parameter	Station 1
Mean Color (SPU)	16
Median EpiCore P (ppb)	8.0
Mean Secchi (m)	6.6
Mean Chl a (ppb)	2.8



Dissolved Oxygen (DO)

Dissolved oxygen (DO) in the lake is critical to the survival of all plants and animal. DO levels below 5 parts per million stress certain cold water fish, and a persistent loss of oxygen may eliminate or reduce habitat for sensitive cold water species. Low DO at the bottom of the lake is of particular concern because it can result in the release of phosphorus from bottom sediments- leading to increased algal production. Recent profiles show low to moderate DO depletion in deep areas of Horn Pond. Therefore, the potential for TP to leave the bottom sediments and become available to algae in the water column (internal loading) is low.

Total Phosphorus (TP)

Phosphorus is an essential element for plant growth, yet is found in limited amounts in lake systems. Therefore, small increases in phosphorus in Horn Pond can lead to substantial increases in algal growth. The range of water column total phosphorus for Horn Pond over the period from 1982 to 2008 for Station 1 is 4 – 11 parts per billion (ppb) with a median of 8.0 ppb. More sampling is needed to clearly define TP trends, and to determine whether this lake is truly non-supporting based on NH standards.

Lake Fact Sheet

Wilson Lake

LAKE FACTS

Watershed: Acton, ME

Counties: York

Midas Number: 3920

Mean Depth: 17 feet (5.2 m)

Max Depth: 44 feet (13.4 m)

Surface Area: 308 acres (0.48 mi²)

Volume: 6,756,766 m³

Perimeter: 19,419 feet

Flushing Rate: 0.85 flushes/year

Avg. Transparency: 5.8 meters (19 ft)

Watershed Area: 2,479 acres (3.9 mi²)

Drains to: Horn Pond

Major Drainage Basin: Salmon Falls River

Wilson Lake is located on Route 109 in Acton, Maine - north of Gerrish Mountain and approximately 2 miles from the New Hampshire Border. The 308-acre waterbody drains to Horn Pond to the northwest, which flows into the Salmon Falls River and eventually empties into the tidal waters of the Piscataqua River in Portsmouth, New Hampshire. Boat access for Wilson Lake is located on the northwest side of the lake, off Young's Ridge Road.

The water quality of Wilson Lake is classified as "good", based on measured water quality parameters. Water quality classifications are assigned by Maine DEP based on measures of Secchi disk transparency (SDT), chlorophyll-a (Chl-a), and total phosphorus (TP). Lakes in this category are clear with an average SDT of 6.1 to 9.1 meters (20 to 30 feet) with relatively low algae levels (chlorophyll-a of 2 to 4 ppb) and phosphorus concentrations ranging from 5 to 10 ppb. This water quality type is common, and lakes in this category are considered to have average water quality.

The Wilson Lake direct watershed covers 3.9 square miles (2,479 acres) and is surrounded by houses on all shores. Although Wilson Lake's water quality is above average, the lake is threatened by polluted runoff from development in the surrounding watershed and along its well developed shoreline. Additionally, low dissolved oxygen levels in deep areas of the lake indicate that it is threatened by polluted runoff. Soil erosion, in particular, is the single greatest source of pollution to Wilson Lake. Soil contains the nutrient phosphorus, which has the potential to promote algae blooms when it enters a lake in large quantities. As the algae die off, the water becomes depleted of oxygen, affecting fish and animals who depend on the lake water.

In the spring of 2009, in an effort to address this concern, a team of 32 local volunteers and technical staff from the Wilson Lake Association, Acton Wakefield Watersheds Alliance, York County SWCD, NHDES, and Maine DEP conducted a survey of the watershed and identified 71 sites that are contributing polluted runoff to Wilson Lake. Teams documented polluted runoff sources from roads, properties, driveways, and shorelines using cameras and standardized field data sheets. Survey results and remediation recommendations were compiled in the *Wilson Lake Watershed Survey Report* (summarized in Appendix C).



Current Water Quality Trends - WILSON LAKE

Water Quality Information

Water quality monitoring data for Wilson Lake has been collected since 1977. This includes 29 years of secchi disk transparencies, 9 years of phosphorus data (including 7 epicore samples), 5 years of chlorophyll-a, data 7 years of color data, and 17 years of dissolved oxygen profiles. The Maine Department of Environmental Protection (Maine DEP) and the Volunteer Lake Monitoring Program (VLMP) have collaborated in the collection of lake data to evaluate present water quality, track algae blooms, and determine water quality trends.

The water quality of Wilson Lake is considered to be good, based on measures of SDT, total phosphorus (TP), and Chlorophyll-a (Chl-a), and the potential for nuisance algal blooms on Wilson Lake is low to moderate. As such, stringent protection loading recommendations have been recommended for Wilson Lake.

The ultimate goal for Wilson Lake is to protect existing water quality by limiting future phosphorus increases to less than 1.0 ppb from current levels. This can be accomplished by limiting non-point source pollution (e.g. soil erosion, stormwater runoff) from existing development and restricting phosphorus loading from new development through watershed-wide planning efforts.

Sampling Location

Wilson Lake has one regular sampling location, Station 1, located in the deepest area (44 ft.) in the lake's center.

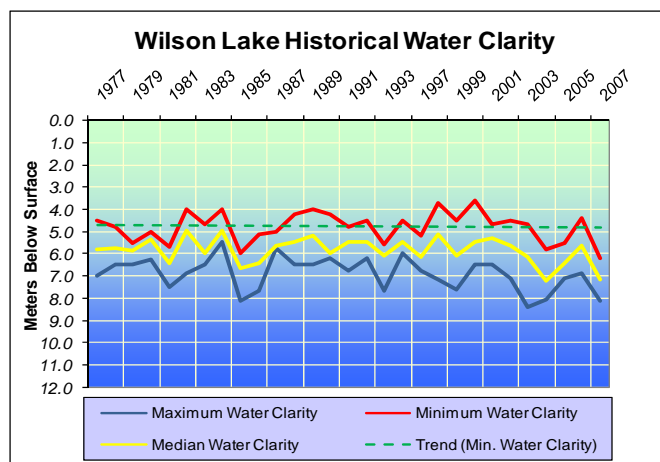


Water Clarity

Secchi Disk Transparency (SDT) is a quick, simple, inexpensive, and accurate method for determining the clarity of a lake. Factors that limit the depth of clarity include algae, zooplankton, water color, and silt. Generally, as algal populations increase, SDT readings decrease. SDT readings have been conducted in Wilson for over 29 years at Station 1. Historical transparency readings range from 3.6 to 8.4 meters, with an average annual SDT of 5.9 m (19.4 ft). According to standards in Maine, Horn Pond has above average water clarity.

Sampling Results for Station 1 (1977-2007)

Sampling Parameter	Station 1
Mean Color (SPU)	16
Median EpiCore P (ppb)	6.5
Mean Secchi (m)	5.9
Mean Chl-a (ppb)	3.5



Dissolved Oxygen (DO)

Dissolved oxygen (DO) in the lake is critical to the survival of all plants and animals. DO levels below 5 parts per million stress certain cold water fish, and a persistent loss of oxygen may eliminate or reduce habitat for sensitive cold water species. Low DO at the bottom of the lake is of particular concern because it can result in the release of phosphorus from bottom sediments- leading to increased algal production. Recent profiles show high DO depletion in deep areas of Wilson Lake. Therefore, the potential for TP to leave the bottom sediments and become available to algae in the water column (internal loading) is high.

Total Phosphorus (TP)

Phosphorus is an essential element for plant growth, yet is found in limited amounts in lake systems. Therefore, small increases in phosphorus in Wilson Lake can lead to substantial increases in algal growth. The range of water column total phosphorus for Wilson Lake over the period from 1979 to 2004 for Station 1 is 4 – 13 parts per billion (ppb) with a median of 6.5 ppb. Wilson Lake may be particularly sensitive to small increases in phosphorus, making management measures to limit phosphorus inputs from the watershed particularly important.

Lake Fact Sheet

Lovell Lake**LAKE FACTS****Watershed:** Wakefield, NH**Counties:** Carroll**Midas Number:** N/A**Mean Depth:** 13 feet (3.9 m)**Max Depth:** 41 feet (12.5 m)**Surface Area:** 538 acres (0.84 mi²)**Volume:** 8,623,000 m³**Perimeter:** 34,777 feet**Flushing Rate:** 0.70 flushes/year**Avg. Transparency:** 5.9 meters (19 ft)**Watershed Area:** 3,076 acres (4.81 mi²)**Drains to:** Branch River**Major Drainage Basin:** Salmon Falls River

Lovell Lake is located in Wakefield, New Hampshire just north of Route 109. The 538-acre lake is both spring-fed and fed by small streams, including Horse Brook to the northwest. Lovell Lake outlets into the Branch River in the village of Sanbornville to the west. From here, the Branch River flows in a southeasterly direction to Milton, NH where it joins the Salmon Falls River on the Maine-New Hampshire border. The Salmon Falls River eventually empties into the tidal waters of the Piscataqua River in Portsmouth, New Hampshire.

Lovell Lake is a “Tier 1” waterbody and is “Fully Supporting” its designated uses according to NH water quality standards. Water quality classifications are assigned by New Hampshire DES based on measures of total phosphorus (TP) and chlorophyll-a (Chl-a). Lakes in this category are generally clear with relatively low algae levels of phosphorus (< 8 ppb) and Chl-a (< 3.3 ppb).

Lovell Lake is an oligotrophic lake, which means that it is generally nutrient-poor, with a rocky substrate and shoreline, limited algae and aquatic plant growth, and an abundance of dissolved oxygen, except in the deepest waters. This profusion of dissolved oxygen is crucial for productive warm water fish habitat, while low dissolved oxygen near the lake bottom prevents the establishment of a cold water fishery.

The Lovell Lake direct watershed covers 4.8 square miles (3,076 acres) in the Village of Sanbornville in the Town of Wakefield. Although Lovell Lake’s water quality is average, the lake is threatened by polluted runoff from development in the surrounding watershed. Soil erosion, in particular, is the single greatest source of pollution to Lovell Lake. Soil contains the nutrient phosphorus, which has the potential to promote algae blooms when it enters a lake in large quantities. As the algae die off, the water becomes depleted of oxygen, affecting fish and animals who depend on the lake water.

In September 2008, in an effort to address this concern, a team of 32 local volunteers and technical staff from the Lovell Lake Association, Acton Wakefield Watersheds Alliance, York County SWCD, NH DES, and Maine DEP conducted a survey of the watershed and identified 161 sites that are contributing polluted runoff to Lovell Lake. Teams documented polluted runoff sources from roads, properties, driveways, and shorelines using cameras and standardized field data sheets. Survey results and remediation recommendations were compiled in the *Lovell Lake Watershed Survey Report* (summarized in Appendix C).



Current Water Quality Trends - LOVELL LAKE

Water Quality Information

Water quality monitoring data for Lovell Lake has been collected at Station 1 since 1979, and Station 2 since 1989. This includes 19 years of secchi disk transparencies, 19 years of phosphorus data, 16 years of chlorophyll-a (Chl-a) and color data, and 3 years of dissolved oxygen profiles. The UNH Lay Lakes Monitoring Program (LLMP) and Center for Freshwater Biology (CFB), and NH Department of Environmental Services (NHDES) have collaborated in the collection of lake data for Lovell Lake in order to evaluate present water quality, track algae blooms, and determine water quality trends.

Based on measures total phosphorus (TP), and Chl-a, Lovell Lake does not meet standards for High Quality Waters in New Hampshire. Lovell Lake has a relatively low flushing rate which can make it sensitive to pollution. It takes 1.4 years for water to flush through the Lovell Lake system. The average Maine and NH lake flushes 1– 1.5 times/year.

Based on a slight decrease in water clarity, and a median phosphorus concentration of 7.5 ppb (which indicates that Lovell Lake has limited capacity to treat additional phosphorus from the land), phosphorus reduction strategies are needed for Lovell Lake. Lowering current in-lake phosphorus levels by 0.3 ppb will help establish Lovell Lake as a high quality waterbody in NH. This can be accomplished by limiting non-point source pollution (e.g. erosion and stormwater runoff) from existing development and restricting phosphorus loading from new development through watershed-wide planning efforts.

Sampling Locations

Lovell Lake has three sampling locations: Station 1 (north), Station 2 (south), and Station 3 (middle). Station 2 is located in the deepest part of the lake (41 ft.).

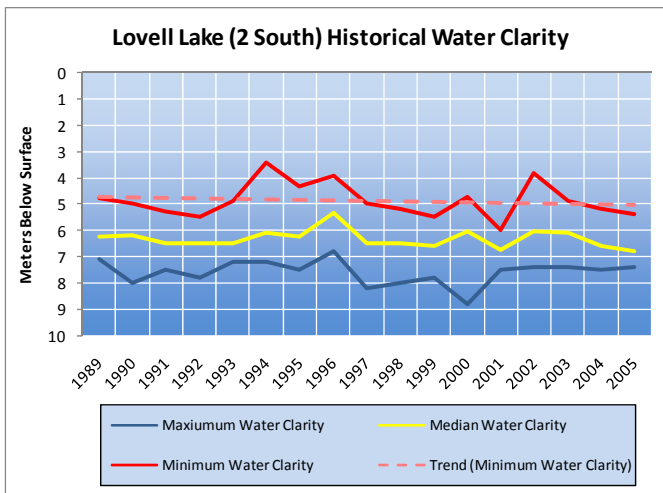


Water Clarity

Secchi Disk Transparency (SDT) is a quick, simple, inexpensive, and accurate method for determining the clarity of a lake. Factors that limit the depth of clarity include algae, zooplankton, water color, and silt. Generally, as algal populations increase, SDT readings decrease. SDT readings have been conducted in Lovell Lake for over 19 years at Station 2, with an average a mean annual SDT of 6.3 m (20.7 ft).

Sampling Results for Station 2 (1989-2007)

Sampling Parameter	Station 2
Mean Color (SPU)	11.7
Median EpiCore P (ppb)	7.5
Mean Secchi (m)	6.3
Mean Chl-a (ppb)	2.7



Dissolved Oxygen (DO)

Dissolved oxygen (DO) in the lake is critical to the survival of all plants and animals. DO levels below 5 parts per million stress certain cold water fish, and a persistent loss of oxygen may eliminate or reduce habitat for sensitive cold water species. Low DO at the bottom of the lake is of particular concern because it can result in the release of phosphorus from bottom sediments- leading to increased algal production. Recent DO profiles have not been collected in Lovell Lake, though profiles from previous decades indicate high DO depletion in deep areas of the lake. Therefore, the potential for TP to be released from bottom sediments and become available to algae in the water column (internal loading) is high.

Total Phosphorus (TP)

Phosphorus is an essential element for plant growth, yet is found in limited amounts in lake systems. Therefore, small increases in phosphorus in Lovell Lake can lead to substantial increases in algal growth. The range of water column total phosphorus for Lovell Lake over the period from 1989 to 2007 for Station 2 is 1.3 – 16.4 parts per billion (ppb) with a median of 7.5 ppb.

Appendix B: Watershed Survey Reports

GREAT EAST LAKE WATERSHED SURVEY REPORT



GREAT EAST LAKE IMPROVEMENT ASSOCIATION
ACTON WAKEFIELD WATERSHEDS ALLIANCE
NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES
MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION
JUNE 2009



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Great East Lake Improvement Association

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When combined with many other erosion sites throughout a watershed, even small sources such as this can have a significant impact on lake water quality.

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Introduction

This report serves to compile, summarize, and analyze the data collected during the Great East Lake soil erosion survey conducted in the summer of 2009 and is intended for residents, landowners, and town officials within the Great East Lake watershed.

Watershed surveys provide a snapshot of the condition of the watershed at the time the survey was conducted and document all evidence of sediment erosion. The information gathered during the Great East Lake survey will be used by the Great East Lake Improvement Association (GELIA), the Acton Wakefield Watersheds Alliance (AWWA), the Town of Acton, and the Town of Wakefield to guide future efforts to preserve the lake's pristine quality for future generations to enjoy.

Great East Lake Watershed

The area of Great East Lake is 1707 acres (2.67 square miles) while the area of the entire watershed is approximately 9990 acres (15.53 square miles). The maximum water depth is 102 feet, with an average depth of 35 feet. The lake is located in the towns of Wakefield, NH and Acton, ME. The shoreline of Great East Lake is highly developed with only about 7% of the shoreline undeveloped. All precipitation that falls in the watershed drains directly into the lake through a network of streams, ditches and overland flow.



The major outlet is at the southeast end of the lake. This outlet is dam controlled and the outflow travels through a canal and enters Horn Pond. A public boat launch is located immediately adjacent to the dam. Great East Lake is part of a larger watershed along with Lovell Lake, Horn Pond, Lake Ivanhoe, and Wilson Lake as the headwaters of the Salmon Falls River, which serves as the border between New Hampshire and Maine. The Salmon Falls River converges with the Cocheco River to become the Piscataqua River and then empties into the Gulf of Maine.

What is a Watershed?

A watershed is defined as all of the land that drains or “sheds” into a given water body. A large watershed is made up of many smaller watersheds. For example, the watershed of Great East Lake is part of the watershed of the Salmon Falls River and the watershed of the Salmon Falls River is part of the watershed of the Gulf of Maine.

Activity in any part of the watershed can affect the quality of the water body as a result of the flow from rivers, streams, surface runoff, and groundwater, roads, ditches, pathways, and beaches. This is why protection of Great East Lake must be addressed on a watershed level rather than simply focusing on shoreline activity.

Great East Lake's Water Quality

Volunteers have been testing the water quality of Great East Lake since 1974. The Maine Department of Environmental Protection (Maine DEP), the Maine Volunteer Lake Monitoring Program (VLMP), the UNH Lay Lakes Monitoring Program (LLMP), and NH Department of Environmental Services (NHDES) have collaborated in order to evaluate present water quality, track algae blooms, and determine water quality trends. This includes 29 years of secchi disk transparencies, 23 years of total phosphorus (TP) data (including 21 years of epicore samples), 20 years of chlorophyll-a, (Chl-a) data 20 years of color data, and 7 years of dissolved oxygen profiles.

Great East Lake is on the cusp of an “outstanding” and “good” classification in Maine, and qualifies as a high quality waterbody in New Hampshire. Outstanding lakes exhibit average secchi disk transparency (SDT) greater than 9.1 meters (30 feet), have very low algae levels (Chl-a of <2 ppb) and have very low phosphorus (TP) concentrations (2 to 5 ppb).

These lakes are rare and unique resources, which are particularly sensitive to small increases in phosphorus concentrations. Great East Lake has an average SDT of 30.2 feet (9.2 meters), average TP of 6.5 ppb and average Chl-a of 1.2 ppb. Detailed analysis has shown that the TP has been increasing slightly in recent years.

Phosphorus -

A nutrient needed for plant growth. It is generally present in small amounts, and limits plant growth in lakes. As the amount of phosphorus increases in the lake, the amount of algae also increases.

Great East Lake is classified as an oligotrophic lake. Oligotrophic lakes are nutrient-poor, they have rocky substrates and shorelines, deeper water, limited algae and aquatic plant growth, and an abundance of dissolved oxygen. Great East Lake has historically shown very little dissolved oxygen depletion in the deepest parts of the lake, which is good news, both for cold water fish and also for limiting internal loading, which is important for prevention of algae blooms. Internal loading occurs in lakes with depleted oxygen, total phosphorus leaves the bottom sediments and enters the water column, where it becomes available to algae, promoting algae growth and the potential for algae blooms.

GELIA has been effective in recruiting volunteers in all capacities of monitoring and ensuring the health and vitality of the lake. A dedicated water quality monitoring group has participated with the UNH Lakes Lay Monitoring program and Maine's Volunteer Lakes Monitoring Program since 1974. Weed Watchers and Lake Hosts have been actively engaged to prevent an infestation of aquatic invasive plants which can enter the lake and disrupt the fragile aquatic ecosystem.

GELIA and the Towns of Acton and Wakefield have also supported the efforts of the AWWA and its Youth Conservation Corps (YCC). AWWA provides technical assistance to landowners with erosion problems and educates them regarding the use of best management practices (BMPs). Landowners participating in the program supply the necessary materials while the YCC's labor has been provided free of charge.

Threats to Great East Lake

The largest threat to Maine and New Hampshire lakes, including Great East Lake, is polluted runoff or nonpoint source (NPS) pollution. Stormwater runoff from rain and snowmelt picks up soil, nutrients and other pollutants as it flows across the land, and washes into the lake.

In an undeveloped, forested watershed, stormwater runoff is slowed and infiltrated by tree and shrub roots, grasses, leaves, and other natural debris on the forest floor. It then soaks into the uneven forest floor and filters through the soil. The earth provides the easiest and most effective filtration of runoff water.

In a developed watershed, however, stormwater does not always receive the filtering treatment the forest once provided. Rain water picks up speed as it flows across impervious surfaces like rooftops, compacted soil, gravel camp roads and pavement, and it becomes a destructive erosive force.

Although much of Great East Lake's watershed is still forested, most of the shoreline is developed with seasonal and year-round residences as well as an extensive network of town and camp roads. While these residences and road convey most of the runoff to the lake several beach and boat access points were also found to be problematic. Camp roads are subject to frequent wash-outs during periods of heavy precipitation and spring thaws. Wash-outs can transport significant quantities of sediment and gravel into the lake increasing the nutrient levels and reducing clarity.

A number of the camps that surround the lake are many decades old and some may have ineffective septic systems. Leaching of these systems can release excess nutrients and potentially dangerous bacteria into the lake.

Why is Storm Water Runoff a Problem?

The problem is not typically the water that is running into the lake, but the pollutants that it carries to the lake. It is the sediment and nutrients in the runoff that can be bad news for New England lakes.

The nutrient, phosphorus, is food for algae and other plants and is found in soils, septic waste, pet waste and fertilizers. Algae in the lake react to the addition of phosphorus in the same way that plants in the home and garden react when nutrients like phosphorus, commonly in fertilizers, are fed to the plant—they grow. In natural conditions, the scarcity of phosphorus in a lake limits algae growth. Consequently, when a lake receives extra phosphorus, algae growth increases dramatically. Sometimes this growth causes choking blooms, but more often it results in small changes in water quality that, over time, damage the ecology, aesthetics and economy of lakes.

Soil is the biggest source of phosphorus to Maine and New Hampshire lakes. As every gardener knows, phosphorus and other nutrients are naturally present in the soil. So, runoff is essentially “fertilizing” Great East Lake with the soil that erodes from our driveways, roads, ditches, pathways, and beaches.



Why Should We Protect Great East Lake from Polluted Runoff?

Great East Lake's pristine conditions make it a valuable asset to the community on numerous levels: economic, recreational, ecological, and cultural.

- ❑ Once a lake has declined, it can be difficult or impossible to restore. Prevention is the key.
- ❑ A 3-foot decline in water clarity could reduce property values as much as 20%. A large portion of both Wakefield's and Acton's revenue is derived from waterfront property taxes, which are based upon property value. Therefore, maintaining a clean, clear lake is crucial to the town's financial viability as well as protecting the investments of property owners.
- ❑ The lake draws in anglers and boaters from across the region. The convenient location thus draws weekenders from out of state who flock to the area to pursue leisurely activities. The large size of the lake makes it a popular site for powerboat activities, especially waterskiing, wakeboarding, and tubing. Likewise, the lake is ideal for sailing, canoeing, and kayaking. Easy access to the lake makes boating the primary use of the lake.
- ❑ Fishing is a popular activity thanks to the abundance of fish species including: smallmouth bass, landlocked alewife, American eel, banded killfish, brook trout, brown bullhead, brown trout, chain pickerel, lake trout, largemouth bass, rainbow smelt, rainbow trout, white perch, and yellow perch.
- ❑ In addition to the numerous fish species, bald eagles and other large birds of prey utilize the lake habitat for hunting, nesting, and breeding. Loons are a frequent site and have become a symbol of the region. Declining water quality could force these majestic birds to find a different and healthier waterbody to call home.
- ❑ A clean lake with clear water is perceived as being a community asset. Healthy lakes are regarded as being more valuable and desirable. The lake becomes a source of community pride to its users and fosters a sense of stewardship.
- ❑ Sediment deposited into the lake from erosion creates the ideal environment for invasive aquatic plants to thrive.



Purpose of the Great East Lake Watershed Survey

The purpose of the survey was to gain an in-depth understanding of the current conditions of the watershed in terms of surface sediment erosion through exhaustive direct observation.

The watershed survey is used for the following purposes:

- ☐ Identify and prioritize existing sources of polluted runoff, particularly soil erosion sites in the Great East Lake watershed.
- ☐ Raise public awareness about the connection between land use and water quality, and the impact of soil erosion on Great East Lake and to inspire people to become active watershed stewards.
- ☐ Provide the basis to obtain funding to assist in fixing identified erosion sites.
- ☐ Use the information gathered as one component of a long term lake protection strategy. The survey strengthens the WMP because every parcel of property is physically inspected and all sediment erosion that reaches the lake is documented. The WMP thus has a real-world perspective with hard data collected from first-hand observation.
- ☐ Make general recommendations to landowners for fixing erosion problems on their properties.
- ☐ Identify sites for future Youth Conservation Corps projects.

The purpose of the survey was NOT to point fingers at landowners with problem spots, nor was it to seek enforcement action against landowners not in compliance with ordinances. It is the hope that the GELIA and AWWA will work together with landowners to solve erosion problems on their property through technical assistance visits and YCC projects.

Local citizen participation was essential in completing the watershed survey and will be even more important in upcoming years. With the leadership of GELIA and AWWA and others concerned with lake water quality, the opportunities for stewardship are limitless.

The Survey Method

The survey was conducted by volunteers with the help of trained technical staff from Maine Department of Environmental Protection, New Hampshire Department of Environmental Services, York County Soil & Water Conservation District, and AWWA. 35 volunteers were trained in survey techniques during a two hour classroom workshop on June 13, 2009. Following the classroom training, the volunteers and technical staff spent the remainder of the day documenting erosion on the roads, properties, driveways, and shorelines in their assigned sectors using cameras and standardized forms. The teams worked together over the following few weeks to complete their sectors.

Impact to Lake: Each site was rated for its potential impact to the lake. Impact was based on slope, soil type, amount of soil eroding, proximity to water, existence of a buffer, and buffer size. The impact was almost evenly distributed between the three classifications, although more sites qualified as “high impact”.

- ☐ “Low” impact sites were those with limited soil transport off site and little or no visible gullies.
- ☐ “Medium” impact sites had some sediment transport off site with noticeable rills in the ground.
- ☐ “High” impact sites exhibited a large amount of sediment transported off site with significant gullies eroded into the ground.

Estimated Remediation Cost: Recommendations were made for fixing each site and the associated cost of labor and materials was estimated. Most sites were classified as low cost, indicating that the fixes would be affordable for the average landowner.

- ☐ “Low” cost sites were estimated to have labor and materials cost less than \$500
- ☐ “Medium” cost sites were estimated to cost between \$500 and \$2500
- ☐ “High” cost sites were estimated to cost in excess of \$2500

Technical staff conducted follow-up examinations of sites in subsequent months to verify data accuracy and estimate soil loss from the sites characterized as having a medium or high impact on Great East Lake. Estimates of soil loss to the lake were made using three different models, the most appropriate model or models were selected for each site. For roads and driveways the Washington State University WEPP Forest Road Erosion Predictor was utilized. For sites with gully erosion the Michigan Department of Environmental Quality Region 5 Watersheds Training Manual gully erosion equation was used. The channel erosion equation from the same Region 5 resource was used for road bank, ditch bank, and stream bank erosion. These models are used by many organizations to estimate soil loss, including Maine DEP. In

situations requiring the use of more than one model care was taken to ensure that soil loss was not estimated twice from one area, in other words, estimates are conservative.

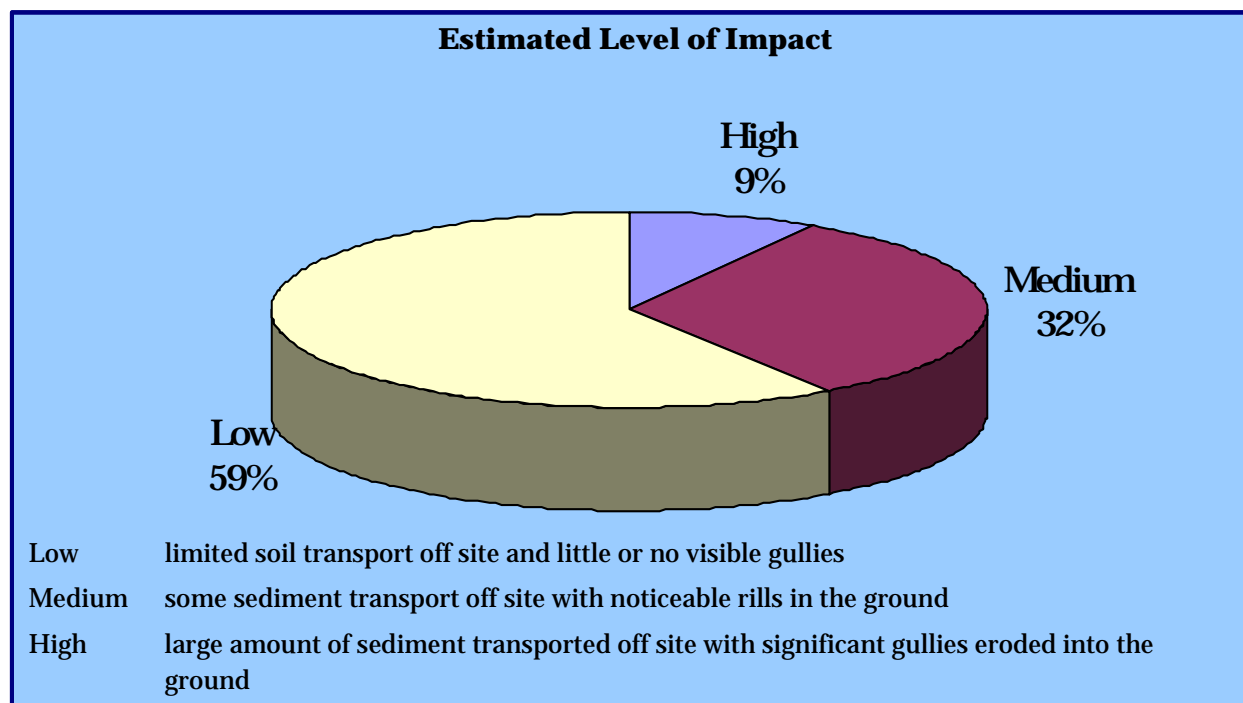
All information collected during the initial survey and subsequent soil loss estimations was entered into a spreadsheet to create a database of the information. This data was standardized, validated, and organized to allow relationships to be realized. The sites that were identified by volunteers were prioritized for remediation based on rankings of their impact to the lake, required technical expertise, and estimated cost of remediation. The documented erosion sites were then marked, along with the Great East Lake watershed boundary, using Google Earth.

A description of sites and associated rankings are discussed in the next section of this report. Maps of the erosion sites are located in Appendix A, and a spreadsheet with data from the documented sites is located in Appendix B. Contact GELIA or AWWA for additional site information.

Summary of Great East Lake Watershed Survey Findings

Volunteers and technical staff identified 66 sites in New Hampshire and 111 sites in Maine with erosion issues on Great East Lake that were either impacting or had the potential to impact water quality in Great East Lake. They estimated the expected impact of these sites on the lake using the criteria explained in the previous section. The majority of the sites that the volunteers identified were expected to have a low level of potential impact on Great East Lake.

Figure 1: Percentage of erosion sites by level of impact



- ❑ 108 of the identified sites (62%) were found on residential properties. Most of these sites have a low impact on water quality.
- ❑ 29 of the sites identified (16%) are associated with roads: State, town, and private. These sites tend to have a more severe impact on the lake .
 - Town roads accounted for 5 of the sites identified by volunteers as having or potentially having an impact on the water quality of Great East Lake. Paved roads produce a large amount of surface runoff during periods of precipitation. Winter sand, road salt, oil and gas, heavy metals, and other pollutants wash off the road and can be carried into the lake, creating a water quality hazard. The buffer between paved roads and the lake is severely limited in some areas, which increases the potential for road pollutants to impact the lake.
 - Private and local camp roads were identified as 24 of the sites (14%). Many of the camp roads are pitched towards the lake. Additionally, these roads are almost exclusively gravel roads whose surface materials often end up in the lake along with the surface runoff. Road associations are an important mechanism to handle the difficulty of properly maintaining private roads. Functioning road associations should focus attention on erosion prevention. When necessary, new associations should be formed. Road maintenance crews should be trained in camp road BMPs and should work closely with road associations.

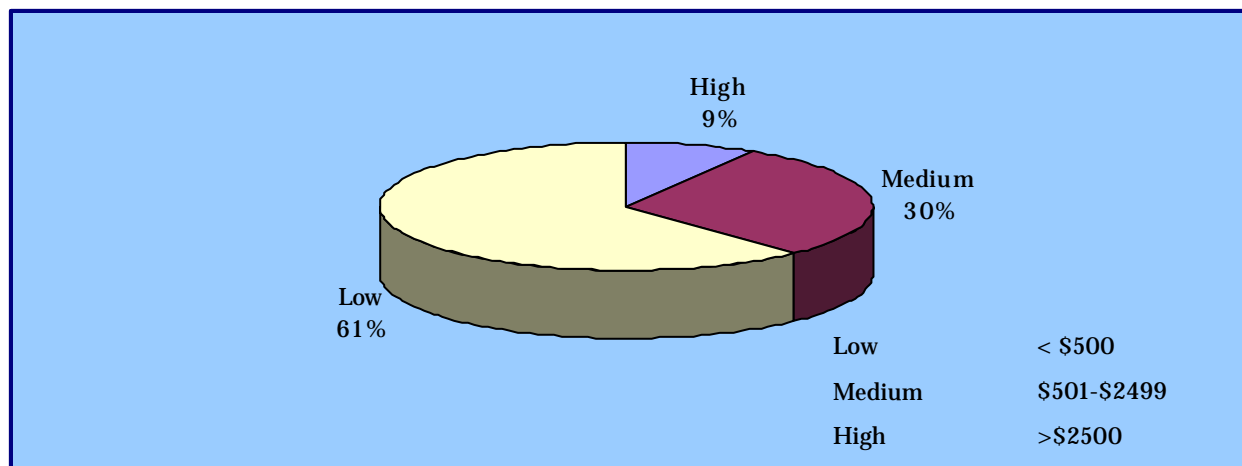
Table 1: Breakdown of sites by Land Use categories and Impact to lake

Land Use Activity	High Impact	Medium Impact	Low Impact	Total
Beach Access	2	7	0	9
Boat Access	2	2	3	7
Construction Site	0	1	0	1
Driveway	2	7	9	18
Municipal/Public	1	0	1	2
Private Road	4	10	10	24
Residential	4	25	79	108
Town Road	0	4	1	5
Trail or Path	0	0	1	1
Total	15	56	104	175

- ❑ Driveways accounted for 18 of the sites identified (10%). Often driveways are placed for the most direct access to the property without planning for the effects of stormwater. Subsequently, many driveways are washed-out and then repaired in the same manner, only to be washed-out again, creating a large delta of sediment in the lake. Driveways should be designed with the same attention to stormwater as roads. It may be strategically and economically wise for adjacent properties to share a common driveway so impervious surfaces are limited.
- ❑ 9 different land uses were identified in the survey. Thus, no single source is responsible for pollution of the lake, and all parties need to be involved in protecting the water quality. Every land use has aspects that can be improved and there are numerous resources to aid in this improvement. Town officials, individual landowners, state and local agencies, GELIA, and AWWA must all play a role and work together for the benefit of Great East Lake.

As mentioned before, the volunteers were also charged with estimating the cost required to remediate the erosion problems that they encountered during the survey. The majority of the sites identified and investigated by the volunteers were assessed to have a relatively low cost of repair (less than \$500). Less than 1 out of 10 sites that the volunteers identified as having a real or potential erosion problem were expected to have a high cost of repair (greater than \$2,500).

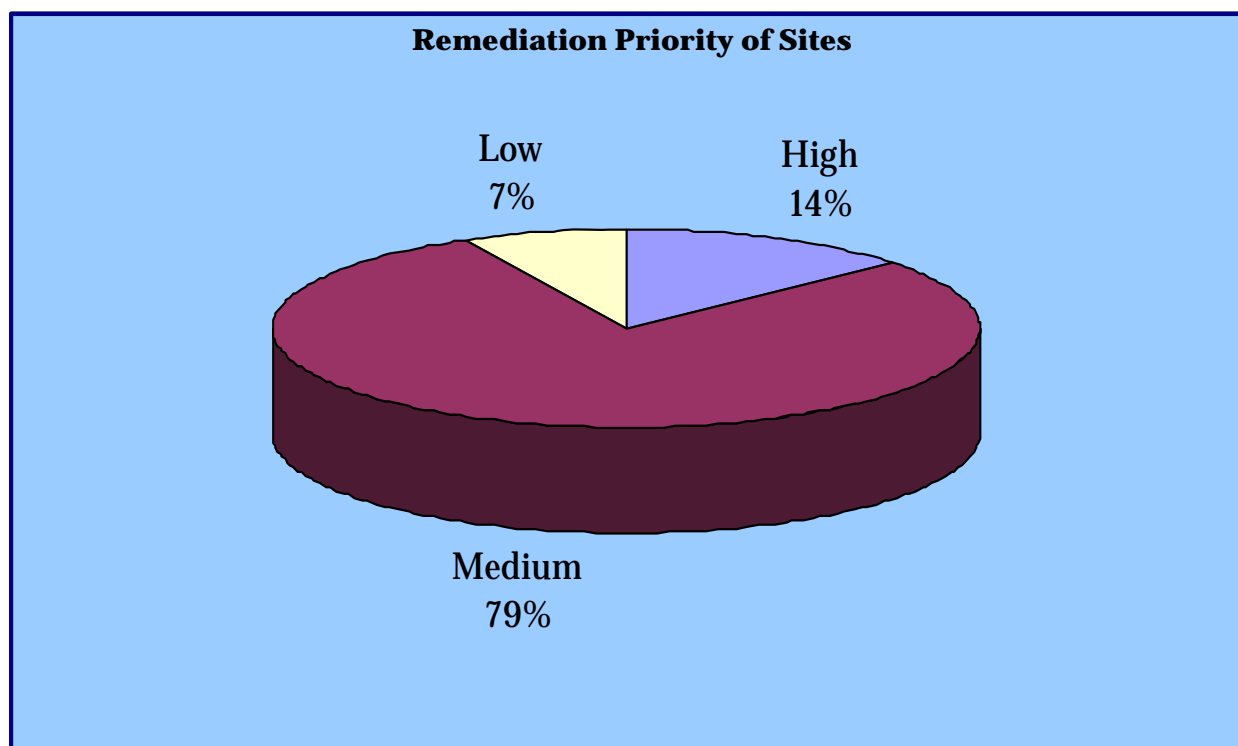
Figure 2: Estimated Erosion Site Remediation Cost



- ❑ Most of the sites believed to be inexpensive to fix were on residential properties. These sites are generally also expected to require little technical expertise for repair. These erosion issues tend to have simple solutions which can be accomplished by the landowners themselves.
- ❑ Roads repairs have higher associated costs (greater than \$2500) and often require technical experience to properly solve the erosion problems.

Site Remediation Priority: Severity of site impact to lake, estimated remediation cost, and speculation as to whether the site should be considered a YCC project were given numerical values and then totaled to score each site. The priority designation will help GELIA, AWWA and the Town develop the remediation plan for the identified sites. 20% of the sites were given “high priority” indicating that effort should be focused on these sites first when conducting remediation.

Figure 3: Estimated Site Remediation Priority



- ☐ “Low” priority sites were those that generally had high associated cost, low impact to the lake, and would not be viable YCC projects.
- ☐ “Medium” priority sites tended to be those that had both medium impact and cost and could possibly serve at YCC projects.
- ☐ “High” priority sites were typically those that had high impact to the lake, low associated cost, and would make good YCC projects.

The efforts of organizations like AWWA and GELIA are best directed towards the sites characterized as high priority, as the positive change affected per dollar and unit of effort is likely to be highest for these sites. Through remediating and encouraging land owner remediation of the high priority sites GELIA and AWWA will be able to prevent a large amount of sediment from entering Great East Lake without expending all of the resources of the organizations. Also, as the high priority erosion problems are repaired by community members and the YCC awareness and support for these efforts will increase.

The majority of sites assessed were determined to be of medium priority for remediation. This category could be refined further based on the criteria of land owner involvement, both willingness to be a YCC host site and ability to participate in the project. As stated earlier, some of the sites visited could be improved by landowners if they were equipped with the correct information. Low impact sites are the ones most likely to be repaired by the landowners themselves, therefore, the low impact sites may have added reason, regardless of potential as YCC host sites, to be categorized as high priority for education (print resources, web resources, and technical assistance visits).

Low priority sites are those that likely have low impact on water quality in Great East Lake and a high cost for repair. These sites will likely be last to receive attention, unless the landowners decide to put forth the time and treasure to repair them. Some high impact sites with high associated costs that are not potential YCC host sites may also be placed in this category or the medium priority category. These sites should probably be addressed by involving professionals and appealing for government support through grants or low interest loans.

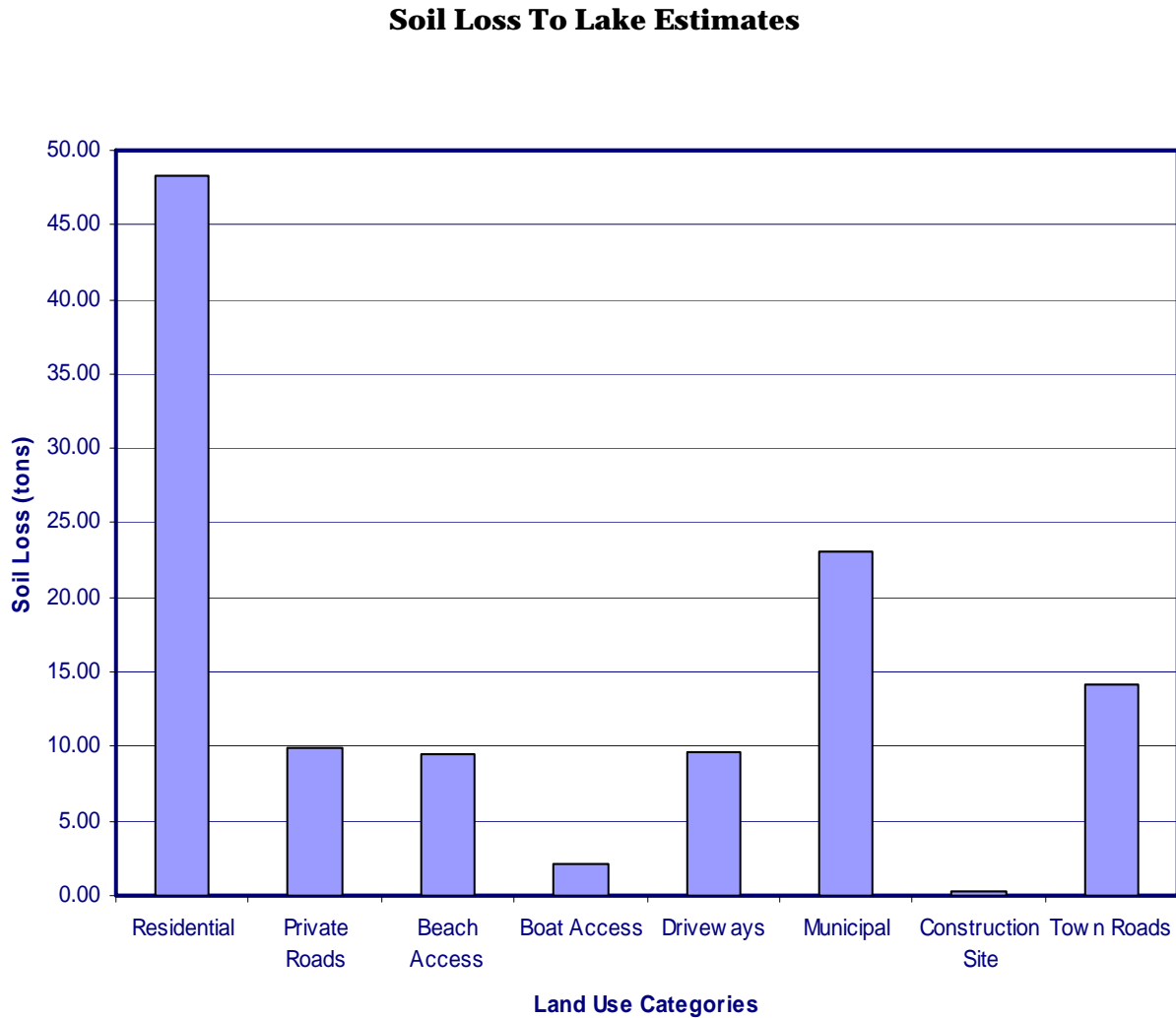
Soil Loss Estimates

After the volunteers completed the initial survey of Great East Lake two trained assessors visited all of the sites that were identified as having a medium or high impact on the water quality of Great East Lake, as well as, many of the sites identified as low impact. Volunteer data sheets were assessed for completeness and thoroughness and any that were questionable were revisited. During this visit the assessors also collected the measurements necessary to estimate soil loss using the WEPP and Region 5 models.

The estimates that were made using the WEPP and Region 5 models are intended to serve as an indicator of the current state of soil loss to the lake. As erosion sites are remediated, if the repair is considered complete, the site can be assumed to add a negligible amount of soil to Great East Lake and be removed from the list of potential soil contributors. The soil loss estimates allow AWWA and GELIA to assess the amount of soil that was prevented from entering the lake by YCC and community remediation projects. This information is also useful for the Salmon Falls Headwater Lakes Watershed Management Plan. Information about soil loss can also be used to estimate the amount of nutrients of interest (phosphorus) being contributed by a particular site where erosion is happening. The total estimated soil entering Great East Lake from the sites identified by the volunteers was over 105 tons per year.

It is not surprising that the majority of soil loss estimated results from residential properties, given that residential properties accounted for the vast majority of sites identified during the survey. The estimated soil contribution of residential properties to Great East Lake is more than 38 tons per year. This demonstrates the significant opportunity that property owners have to protect the water quality of Great East Lake. It is important to arm these community members with good information about selecting and utilizing BMPs.

Figure 4: Estimated Soil Loss Impact to Lake



Private roads and town roads combined were estimated to contribute more than 24 tons of soil per year to Great East Lake. Considering that there were far fewer of these types of sites identified, each one is contributing a significant amount of sediment. This makes them both a danger to the lake and a chance to significantly decrease the amount of soil entering Great East Lake with just a few large projects. If road projects can be funded by grant money through the Clean Water Act then the towns and road associations will not be overly burdened by costs of the repairs.

Lake access points seems to pose a problem for residential property owners and municipalities alike with a combined soil contribution of over 11 tons per year from boat and beach access points on residential properties and additional soil loss from municipal boat launches. This might demonstrate a need for education about techniques for accessing the lake that are safe and do not cause erosion.

Residential Areas BMPs

Volunteers identified 108 sites associated with residential areas. They estimated that 79 sites have low impact on water quality, 25 have medium impact, and 4 have high impact. Some of the most common problems and recommended conservation practices are pictured below.



Roof Runoff—Install stone-filled trenches along roof drip-line to help infiltrate runoff.



Problem— Roof runoff causing bare soils to erode.

Solution— Cover soil with erosion control mulch, plant grass and / or install drip-line trench.



Mulch—Place heavy-duty “erosion control mix” on bare soil.

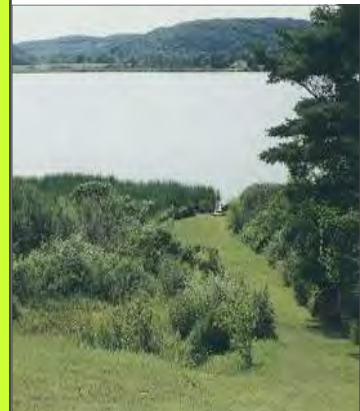


Waterbars—Place timbers or log “speed bumps” across paths to slow runoff and trap soil.



Problem—The lack of a buffer allows erosion to easily enter Great East Lake.

Solution— Plant a native buffer along shoreline to treat storm water runoff.



Buffers—Plant trees and shrubs along the shoreline or let them grow back naturally.

Residential areas were associated with the majority of the identified sources of polluted runoff. These problems pose a significant threat to lake water quality. Fortunately, most of these sites can be corrected with easy, low cost fixes.

Town Road BMPs

There were 5 town road sites identified during the survey. The volunteers estimated that 4 of the town road sites have a medium impact on water quality and 2 have a low impact. Some of the most common problems and recommended conservation practices are pictured below.



Ditching—Create U-shaped ditches and armor them with rocks and/or grass.



Problem— Unstable road shoulder and culvert erode sediment into stream

Solution— Armor with stone riprap, vegetate and reshape road shoulder and ditch



Turnouts—Create openings along roads or ditches to direct water into vegetated areas.



Culverts—Armor culvert inlets and outlets with rock riprap. Create 'plunge pools' to protect the outlet and trap sediment.



Problem— Road shoulder erosion and inadequate armoring delivers sediment to lake

Solution— Reshape and vegetate road shoulders and ditch, install check dams in ditch to trap sediment



Crown—Grade the road so that water runs off the sides. Remove sand and grader berms from the edges of the road.

Roads are one of the biggest sources of pollution to Maine and NH lakes. Regular maintenance by road associations and town and state road departments is critical.

Private Road BMPs

There were 24 private road sites identified by the volunteers as having erosion problems. Volunteers estimated that 4 of these sites had a high impact on water quality, 10 had medium impact, and 10 had low impact. Some of the most common problems and recommended conservation practices are pictured below.



Rubber Razors—Direct water off the driveway and into vegetation with rubber razors.



Problem— Moderate surface erosion with direct flow to the lake.

Solution— Reshape and crown, install runoff diverter, add new surface material.



Open Top Culverts—Direct water off the driveway with open top culverts.



Road Material—Add hard-packing, cohesive surface material to the driveway.



Problem— Severe road shoulder erosion.

Solution— Reshape the bank with a more gentle slope, armor the slope with rip rap, add plantings above slope as needed.



Ponding Areas—Create small ponding areas to trap sediment and infiltrate driveway runoff.

Preserve water quality and save time, money and wear on your vehicle by having a lake-friendly camp road. Use adequate surface material, establish a crown, and add diversions to direct runoff into buffers.

Remediating the erosion issues identified in this survey will require efforts by community members, the Great East Lake Improvement Association, the Acton Wakefield Watersheds Alliance, road associations, and municipal officials.

Great East Lake Improvement Association and Acton Wakefield Watersheds Alliance

- ☐ Send letter offering technical assistance to property owners, road associations, and towns with identified erosion problems and encourage them to make improvements.
- ☐ Make available copies of the survey report to property owners, road associations, and towns.
- ☐ Apply for grants to help fix erosion problems identified in the survey.
- ☐ Continue to promote the Lake Host, Weed Watch, and water quality monitoring programs by hosting workshops, encouraging landowners to have property evaluations, and good lake stewardship.
- ☐ Continue to increase and empower the association's membership, and provide educational materials and guidance to members of the Great East Lake watershed community.
- ☐ Continue to partner with NHDES, MEDEP, the Town of Wakefield, the Town of Acton, and others to seek funding and implement projects to protect lake water quality.
- ☐ Organize workshops and volunteers to start fixing identified erosion problems and teach citizens how to fix similar problems on their own properties.
- ☐ Educate municipal officials about lake issues and work cooperatively to find solutions.

Individual Landowners

- ☐ Consider repairing areas of your property where erosion is happening. Please contact AWWA for technical assistance and or educational materials about BMPs.
- ☐ Contact the Great East Lake Improvement Association about getting involved with the Lake Host, Weed Watch, and water quality monitoring programs.
- ☐ Stop mowing and raking your shoreline and parts of your property. Let lawn and raked areas revert back to natural plants. Deep shrub and tree roots help hold the soil.
- ☐ Avoid exposing bare soil. Seed and mulch bare areas.
- ☐ Call the Town of Wakefield Code Enforcement Officer or the Acton Code Enforcement Officer before doing any tree cutting or soil disturbance projects.
- ☐ Visit www.pwd.org/news/publications.php#Brochures to learn more about conservation practices you can do yourself.
- ☐ Maintain septic systems properly. Pump septic tanks (every 2 to 3 years for year round residences; 4-5 years if seasonal) and upgrade marginal systems.
- ☐ Join the Great East Lake Improvement Association and get involved with their activities.

Municipal Officials

- ☐ Enforce shoreland zoning and other ordinances to ensure protection of Great East Lake.
- ☐ Conduct regular maintenance on town roads in the watershed, and fix town road problems identified in this

Forming Road Associations

Effective maintenance of camp roads is a pivotal step in the ongoing protection of Great East Lake.

What is a road association?

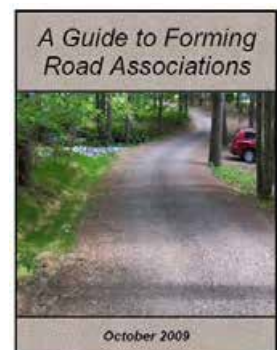
- Simply put, a road association is a way for landowners on a private camp road to share responsibility, make decisions and split costs for road maintenance and repairs.
- There are three types of road associations: Informal, Statutory and Nonprofit Corporation. Each type of road association varies in the formation time, complexity and legal standing.
- While some small roads make do with informal associations, more and more roads are becoming statutory associations. Once formed, statutory associations are run through a straight-forward, democratic process and have the ability to collect dues and receive some legal protections.

Why form a road association on Great East Lake?

- 14 of the high and medium impact sites identified during the watershed survey are private camp roads. Maintaining these camp roads through a road association would help to protect Great East Lake from the negative impacts of soil erosion.
- A road association provides an avenue for you and other private camp road users to formally manage your road in a fair, organized and cost-effective manner.
- Road associations help to reduce the maintenance costs over time. The *Camp Road Maintenance Manual* estimates that \$1 spent on routine maintenance will save \$ 15 in capital repairs.
- Acton's own Senator Richard Nass sponsored a new provision in the Private Ways Law that now allows municipalities to use public funds to assist in the maintenance of private roads if such work contributes to the protection or restoration of a "great pond." As a result, all of the private roads surrounding Great East Lake would therefore be eligible if they formed a formal road association (either statutory and nonprofit corporation). Acton's Road Committee has been working to implement this provision and encourage residents to form associations.

More information on road associations:

- The DEP's 'Guide to Forming a Road Association' is available at the YCSWCD office or www.maine.gov/dep/blwq/docwatershed/roadassociation.htm. The manual describes the different types of road associations, legal issues, and steps to forming associations, including templates for bylaws and forms.
- For other resources about laws, maintenance, and the impact of poor camp roads on water quality, go to www.maine.gov/dep/blwq/docwatershed/camp/roads/index.htm



Conservation Practices for Homeowners

After reading this report you probably have a general idea about how to make your property more lake-friendly. However, making the leap from concept to construction may be a challenge.

The Maine DEP and Portland Water District offer a series of fact sheets that answer many common how-to questions. The fact sheets profile 20 common conservation practices and include detailed instructions, diagrams and color photos about installation and maintenance. The series includes the following fact sheets:

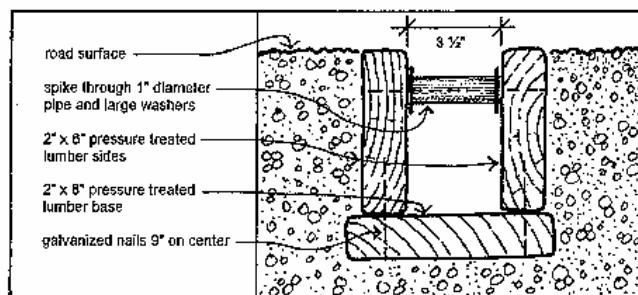
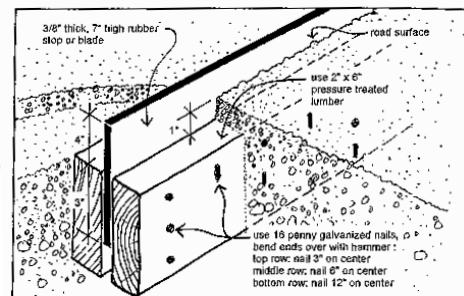
Construction BMPs	Erosion Control Mix	Native Plant Lists
Dripline Trench	Infiltration Steps (2)	(6)
Drywells	Infiltration Trench	Open-Top Culverts

The series also includes four native plant lists. Each one is tailored to different site conditions (e.g., full sun and dry soils). The lists include plant descriptions from the DEP's *Buffer Handbook* and small color photos of each plant to make plant selection easier.



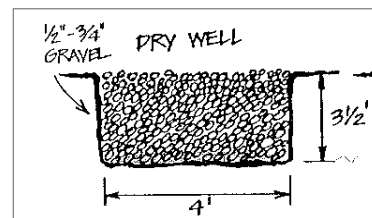
Fact sheets are available to help you install conservation practices on your property
Download at <http://www.maine.gov/dep/blwq/docwatershed/materials.htm>.

Rubber Razor Blade: Use this structure in a gravel driveway or camp road. It can be plowed over only if the plow operator is aware of its presence and lifts the plow blade slightly. Place it at a 30 degree angle to the road edge and direct the outlet toward a stable vegetated area.



Open Top Culvert: Use this structure in a gravel driveway or camp road that does not get plowed in the winter. Place it at a 30 degree angle to the road edge and point the outlet into stable vegetation. Remove leaves and debris as needed.

Drywell: Use a drywell to collect runoff from roof gutter downspouts. Drywells can be covered with sod, or left exposed for easy access and cleanout. Drywells and infiltration trenches work best in sandy or gravelly soils.



Permitting ABC's for Maine

Protection of Maine's watersheds is ensured through the goodwill of lake residents and through laws and ordinances created and enforced by the State of Maine and local municipalities. The following laws and ordinances require permits for activities adjacent to wetlands and water bodies.

Shoreland Zoning Law—Construction, clearing of vegetation and soil movement within 250 feet of lakes, ponds, and many wetlands, and within 75 feet of most streams, falls under the Shoreland Zoning Act, which is administered by the Town through the Code Enforcement Officer and the Planning Board.

Natural Resources Protection Act (NRPA) - Soil disturbance & other activities within 75 feet of the lakeshore or stream also falls under the NRPA, which is administered by the DEP.

Contact the DEP and Town Code Enforcement Officer if you have any plans to construct, expand or relocate a structure, clear vegetation, create a new path or driveway, stabilize a shoreline or otherwise disturb the soil on your property. Even if projects are planned with the intent of enhancing the environment, contact the DEP and town to be sure.

How to apply for a Permit by Rule with DEP:

To ensure that permits for small projects are processed swiftly, the DEP has established a streamlined permit process called **Permit by Rule**. These one page forms (shown here) are simple to fill out and allow the DEP to quickly review the project.

- Fill out a notification form before starting any work. Forms are available from your town code enforcement officer, Maine DEP offices, or online at <http://www.state.me.us/dep/blwq/docstand/nrpa/pbrform.pdf>
- The permit will be reviewed by DEP within 14 days. If you do not hear from DEP in 14 days, you can assume your permit is approved and you can proceed with work on the project.
- Follow all standards required for the specific permitted activities to keep soil erosion to a minimum. It is important that you obtain a copy of the standards so you will be familiar with the law's requirements.

52000
DEPARTMENT OF ENVIRONMENTAL PROTECTION
PERMIT BY RULE NOTIFICATION FORM
(For use with DEP Regulation, Chapter 305)

PLEASE TYPE OR PRINT IN BLACK INK ONLY

Name of Applicant (owner):	Sandy Waters	Applicant Mailing Address:	123 Blueberry Lane
Town/City:	Brunswick	State:	Maine
Zip Code:	04011	Daytime Telephone No. (include area code)	(207) 555-1234
County:	Cumberland	Map #:	20
Name of Agent:		Lot #:	50
		Name of Wetland or Waterbody:	Sabbathday Lake
		Agents Telephone No. (include area code)	
Disturbance to Site:	121 Outlet Road, Rte 26 North, turn right onto Outlet Road, 121 Outlet Road is on the left 4th 5 houses before Barefoot Beach		
Description of Project:	Installation of a drywell to allow infiltration of roof runoff		
Part of a larger project?	Yes	No	X

(CHECK ONE) This project: does ☐ does not ☒ involve work below mean low water.

I am filing notice of my intent to carry out work which meets the requirements for Permit By Rule (PBR) under DEP Rules, Chapter 305. I and my agents, if any, have read and will comply with all of the standards in the Sections checked below.

<input checked="" type="checkbox"/> Sec. (2) Act. Adjacent to Protected Natural Res.	<input type="checkbox"/> Sec. (8) Shoreline Stabilization	<input type="checkbox"/> Sec. (14) REPEALED
<input type="checkbox"/> Sec. (3) Intake Pipes	<input type="checkbox"/> Sec. (9) Utility Crossing	<input type="checkbox"/> Sec. (15) Public Boat Ramps
<input type="checkbox"/> Sec. (4) Replacement of Structures	<input type="checkbox"/> Sec. (10) Stream Crossing	<input type="checkbox"/> Sec. (16) Coastal Sand Dune Projects
<input type="checkbox"/> Sec. (5) REPEALED	<input type="checkbox"/> Sec. (11) State Transportation Facilities	<input type="checkbox"/> Sec. (17) Transfer/Permit Extension
<input type="checkbox"/> Sec. (6) Movement of Rocks or Vegetation	<input type="checkbox"/> Sec. (12) Restoration of Natural Areas	<input type="checkbox"/> Sec. (18) Maintenance Dredging
<input type="checkbox"/> Sec. (7) Outlet Pipes	<input type="checkbox"/> Sec. (13) FERN Creation/Enhancement/Quality Improvement	

I authorize staff of the Departments of Environmental Protection, Inland Fisheries & Wildlife, and Marine Resources to access the project site for the purpose of determining compliance with the rules. I also understand that this permit is not valid until approved by the Department or 14 days after receipt by the Department, whichever is less.

I have attached the following required submittals. NOTIFICATION FORMS CANNOT BE ACCEPTED WITHOUT THE NECESSARY ATTACHMENTS.

☒ Attach a check for \$55 (non-refundable) made payable to: "Treasurer, State of Maine".
☒ Attach a U.S.G.S. topo map or Maine Atlas & Gazetteer map with the project site clearly marked.
☒ Attach all other required submittals as outlined in the PBR Sections checked above.

By signing this Notification Form, I represent that the project meets all applicability requirements and standards in the rule and that the applicant has sufficient title, right, or interest in the property where the activity takes place.

Signature of Agent or Applicant: Sandy Waters Date: 3/4/06

Keep a copy as a record of permit. Send the form with attachments via certified mail to the Maine Dept. of Environmental Protection at the appropriate regional office listed below. The DEP will send a copy to the Town Office as evidence of the DEP's receipt of notification. No further authorization by DEP will be issued after receipt of notice. Permits are valid for two years. Work carried out in violation of any standard is subject to enforcement action.

AUGUSTA DEP STATE HOUSE STATION 17 AUGUSTA, ME 04333-0017 (207) 627-2111	PORTLAND DEP 312 CANCO ROAD PORTLAND, ME 04103 (207) 852-6300	BANGOR DEP 106 HOGAN ROAD BANGOR, ME 04401 (207) 941-4070	PRESQUE ISLE DEP 6225 CENTRAL DRIVE PRESQUE ISLE, ME 04769 (207) 764-0477
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OFFICE USE ONLY	OK#	Date	Staff	Staff	After
PBR #	FP	Date	Date	Date	Photo

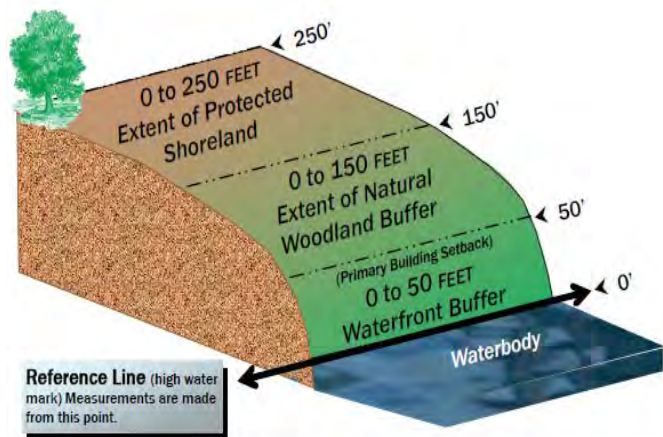
DEPLY0200-52000

Permitting ABC's for New Hampshire

Protection of New Hampshire's watersheds is ensured through the goodwill of lake residents and through laws and ordinances created and enforced by the State of New Hampshire and local municipalities. The following explains laws and ordinances regarding permits for activities adjacent to wetlands and water bodies.

THE COMPREHENSIVE SHORELAND PROTECTION ACT (CSPA) was enacted in 1992 to protect the water quality of larger water bodies by setting minimum requirements for the development and use of all land within 250 feet of the Reference Line (the high water mark - at right). Within this area, called the Protected Shoreland (at right), there are setbacks and restricted use areas that you need to know about. Effective July 1, 2008, a state shoreland permit is required for many construction, excavation or filling activities within the protected shoreland.

WETLANDS BUREAU JURISDICTION—All projects involving dredge, fill or the placement of structures in, or within the banks (*the transitional slope immediately adjacent to the edge of a surface water body, the upper limit of which is usually defined a break in slope*) of surface waters require a permit from the Department of Environmental Services Wetlands Bureau. The NH Code of Administrative Rules Env-Wt 100-800 under which the Wetlands Bureau operates, require that impacts to jurisdictional areas be avoided whenever possible and minimized where they cannot be avoided. In keeping with this requirement, Env-Wt 404 requires the applicant to use the least intrusive stabilization method, with vegetative stabilization being the least impacting alternative, followed by riprap, then retaining wall construction, which is considered to have the greatest environmental impact.



The Protected Shoreland showing setbacks and areas of restricted use.

No Shoreland or Wetlands Permit is needed when:

The stormwater management techniques included in the **NH Homeowner's Guide to Stormwater Management**, are allowed without a permit if the work is done using only hand tools and is conducted above the bank of the lake or river. For a complete list of all activities in the protected shoreland that do not require a permit go to: <http://des.nh.gov/organization/divisions/water/wetlands/cspa/categories/faq.htm#faq7>

All other activities within the Shoreland Zone:

Depending on the location and scope of the project a Wetlands and/or Shoreland permit will be required.

- If the activity will take place in the water or within the bank follow the guidelines for a Wetlands permit: <http://des.nh.gov/organization/commissioner/pip/factsheets/wet/documents/wb-11.pdf>
- If the activity will take place within 250 feet of the reference line follow the guidelines for a Shoreland permit: <http://des.nh.gov/organization/divisions/water/wetlands/cspa/categories/forms.htm>

For all information about permitting in the protected shoreland contact NHDES:

NH Department of Environmental Services, Wetlands Bureau, 29 Hazen Drive, Concord, NH 03302
603-271-2147 wetmail@des.nh.gov www.des.nh.gov/cspa

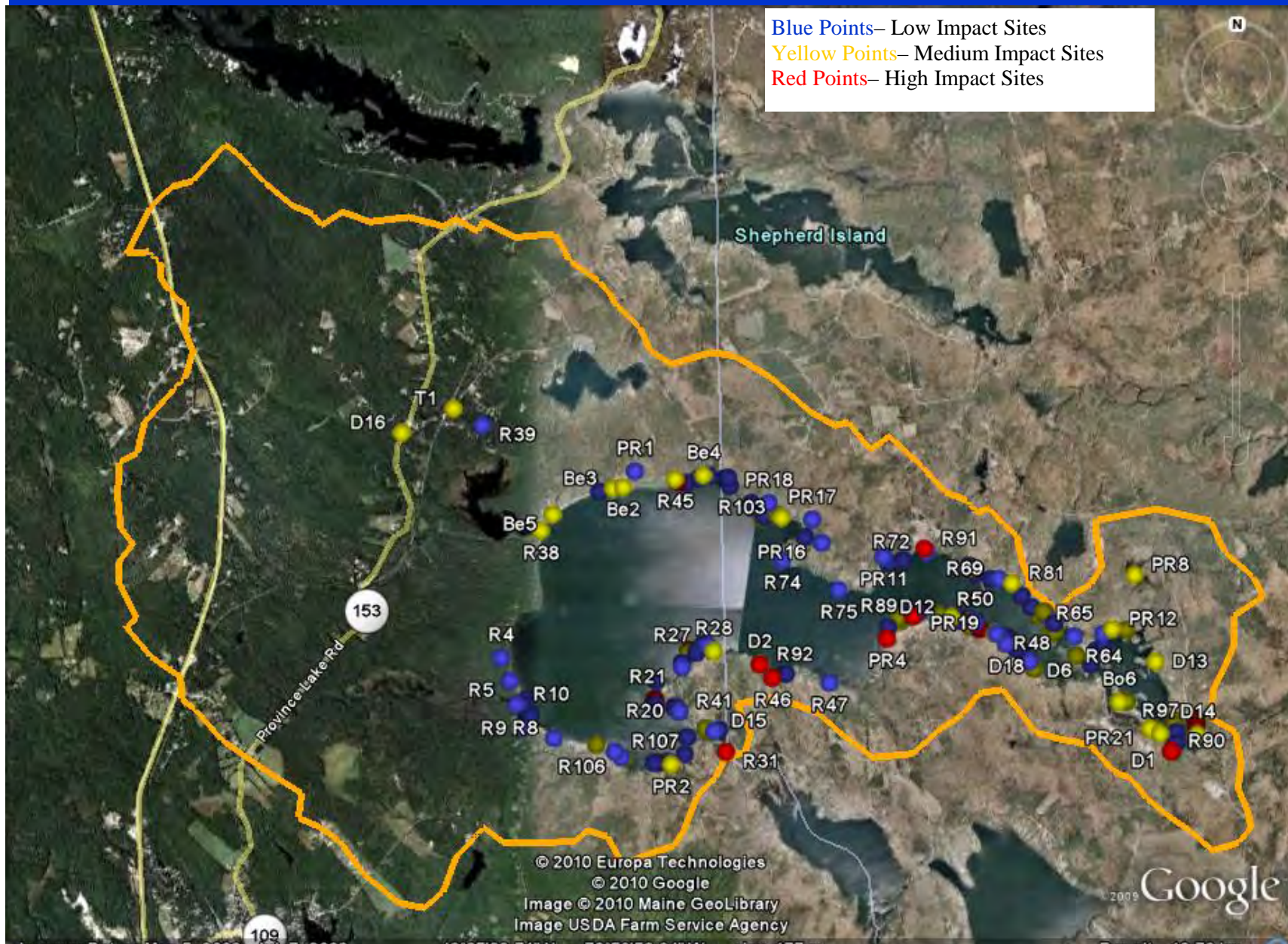


Example of erosion from wave action on Lake Waukewan that eroded the shoreline at Lake Waukewan Park.

The Town of Meredith received a permit to stabilize 45 feet of shoreline with additional boulders and stone and the Lake Conservation Corps planted 125 feet of vegetation above the bank which did not require a permit.



Appendix A: Great East Lake Watershed Maps



The map shows the Great East Lake Watershed boundary in orange, with major road ways in yellow. The sites with erosion issues identified by the volunteers are marked on this map by severity of impact to the lake.

Where Do I Get More Information?

Great East Lake Improvement Association

President, Bess Smith 978-689-9202 prez@greateastlake.org

Town of Wakefield

Arthur Capello, Code Enforcement Officer 603-522-6205

Town of Acton

Ken Paul, Code Enforcement Officer 207-636-3497 ext. 410

Acton Wakefield Watersheds Alliance

Linda Schier, Executive Director 603-473-2500 info@awwatersheds.org

York County Soil & Water Conservation District

Joe Anderson, Project Manager 207-324-0888 x 208 janderson@yorkswcd.org

New Hampshire Department of Environmental Services

Watershed Assistance Section

For technical assistance, grant program information, outreach materials, and general water quality information:

Sally Soule 603-559-0032 Sally.Soule@des.nh.gov

Wetlands & Shoreland Protection

For permitting, enforcement, and general information about NH wetlands regulations:

NH DES Wetlands Bureau 603-271-2147 wetmail@des.nh.gov

Maine Department of Environmental Protection

Watershed Management Division

For technical assistance, 319 grant information, outreach materials:

Wendy Garland (207) 822-6320 wendy.garland@maine.gov

Field Services Section

For permitting and enforcement

Jeff Kalinich (207) 822-6325 jeffrey.c.kalinich@maine.gov

Publications

Camp Road Maintenance Manual: A Guide for Landowners. Kennebec County SWCD and Maine DEP. 2000. 54 pgs. www.maine.gov/dep/blwq/docwatershed/camproad.pdf

Conservation Practices for Homeowners. Maine DEP and Portland Water District. 2006. 20 fact sheets. <http://www.maine.gov/dep/blwq/docwatershed/materials.htm>.

A Guide to Forming Road Associations. Maine DEP. October 2009. 21 pgs. www.maine.gov/dep/blwq/docwatershed/roadassociation.htm

Maine Shoreland Zoning—A Handbook for Shoreland Owners. Maine DEP. 2008. 42 pgs. www.maine.gov/dep/blwq/docstand/sz/citizenguide.pdf

Summary of the 2008 NH Shoreland Protection Act. NHDES 2008. http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/cspa_brochure.pdf

NH Homeowner's Guide to Stormwater Management. NHDES 2010. <http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm>—then search for Guide under Hot Topics

HORN POND WATERSHED SURVEY REPORT



photo courtesy of Saugus Photos Online

ACTON WAKEFIELD WATERSHEDS ALLIANCE
NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES
MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

JUNE 2008

Acknowledgements

The following people and organizations were instrumental in the Horn Pond Watershed Survey Project and deserve special recognition for their efforts:

Watershed Survey Volunteers

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Lisa Loosigian
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Glenn Wildes

Technical Staff

Joe Anderson — York County Soil & Water Conservation District
Wendy Garland — Maine Department of Environmental Protection
Linda Schier — Executive Director, Acton Wakefield Watersheds Alliance
Adam Shoukimas — Technical Director, Acton Wakefield Watersheds Alliance
Sally Soule — New Hampshire Department of Environmental Services

Sponsors

Acton Wakefield Watersheds Alliance
Maine Department of Environmental Protection
New Hampshire Department of Environmental Services



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Introduction

This report serves to compile, summarize, and analyze the data collected during the Horn Pond watershed survey conducted in June 2008 and is intended for residents, landowners, and town officials within the Horn Pond watershed. This survey is one aspect of a larger project to develop a Watershed Based Management Plan (WBMP) for the entire Salmon Falls headwaters watershed including Great East Lake, Horn Pond, Lake Ivanhoe, Lovell Lake and Wilson Lake. All of these lakes are considered high quality waters. The purpose of the WBMP project is to preserve the high quality waters status by identifying current problems, predicting future problems and recommending solutions.

Watershed surveys provide a snapshot of the condition of the watershed at the time the survey was conducted and document all evidence of sediment erosion. The information gathered during the Horn Pond survey will be used by residents in the Horn Pond watershed, the Acton Wakefield Watersheds Alliance, and the Towns of Wakefield and Acton to guide future efforts to preserve the lake's pristine quality for future generations to enjoy.

Horn Pond's Water Quality

Horn Pond is approximately 227 acres in size. The maximum water depth is 30 feet, with an average depth of 13 feet. Horn Pond has been identified by the States of New Hampshire and Maine as a high-quality waterbody based on its water quality parameters.

According to the UNH Center for Fresh Water Biology, the water in Horn Pond is remarkably clear, with an average Secchi disc reading in 2007 of approximately 21 feet (6.5 meters). This high transparency is the result of various factors. While brief intense storm events and periods of prolonged runoff such as spring snowmelt contribute to short-term increased turbidity and

lowered transparency, little chronic sediment erosion persists throughout the watershed to compromise water clarity. Additionally, a rocky lake bottom provides a poor substrate for vegetation and is not easily stirred up by boat activity or wave action. Lack of vegetation also prevents the release of tannins into the water that can compromise clarity. The lake is both spring-



photo courtesy of Saugus Photos Online

fed, where some of the water that feeds the lake has been filtered, and fed by outflow from Great East Lake and Wilson Lake, two other high-quality waterbodies.

Horn Pond has a high flushing rate making it less susceptible to pollution. Water flushes through the Horn Pond system 8.2 times per year. The average Maine and NH lake flushes once a year.

Horn Pond has an average phosphorus concentration of 9.0 ppb. Phosphorus is a nutrient that can encourage algae growth and affect lake health. This low phosphorus concentration is reflected in a low chlorophyll reading of 3.6 ppb. The lack of chlorophyll indicates very little algae in the lake.

Horn Pond is classified as an oligotrophic lake. Oligotrophic lakes are characterized as being nutrient-poor, having rocky substrates and shorelines, deeper water, limited algae and aquatic plant growth, and an abundance of dissolved oxygen, even in deep water. This profusion of dissolved oxygen is crucial for productive fish habitat and is exemplified by the abundance of fish in the lake.

Water quality data has been collected for Horn Pond since 1995. This sampling is orchestrated by the Maine Department of Environmental Protection, the University of Maine, and the Maine Volunteer Lake Monitoring Program. Volunteers collect samples for testing water quality parameters in order to maintain and keep current a water quality database of the lake.

Residents in the Horn Pond watershed and the Towns of Wakefield and Acton have also supported the efforts of the Acton Wakefield Watersheds Alliance (AWWA) and its Youth Conservation Corps (YCC). AWWA provides technical assistance to landowners with erosion problems and educates them regarding the use of best management practices (BMPs). The AWWA YCC committee and technical director select sites based on specific criteria as YCC project sites with the youth crew installing the recommended BMPs. Landowners participating in the program supply the necessary materials while the YCC's labor has been provided free of charge.

Threats To Horn Pond

Horn Pond has a number of issues threatening its water quality. The primary threat to the lake is polluted runoff, or nonpoint source (NPS) pollution. Whenever surface water is allowed to flow directly into the lake, it carries with it whatever it has picked up along its path, including nutrients, pollutants, metals, sediment, heat, and bacteria. In an undeveloped, forested watershed, runoff is slowed by the uneven forest floor and is allowed to infiltrate into the ground. The earth provides the easiest and most effective filtration of runoff.

In developed watersheds, stormwater does not always receive the filtering treatment that the forest provided. Rain water picks up speed as it flows across impervious surfaces like rooftops, compacted soil, gravel camp roads and pavement, and it becomes a destructive force.

Future development may place a serious strain on the lake. Wakefield and Acton are expected to grow by approximately 35% by the year 2025, inevitably reducing forest land and increasing impervious surfaces.



Runoff from residential properties can adversely affect water quality. Erosion on these sites carries sediment, chemicals, and fertilizers into the water. Sediment increases phosphorus loading, chemicals can be poisonous, and fertilizers feed the lake excess nutrients, all leading to compromised water quality. The recent amendments to New Hampshire's Comprehensive Shoreline Protection Act are intended to reduce the negative impacts of development on water quality. Additionally, Maine's shoreland zoning ordinances are aimed at protecting lake health.

Many of the camps that surround the lake are many decades old and some may have ineffective septic systems. Leaching of these systems can release excess nutrients and dangerous bacteria into the lake.

Camp roads pose another risk to water quality. Many of the roads surrounding the lake are unpaved and only seasonally maintained. Camp roads are subject to frequent wash-outs during periods of heavy precipitation and spring thaws. Wash-outs can transport significant quantities of sediment and gravel into the lake increasing the nutrient levels and turbidity.

Why Is Runoff a Problem?

The problem is not necessarily the water itself. It is the sediment and nutrients in the runoff that can be bad news for Maine lakes. Studies have shown that runoff from developed areas has 5 to 10 times the amount of phosphorus compared to runoff from forested areas.

The nutrient, phosphorus, is food for algae and other plants and is found in soils, septic waste, pet waste and fertilizers. In natural conditions, the scarcity of phosphorus in a lake limits algae growth. However, when a lake receives extra phosphorus, algae growth increases dramatically. Sometimes this growth causes choking blooms, but more often it results in small changes in water quality that, over time, damage the ecology, aesthetics and economy of lakes.

Soil is the biggest source of phosphorus to lakes. As every gardener knows, phosphorus and other nutrients are naturally present in the soil. So, runoff is essentially “fertilizing” Horn Pond with the soil that erodes from our driveways, roads, ditches, pathways, and beaches.

Horn Pond Watershed

A watershed is defined as all of the land that drains or “sheds” into a given waterbody. Activity in any part of the watershed can affect the quality of the waterbody as a result of the flow from rivers, streams, surface runoff, and groundwater. This is why protection of Horn Pond must be addressed on a watershed level rather than simply focusing on shoreline activity. See Appendix A, map 1 for a map of the Horn Pond watershed.

The area of the lake itself is 227 acres (0.35 square miles) while the area of the entire watershed is approximately 1.8 square miles. The lake straddles the border between the towns of Wakefield, NH, and Acton, ME. The shoreline is moderately developed on the north and east sides of the lake, with only a handful of undeveloped lots. There is partial development of the west and south sides of the lake. There are very few developed backlots. Large tracts of undeveloped land exist in the northwest corner of the lake, the site of a wetland, and along the west side, as well, where much of the land is in under conservation. There are no major municipal centers or other locations of heavy development.

New Bridge Road runs along the northwest side of the lake. Camp roads stemming from New Bridge Road are the sites of the highest concentration of development. The lake is fed by springs, outflow from Great East Lake to the north through the Great East Lake canal, and outflow from Wilson Lake to the east. The major outlet is at the south end of the lake. This outlet is dam controlled and the outflow becomes the Salmon Falls River. A public boat launch is located immediately adjacent to the dam with access from Route 109 to the south.

Horn Pond is part of a larger watershed along with Great East Lake, Lake Ivanhoe, Wilson Lake, and Lovell Lake as the headwaters of the Salmon Falls River, which serves as the border between New Hampshire and Maine. The Salmon Falls River converges with the Cocheco River to become the Piscataqua River and then empties into the Gulf of Maine.

Why Should We Protect Horn Pond?

Horn Pond's pristine conditions make it a valuable asset to the community on numerous levels: economic, recreational, ecological, and cultural.

Economically: A 1996 study by the University of Maine found that water quality is directly related to property values. The report estimated that a 3-foot decline in water clarity could reduce property values as much as 20%. The majority of the town's revenue is derived from waterfront property taxes, a figure that is based upon property value. Therefore, maintaining a clean, clear lake is crucial to the town's financial viability as well as protecting the investments of property owners. Additionally, it is much cheaper, easier, and more practical to maintain and protect a high quality lake than to clean and restore an impaired one. Prevention is much less expensive than remediation.

Recreationally: The lake draws in anglers and boaters from across the region. Horn Pond is in one of the first lakes one encounters traveling north on Route 16 from major cities to the south. The convenient location thus draws weekenders from out of state who flock to the area to pursue leisurely activities. Fishing is a popular activity thanks to the abundance of fish species including:

- brook trout
- rainbow trout
- brown trout
- smallmouth bass
- largemouth bass
- chain pickerel
- brown bullhead
- white perch
- bluegill



Horn Pond is also a popular site for powerboat activities, including waterskiing, wakeboarding, and tubing. Likewise, the lake is ideal for sailing, canoeing, and kayaking. Easy access to the lake makes boating one of the primary uses of the lake.

Ecologically: In addition to the numerous fish species, bald eagles and other large birds of prey utilize the lake habitat for hunting, nesting, and breeding. Loons are a frequent site and have become a symbol of the region. Well-oxygenated water with a large littoral zone is essential for viability of numerous aquatic species. Natural and uninterrupted shoreline and adjacent water is both the most productive and most fragile area of the lake and is critical for biodiversity. Pristine freshwater ecosystems are becoming ever more rare with the pressing encroachment of human development. This makes the preservation of Horn Pond even more important.

Culturally: A clean lake with clear water is perceived as being a community asset. Healthy lakes are regarded as being more valuable and desirable. The lake becomes a source of community pride to its users and fosters a sense of stewardship.

Purpose of the Horn Pond Survey

The purpose of the survey was to gain an in-depth understanding of the current conditions of the watershed in terms of surface sediment erosion through exhaustive direct observation.

The watershed survey is used for the following purposes:

- ☐ Identify and prioritize existing sources of polluted runoff, particularly soil erosion sites in the Horn Pond watershed.
- ☐ Raise public awareness about the connection between land use and water quality, and the impact of soil erosion on Horn Pond and to inspire people to become active watershed stewards.
- ☐ Provide the basis to obtain funding to assist in fixing identified erosion sites.
- ☐ Use the information gathered as one component of a long term lake protection strategy. The survey strengthens the WBMP because every parcel of property is physically inspected and all sediment erosion that reaches the lake is documented. The WBMP thus has a real-world perspective with hard data collected from first-hand observation.
- ☐ Make general recommendations to landowners for fixing erosion problems on their properties.
- ☐ Identify sites for future Youth Conservation Corps projects.

The purpose of the survey was NOT to point fingers at landowners with problem spots, nor was it to seek enforcement action against landowners not in compliance with ordinances. It is the hope AWWA will work with landowners to solve erosion problems on their property through technical assistance visits and YCC projects.

Local citizen participation was essential in completing the watershed survey and will be even more important in upcoming years. With assistance from AWWA and others concerned with lake water quality, the opportunities for stewardship are limitless.



The Survey Method

The survey was conducted by volunteers with the help of trained technical staff from Maine Department of Environmental Protection, NH Department of Environmental Services, York County Soil & Water Conservation District, and AWWA. 15 volunteers were trained in survey techniques during a two hour classroom workshop on June 14, 2008. Following the classroom training, the volunteers and technical staff spent the remainder of the day documenting erosion on the roads, properties, driveways, and shorelines in their assigned sectors using cameras and standardized forms. The teams worked together over the following few weeks to complete their sectors. Technical staff conducted follow-up examinations of sites over the following month to verify data accuracy.

All information collected was entered into a computerized spreadsheet to create a database of the raw data. This data was standardized and sorted into appropriate categories, and prioritized based on rankings of their impact to the lake, technical ability required to fix the problems, and estimated cost of remediation. The documented erosion sites were then plotted on maps using GIS software.

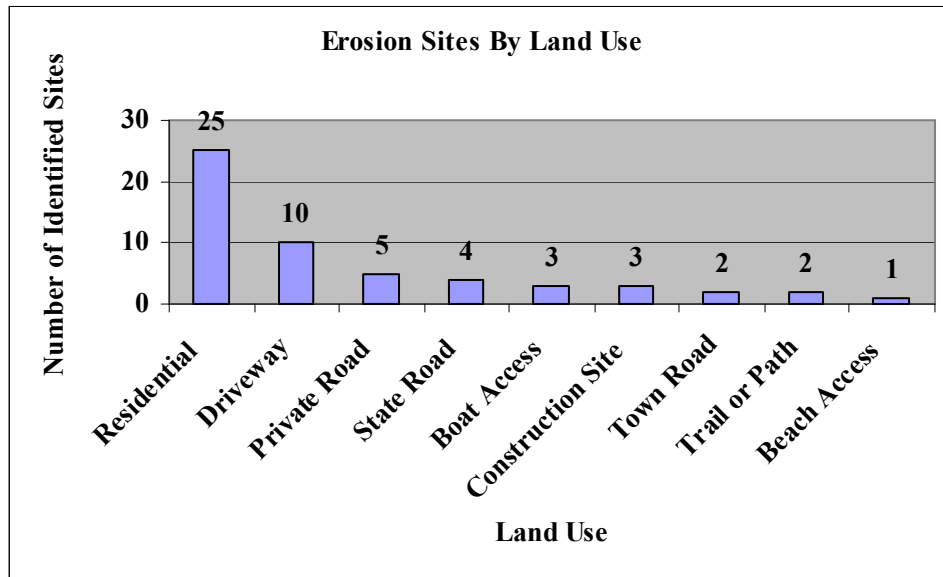
A description of sites and associated rankings are discussed in the next section of this report. Maps of the erosion sites are located in Appendix A, and a spreadsheet with data from the documented sites is located in Appendix B. Contact AWWA for additional site information.



Summary of the Horn Pond Survey

Volunteers and technical staff identified 55 sites in the watershed survey that were either impacting or had the potential to impact water quality.

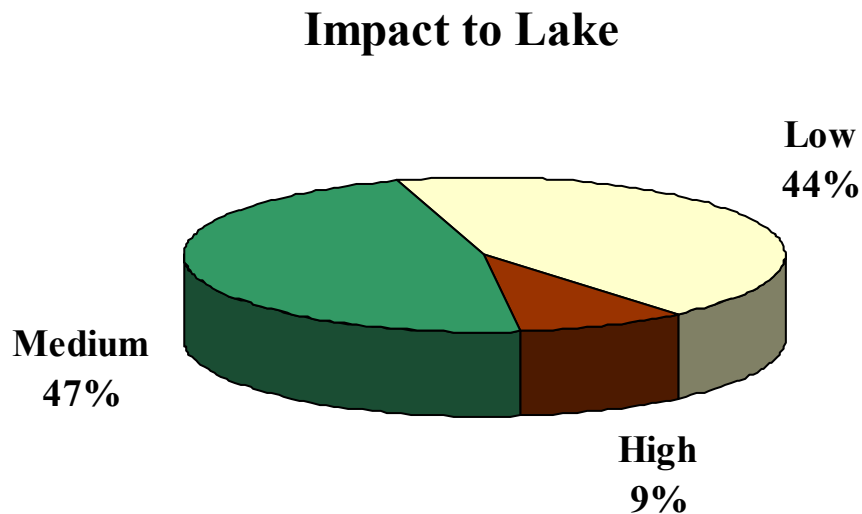
- ❑ 25 of the identified sites (45%) were found on residential properties. Most of these sites have a low impact on water quality and will be inexpensive to fix (less than \$500) with little technical expertise required. These tend to be simple fixes that can be done by the landowners themselves.
- ❑ 11 of the sites identified (24%) are associated with roads: State, town, and private. These sites tend to have a much more severe impact on the lake with higher associated costs (greater than \$2500) and required technical knowledge. Also, the procedures involved with remediating these sites are much more time and resource consuming.
 - Canal Road and New Bridge Road pose serious problems for the lake. These paved roads produce a large amount of surface runoff during periods of precipitation. The roads are also pitched in such a way as to shed the majority of this runoff towards the lake. Winter sand, road salt, oil and gas, heavy metals, and other pollutants wash off the road and are carried into the lake, creating a water quality hazard. Canal Road drains directly into the Great East Lake Canal that flows into Horn Pond. The buffer between New Bridge Road and the lake is severely limited. In some areas only a few feet separate the two.
 - Private and local camp roads were identified as 5 of the sites (9%). Many of the camp roads are pitched towards the lake. Additionally, these roads are almost exclusively dirt roads whose surface materials often end up in the lake along with the surface runoff. Road associations are an important mechanism to handle the difficulty of properly maintaining private roads. Functioning road associations should focus attention on erosion prevention. When necessary, new associations should be formed. Road maintenance crews should be trained in camp road BMPs and should work closely with road associations.
- ❑ Driveways accounted for 10 of the sites identified (18%). Often driveways are placed for the most direct access to the property without planning for the effects of stormwater. Subsequently, many driveways are washed-out and then repaired in the same manner, only to be washed-out again, creating a large delta of sediment in the lake. Driveways should be designed with the same attention to stormwater as roads. It may be strategically and economically wise for adjacent properties to share a common driveway so impervious surfaces are limited.
- ❑ 9 different land uses were identified in the survey. Thus, no single source is responsible for pollution of the lake, and all parties need to be involved in protecting the water quality. Every land use has aspects that can be improved and there are numerous resources to aid in this improvement. Town officials, individual landowners, state and local agencies, and AWWA must all play a role and work together for the benefit of Horn Pond.



Land Use Activity	High Impact	Medium Impact	Low Impact	Total
Beach Access	0	0	1	1
Boat access	0	2	1	3
Construction site	1	2	0	3
Driveway	0	6	4	10
Private Road	0	4	1	5
Residential	0	10	15	25
State Road	3	0	1	4
Town Road	1	1	0	2
Trail or Path	0	1	1	2
Total	5	26	24	55

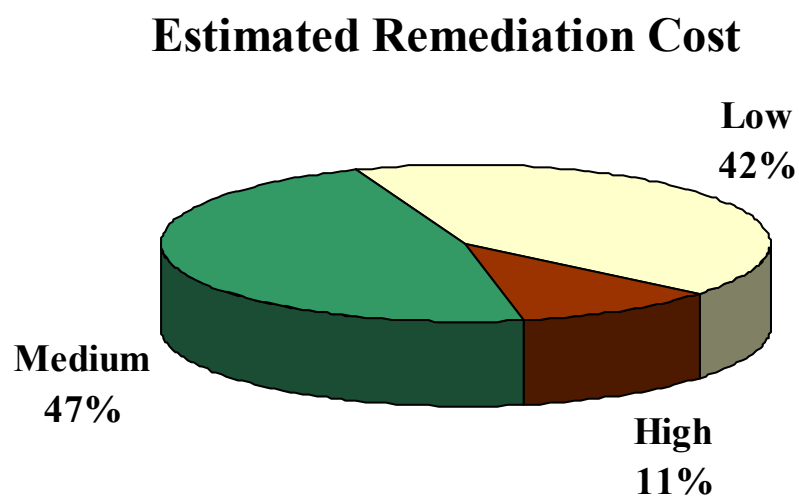
Impact to Lake: Each site was rated for its potential impact to the lake. Impact was based on slope, soil type, amount of soil eroding, proximity to water, existence of a buffer, and buffer size. The impact was almost evenly distributed between “low” and “medium” impact sites, while relatively few qualified as “high impact”.

- “Low” impact sites were those with limited soil transport off site and little or no visible gullies.
- “Medium” impact sites had some sediment transport off site with noticeable rills in the ground.
- “High” impact sites exhibited a large amount of sediment transported off site with significant gullies eroded into the ground.



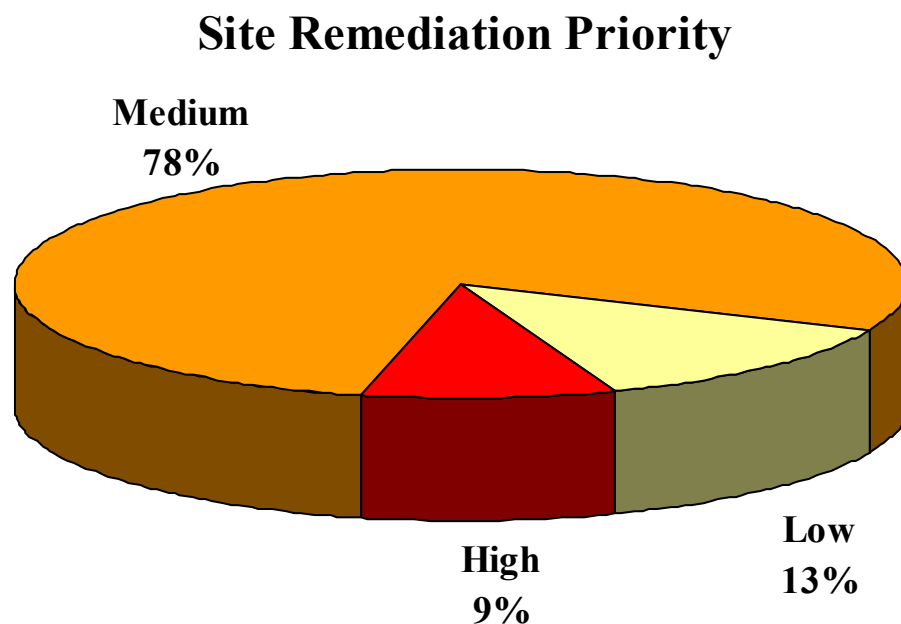
Estimated Remediation Cost: Recommendations were made for fixing each site and the associated cost of labor and materials was estimated. More sites were classified as medium cost, indicating that the fixes could be affordable for the average landowner, although assistance would be beneficial.

- “Low” cost sites were estimated to have labor and materials cost less than \$500
- “Medium” cost sites were estimated to cost between \$500 and \$2500
- “High” cost sites were estimated to cost in excess of \$2500



Site Remediation Priority: Severity of site impact to lake, estimated remediation cost, and speculation as to whether the site should be considered a YCC project were given numerical values and then totaled to score each site. The priority designation will help the LLA, AWWA and the Town develop the remediation plan for the identified sites. 9% of the sites were given “high priority” indicating that effort should be focused on these sites first when conducting remediation.

- “Low” priority sites were those that generally had high associated cost, low impact to the lake, and would not be viable YCC projects.
- “Medium” priority sites tended to be those that had both medium impact and cost and could possibly serve at YCC projects.
- “High” priority sites were typically those that had high impact to the lake, low associated cost, and would make good YCC projects.



Next Steps - Where Do We Go From Here?

Fixing the sites identified in this survey will require efforts by individuals, the Acton Wakefield Watersheds Alliance, road associations, and municipal officials.

Acton Wakefield Watersheds Alliance

- Send letters offering technical assistance to property owners, road associations, and towns with identified erosion problems and encourage them to make improvements.
- Make copies of the survey report available to property owners, road associations, and towns.
- Apply for grants to help fix erosion problems identified in the survey.
- Promote lake conservation programs such as Lake Host, Weed Watch, and water quality monitoring programs by hosting workshops, encouraging landowners to have property evaluations, and good lake stewardship.
- Increase and empower the association's membership, and provide educational materials and guidance to members of the Horn Pond watershed community.
- Partner with NH DES, ME DEP, the Towns of Wakefield and Acton, and others to seek funding and implement projects to protect lake water quality.
- Organize workshops and volunteers to start fixing identified erosion problems and teach citizens how to fix similar problems on their own properties.
- Educate municipal officials about lake issues and work cooperatively to find solutions.

Individual Landowners

- Organize to form a Horn Pond Lake Association to start a Lake Host, Weed Watch, and water quality monitoring program. Lake associations are the most effective tools to protect water quality.
- If you have an identified erosion problem, call AWWA for free advice about how to solve the issue.
- Stop mowing and raking your shoreline and parts of your property. Let lawn and raked areas revert back to natural plants. Deep shrub and tree roots help hold the soil.
- Avoid exposing bare soil. Seed and mulch bare areas.
- Call the Town of Wakefield Zoning and Shoreland Compliance Officer and NH DES, or the Acton Code Enforcement Officer and ME DEP before doing any cutting or soil disturbance projects.
- Visit www.pwd.org/news/publications.php#Brochures to learn more about conservation practices you can do yourself.
- Maintain septic systems properly. Pump septic tanks (every 2 to 3 years for year round residences; 4-5 years if seasonal) and upgrade marginal systems.

Municipal Officials

- Enforce shoreland zoning and other ordinances to ensure protection of Horn Pond.
- Conduct regular maintenance on town roads in the watershed, and fix town road problems identified in this survey.
- Participate in and support long term watershed management projects.
- Promote training for road crews, boards, commissions, and other decision-makers.

Where Do I Get More Information?

Acton Wakefield Watersheds Alliance

Linda Schier, Executive Director (603) 473-2500 info@awwatersheds.org
Adam Shoukimas, Tech. Director (603) 473-2500 techdirector@awwatersheds.org

Town of Wakefield

John Ciardi, Zoning and Shoreland Compliance Officer (603) 522-6205 x310

Town of Acton

Kenneth Paul, Code Enforcement Officer (207) 636-3497 x410 ceo@actonmaine.org

New Hampshire Department of Environmental Services

Watershed Assistance Section

For technical assistance, grant program information, outreach materials, and general water quality information

Sally Soule (603) 559-0032 ssoule@des.state.nh.gov

Wetlands & Shoreland Protection

For permitting, enforcement, and general information about NH wetlands regulations

NH DES Wetlands Bureau (603) 271-2147 wetmail@des.nh.gov

New Hampshire Fish and Game

For fishing, wildlife, and conservation officers

NH Fish and Game Region 2 (603) 744-5470 reg2@wildlife.nh.gov

Maine Department of Environmental Protection

Watershed Management Division

For technical assistance, 319 grant information, outreach materials

Wendy Garland (207) 822-6320 wendy.garland@maine.gov

Field Services Section

For permitting and enforcement

Jeff Kalinich (207) 822-6325 jeffrey.c.kalinich@maine.gov

LAKE IVANHOE WATERSHED SURVEY REPORT



ROUND POND ASSOCIATION

ACTON WAKEFIELD WATERSHEDS ALLIANCE

NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES

JUNE 2009



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Watershed Survey Volunteers

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Wendy Garland – Maine Department of Environmental Protection (ME DEP)

Heather Germadnik – Maine Department of Environmental Protection (ME DEP)

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Patrick Marass— Maine Department of Environmental Protection (ME DEP)

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Acton Wakefield Watersheds Alliance

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When combined with many other erosion sites throughout a watershed, even small sources such as this can have a significant impact on lake water quality.

Introduction

This report serves to compile, summarize, and analyze the data collected during the Lake Ivanhoe watershed survey conducted in the summer of 2009 and is intended for residents, landowners, and town officials within the Lake Ivanhoe watershed.

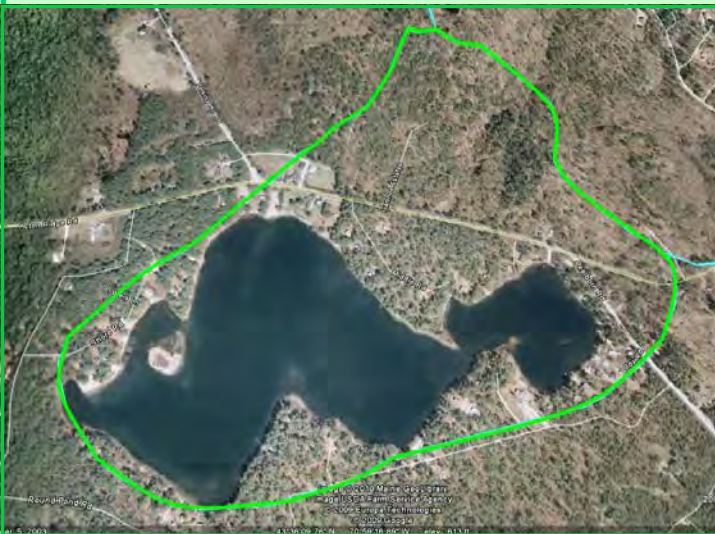
Watershed surveys provide a snapshot of the condition of the watershed at the time the survey was conducted and document all evidence of sediment erosion. The information gathered during the Lake Ivanhoe survey will be used by the Round Pond Association, the Acton Wakefield Watersheds Alliance, and the Town of Wakefield to guide future efforts to preserve the lake's water quality for future generations to enjoy.

Lake Ivanhoe Watershed

The area of Lake Ivanhoe is 68 acres while the area of the entire watershed is approximately 454 acres (0.71 square miles). The maximum water depth is 20 feet, with an average depth of 11.8 feet. The lake is located in the town of Wakefield, NH. The shoreline of Lake Ivanhoe is highly developed with only a small island in the lake undeveloped. Lake Ivanhoe is part of a larger watershed along with Lovell Lake, Horn Pond, Great East Lake, and Wilson Lake as the headwaters of the Salmon Falls River, which serves as the border between New Hampshire and Maine. The Salmon Falls River converges with the Cocheco River to become the Piscataqua River and then empties into the Gulf of Maine.

Lake Ivanhoe is fed by springs, groundwater and overland flow. The natural outflow streams that once flowed to Great East Lake have been filled and in heavy precipitation events the lake is currently flowing over land toward Great East Lake causing serious flooding problems including flooding of septic systems.

What is a Watershed?



A watershed is defined as all of the land that drains or “sheds” into a given water body. A large watershed is made up of many smaller watersheds. For example, the watershed of Lake Ivanhoe is part of the watershed of the Salmon Falls River and the watershed of the Salmon Falls River is part of the watershed of the Gulf of Maine.

Activity in any part of the watershed can affect the quality of the water body as a result of the flow from rivers, streams, surface runoff, and

groundwater, roads, ditches, pathways, and beaches. This is why protection of Lake Ivanhoe must be addressed on a watershed level rather than simply focusing on shoreline activity.

Lake Ivanhoe's Water Quality

The Round Pond Association has partnered with NHDES to collect information about the water quality of Lake Ivanhoe since 1991. In order to gather sufficient information for the Salmon Falls Headwater Lakes Watershed Management Plan (WMP) Chuck Hodsdon of AWWA gathered water quality information in 2008 and 2009 in partnership with the University of New Hampshire Lakes Lake Monitoring Program (UNH LLMP).

The water quality of Lake Ivanhoe is classified as "Potentially Impaired" based on recent analysis of measured water quality parameters. Lake Ivanhoe is potentially impaired because its in-lake phosphorus concentration exceeds the water quality standard for oligotrophic lakes in NH (< 8 ppb) as well as for chlorophyll-a (< 3.3 ppb). It is recommended that the Round Pond Association enhance its monitoring efforts to gather a more

complete data set for further analysis. The WMP recommends reducing in-lake phosphorus by 0.8 ppb to enable Lake Ivanhoe to be considered a high quality waterbody.

Phosphorus -

A nutrient needed for plant growth. It is generally present in small amounts, and limits plant growth in lakes. As the amount of phosphorus increases in the lake, the amount of algae also increases.

Lake Ivanhoe has historically shown very little dissolved oxygen depletion in the deepest parts of the lake, which is good news for limiting internal loading, which is important for prevention of algae blooms. Internal loading occurs in lakes with depleted oxygen, total phosphorus leaves the bottom sediments and enters the water column, where it becomes available to algae, promoting algae growth and the potential for algae blooms.

While brief intense storm events and periods of prolonged runoff such as spring snowmelt contribute to short-term increased turbidity and lowered transparency, little chronic sediment erosion persists throughout the watershed to compromise water clarity. Lake Ivanhoe has a very fine silty bottom which can be more easily colonized by aquatic plant species than a rocky bottom. Vegetation is important to keep track of because it can release tannins into the water that may compromise the water clarity.

The Round Pond Association has actively participated in water quality monitoring since 1991 and has been proactive in the effort to prevent and invasive aquatic plant infestation. They closely monitor the boat launch area. Fortunately non-resident boating visitors are infrequent and the association works to educate the residents about water quality protection.

The efforts of the Acton Wakefield Watersheds Alliance (AWWA) and its Youth Conservation Corps (YCC) are supported by the town of Wakefield and residents of the Lake Ivanhoe watershed. AWWA provides technical assistance to landowners with erosion problems and educates them regarding the use of best management practices (BMPs). The AWWA YCC committee and technical director select sites based on specific criteria as YCC project sites with the youth crew installing the recommended BMPs. Landowners participating in the program supply the necessary materials while the YCC's labor has been provided free of charge.

Threats to Lake Ivanhoe

The primary threat to New Hampshire lakes, including Lake Ivanhoe, is polluted storm water runoff, also known as nonpoint source (NPS) pollution. Stormwater runoff from rain and snowmelt picks up soil, nutrients and other pollutants as it flows across the land, and washes into the lake.

In an undeveloped, forested watershed, stormwater runoff is slowed and infiltrated by tree and shrub roots, grasses, leaves, and other natural debris on the forest floor. It then soaks into the uneven forest floor and filters through the soil. The earth provides the easiest and most effective filtration of runoff water.

In a developed watershed, however, stormwater does not always receive the filtering treatment the forest once provided. Rain water picks up speed as it flows across impervious surfaces like rooftops, compacted soil, gravel camp roads and pavement, and it becomes a destructive erosive force.

Although much of Lake Ivanhoe's watershed is still forested, most of the shoreline is developed with seasonal and year-round residences as well as an extensive network of town and camp roads. While these residences and road convey most of the runoff to the lake several beach and boat access points were also found to be problematic. Camp roads are subject to frequent wash-outs during periods of heavy precipitation and spring thaws. Wash-outs can transport significant quantities of sediment and gravel into the lake increasing the nutrient levels and reducing clarity.

A number of the camps that surround the lake are many decades old and some may have ineffective septic systems. Leaching of these systems can release excess nutrients and potentially dangerous bacteria into the lake.

Why is Storm Water Runoff a Problem?

The problem is not typically the water that is running into the lake, but the pollutants that it carries to the lake. It is the sediment and nutrients in the runoff that can be bad news for New England lakes.

The nutrient, phosphorus, is food for algae and other plants and is found in soils, septic waste, pet waste and fertilizers. Algae in the lake react to the addition of phosphorus in the same way that plants in the home and garden react when nutrients like phosphorus, commonly in fertilizers, are fed to the plant—they grow. In natural conditions, the scarcity of phosphorus in a lake limits algae growth. Consequently, when a lake receives extra phosphorus, algae growth increases dramatically. Sometimes this growth causes choking blooms, but more often it results in small changes in water quality that, over time, damage the ecology, aesthetics and economy of lakes.

Soil is the biggest source of phosphorus to New Hampshire lakes. As every gardener knows, phosphorus and other nutrients are naturally present in the soil. So, runoff is essentially “fertilizing” Great East Lake with the soil that erodes from our driveways, roads, ditches, pathways, and beaches.



Why Should We Protect Lake Ivanhoe?

Lake Ivanhoe's high water quality makes it a valuable asset to the community on numerous levels: economic, recreational, ecological, and cultural.

- ❑ Once a lake has declined, it can be difficult or impossible to restore. Prevention is the key.
- ❑ A 3-foot decline in water clarity could reduce property values as much as 20%. A large portion of Wakefield's revenue is derived from waterfront property taxes, which are based upon property value. Therefore, maintaining a clean, clear lake is crucial to the town's financial viability as well as protecting the investments of property owners.
- ❑ The lake draws in anglers from across the region. The convenient location thus draws weekenders from out of state who flock to the area to pursue leisurely activities. The small size of the lake and clarity make it ideal for swimming, sailing, canoeing, and kayaking.
- ❑ Fishing is a popular activity thanks to the abundance of fish species including: smallmouth bass, American eel, chain pickerel, lake trout, largemouth bass, rainbow smelt, white perch, and yellow perch.
- ❑ In addition to the numerous fish species, bald eagles and other large birds of prey utilize the lake habitat for hunting, nesting, and breeding. Nesting loons are a frequent site and have become a symbol of the region with only a few hundred nesting pairs in the entire state. Declining water quality could force these majestic birds to find a different and healthier waterbody to call home.
- ❑ A clean lake with clear water is perceived as being a community asset. Healthy lakes are regarded as being more valuable and desirable. The lake becomes a source of community pride to its users and fosters a sense of stewardship.
- ❑ Sediment deposited into the lake from erosion creates the ideal environment for invasive aquatic plants to thrive.



Purpose of the Lake Ivanhoe Survey

The purpose of the survey was to gain an in-depth understanding of the current conditions of the watershed in terms of surface sediment erosion through exhaustive direct observation.

The watershed survey is used for the following purposes:

- ☐ Identify and prioritize existing sources of polluted runoff, particularly soil erosion sites in the Lake Ivanhoe watershed.
- ☐ Raise public awareness about the connection between land use and water quality, and the impact of soil erosion on Lake Ivanhoe and to inspire people to become active watershed stewards.
- ☐ Provide the basis to obtain funding to assist in fixing identified erosion sites.
- ☐ Use the information gathered as one component of a long term lake protection strategy. The survey strengthens the WMP because every parcel of property is physically inspected and all sediment erosion that reaches the lake is documented. The WBMP thus has a real-world perspective with hard data collected from first-hand observation.
- ☐ Make general recommendations to landowners for fixing erosion problems on their properties.
- ☐ Identify sites for future Youth Conservation Corps demonstration projects.

The purpose of the survey was NOT to point fingers at landowners with problem spots, nor was it to seek enforcement action against landowners not in compliance with ordinances. It is the hope that the Round Pond Association and AWWA will work together with landowners to solve erosion problems on their property through technical assistance visits and YCC projects.

Local citizen participation was essential in completing the watershed survey and will be even more important in upcoming years. With the leadership of AWWA, the Round Pond Association and others concerned with lake water quality, the opportunities for stewardship are limitless.

The Survey Method

The survey was conducted by volunteers with the help of trained technical staff from NH DES, York County SWCD, and AWWA. 35 volunteers were trained in survey techniques during a two hour classroom workshop on June 13, 2009. Following the classroom training, the volunteers and technical staff spent the remainder of the day documenting erosion on the roads, properties, driveways, and shorelines in their assigned sectors around Ivanhoe and Great East using cameras and standardized forms. The teams worked together over the following few weeks to complete their sectors.

Impact to Lake: Each site was rated for its potential impact to the lake. Impact was based on slope, soil type, amount of soil eroding, proximity to water, existence of a buffer, and buffer size. The impact was almost evenly distributed between the three classifications, although more sites qualified as “high impact”.

- ☐ “Low” impact sites were those with limited soil transport off site and little or no visible gullies.
- ☐ “Medium” impact sites had some sediment transport off site with noticeable rills in the ground.
- ☐ “High” impact sites exhibited a large amount of sediment transported off site with significant gullies eroded into the ground.

Estimated Remediation Cost: Recommendations were made for fixing each site and the associated cost of labor and materials was estimated. Most sites were classified as low cost, indicating that the fixes would be affordable for the average landowner.

- ☐ “Low” cost sites were estimated to have labor and materials cost less than \$500
- ☐ “Medium” cost sites were estimated to cost between \$500 and \$2500
- ☐ “High” cost sites were estimated to cost in excess of \$2500

Technical staff conducted follow-up examinations of sites in subsequent months to verify data accuracy and estimate soil loss from the sites characterized as having a medium or high impact on Lake Ivanhoe. Estimates of soil loss to the lake were made using three different models, the most appropriate model or models were selected for each site. For roads and driveways the Washington State University WEPP Forest Road Erosion Predictor was utilized. For sites with gully erosion the Michigan Department of Environmental Quality Region 5 Watersheds Training Manual gully erosion equation was used. The channel erosion equation from the same Region 5 resource was used for road bank, ditch bank, and stream bank erosion. These models are used by many organizations to estimate soil loss, including ME DEP. In situations requiring the use of more than one model care was taken to ensure that soil loss was not

estimated twice from one area, in other words, estimates are conservative.

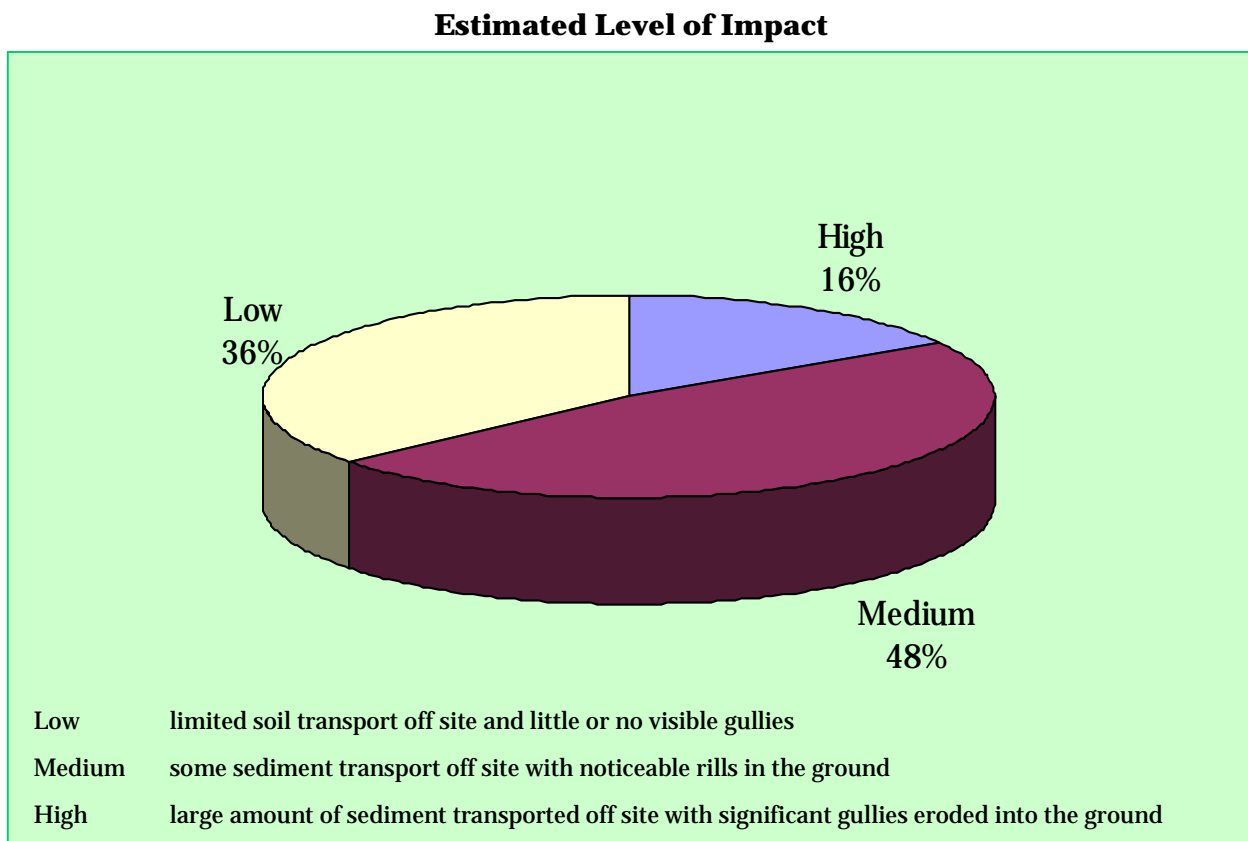
All information collected during the initial survey and subsequent soil loss estimations were entered into a spreadsheet to create a database of the information. This data was standardized, validated, and organized to allow relationships to be realized. The sites that were identified by volunteers were prioritized for remediation based on rankings of their impact to the lake, required technical expertise, and estimated cost of remediation. The documented erosion sites were then marked, along with the Lake Ivanhoe watershed boundary, using Google Earth.

Lake Ivanhoe Survey Results

A description of sites and associated rankings are discussed in the next section of this report. Maps of the erosion sites are located in Appendix B, and a spreadsheet with data from the documented sites is located in Appendix C. Please contact AWWA for any additional site information.

Potential to Impact Water Quality: Volunteers and technical staff identified 25 sites with erosion issues on Lake Ivanhoe that were either impacting or had the potential to impact water quality in Lake Ivanhoe. They estimated the expected impact of these sites on the lake using the criteria explained in the previous section. Almost half of the sites that the volunteers identified were expected to have a medium level of potential impact on Lake Ivanhoe.

Figure 1: Percentage of erosion sites by level of impact



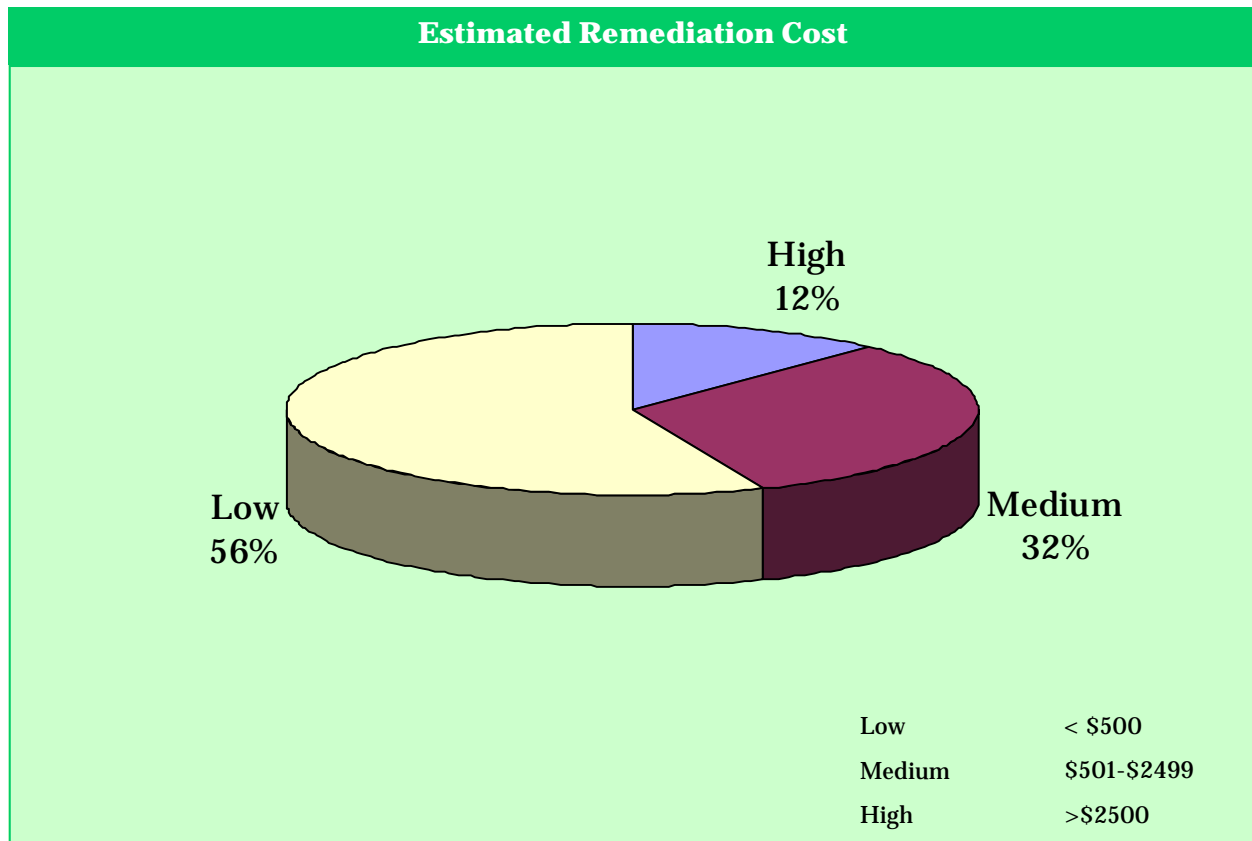
- ❑ 20 of the identified sites (80%) were found on residential properties.
 - More than half of the residential sites identified were expected to have a high or medium impact on the lake. Most frequently the volunteers sited erosion, lack of shoreline vegetation or inadequate shoreline vegetation as problems associated with these sites.
- ❑ 2 of the sites identified were associated with beach access points and one site (4%) was associated with a boat access point.
 - Erosion problems in the areas where people are accessing the lake accounted for 12% of the sites identified by the volunteers as potentially impacting the quality of Lake Ivanhoe. Frequent traffic and a desire for a sandy beach can make these access points vulnerable and likely to pose erosion problems.
- ❑ One of the sites identified was associated with a town road. This site was estimated to have a medium impact to the lake.
 - Paved roads produce a large amount of surface runoff during periods of precipitation. Winter sand, road salt, oil and gas, heavy metals, and other pollutants wash off the road and can be carried into the lake, creating a water quality hazard. When the buffer between paved roads and the lake is limited the potential for road pollutants to impact the lake increases.
- ❑ 5 different land uses were identified in the survey. Thus, no single source is responsible for pollution of the lake, and all parties need to be involved in protecting the water quality. Every land use has aspects that can be improved and there are numerous resources to aid in this improvement. Town officials, individual landowners, state and local agencies, the Round Pond Association, and AWWA must all play a role and work together for the benefit of Lake Ivanhoe.

Table 1: Breakdown of sites by Land Use categories and Impact to Lake

Land Use Activity	High Impact	Medium Impact	Low Impact	Total
Beach Access	0	1	1	2
Boat Access	1	0	0	1
Construction/Logging	1	0	0	1
Residential	1	11	8	20
Town Road	1	0	0	1
Total	3	13	9	25

As mentioned before, the volunteers were also charged with estimating the cost required to remediate the erosion problems that they encountered during the survey. The majority of the sites identified and investigated by the volunteers were assessed to have a relatively low cost of repair (less than \$500).

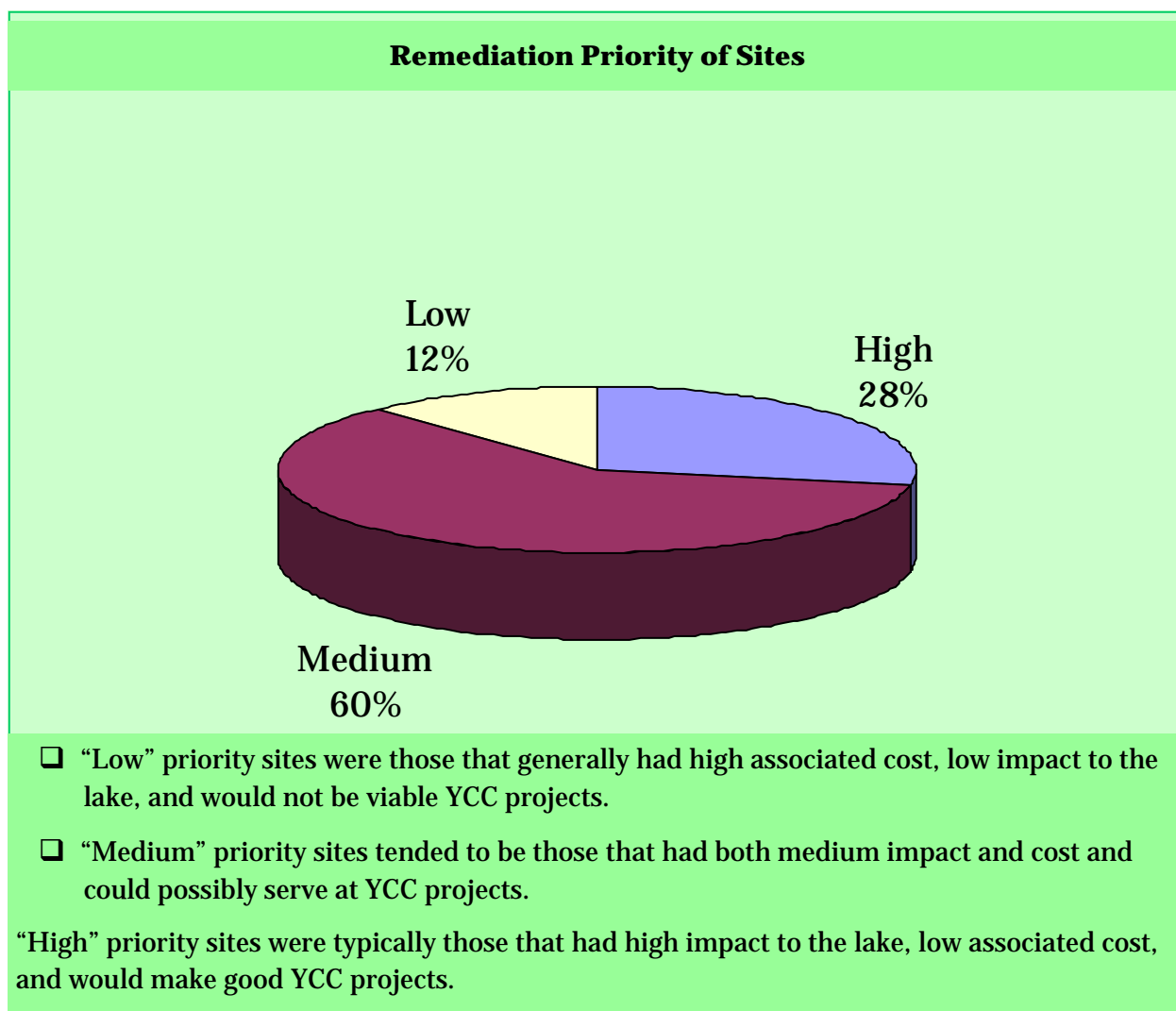
Figure 2: Estimated Erosion Site Remediation Cost



- ☐ Many of the residential sites identified are generally also expected to require little technical expertise for repair. These erosion issues tend to have simple solutions which can be accomplished by the landowners themselves. One issue that seemed prevalent was the lack of a vegetative buffer and this can be simply and affordably repaired by no mow areas and the addition of some hardy shrubs.
- ☐ Roads repairs often require technical experience to properly solve the erosion problems.
- ☐ The two sites expected to have high costs for remediation were the construction/logging area and the boat access. Neither of these sites were approached with mindfulness of lake health and their estimated remediation costs reflect this fact. Repairing these sites would require technical assistance/expertise.
- ☐ Some of the common issues associated with the sites estimated to have medium costs associated with repairs was aging and/or failing retaining walls.

Site Remediation Priority: Severity of site impact to lake, estimated remediation cost, and speculation as to whether the site should be considered a YCC project were given numerical values and then totaled to score each site. The priority designation will help AWWA, the Round Pond Association and the Town develop the remediation plan for the identified sites. 20% of the sites were given “high priority” indicating that effort should be focused on these sites first when conducting remediation.

Figure 3: Estimated Site Remediation Priority



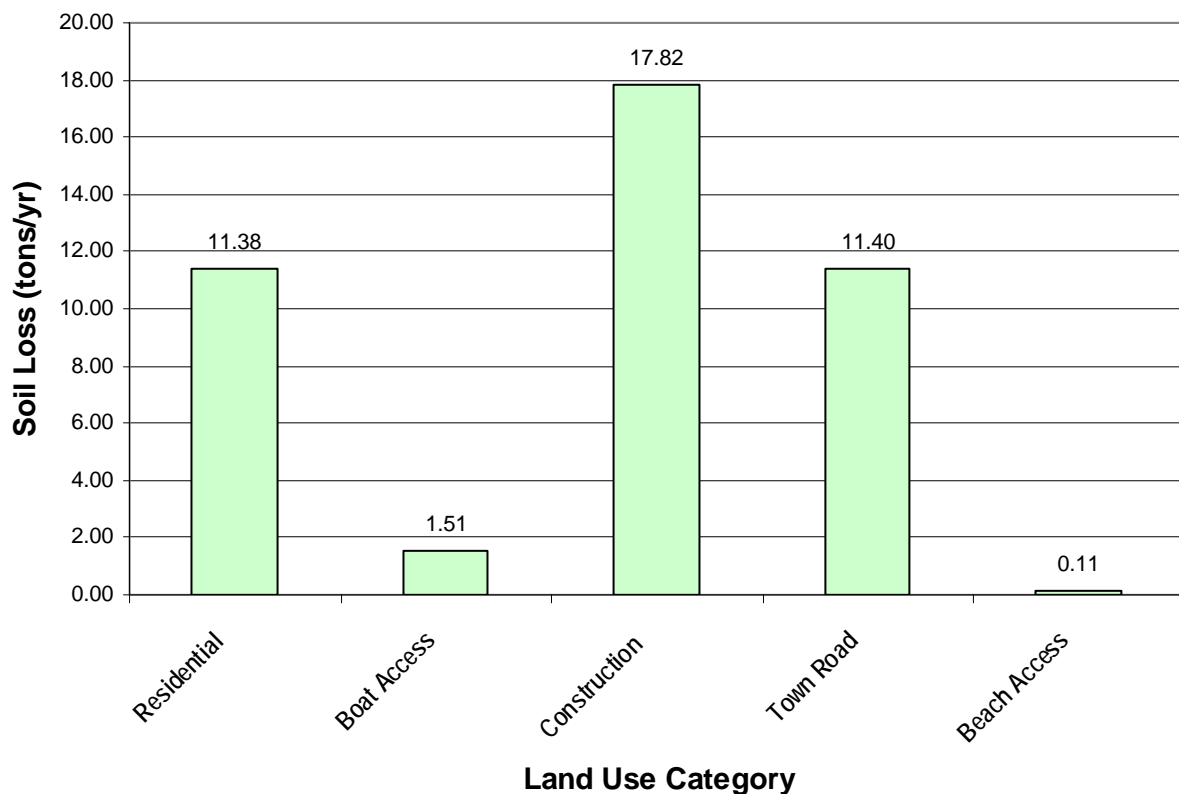
The efforts of organizations like AWWA and the Round Pond Association are best directed towards the sites characterized as high priority, as the positive change affected per dollar and unit of effort is likely to be highest for these sites. Through remediating and encouraging land owner remediation of the high priority sites the Round Pond Association and AWWA will be able to prevent a large amount of sediment from entering Lake Ivanhoe with out expending all of the resources of the organizations. Also, as the high priority erosion problems are repaired by community members and the YCC awareness and support for these efforts will increase.

The majority of sites assessed were determined to be of medium priority for remediation. This category could be refined further based on the criteria of land owner involvement, both willingness to be a YCC host site and ability to participate in the project. As stated earlier, some of the sites visited could be improved by landowners if they were equipped with the correct information. Low impact sites are the ones most likely to be repaired by the landowners themselves, therefore, the low impact sites may have added reason, regardless of potential as YCC host sites, to be categorized as high priority for education (print resources, web resources, and technical assistance visits).

Low priority sites are those that likely have low impact on water quality in Lake Ivanhoe and a high cost for repair. These sites will likely be last to receive attention, unless the landowners decide to put forth the time and treasure to repair them. Some high impact sites with high associated costs that are not potential YCC host sites may also be placed in this category or the medium priority category. These sites should probably be addressed by involving professionals and appealing for government support through grants or low interest loans.

Soil Loss Estimates

Figure 4: Estimated Soil Loss Impact to Lake



After the volunteers completed the initial survey of Lake Ivanhoe two trained assessors visited all of the sites that were identified as having a medium or high impact on the water quality of Lake Ivanhoe, as well as, many of the sites identified as low impact. Volunteer data sheets were assessed for completeness and thoroughness and any that were questionable were revisited. During this visit the assessors also collected the measurements necessary to estimate soil loss using the WEPP and Region 5 models.

The estimates that were made using the WEPP and Region 5 models are intended to serve as an indicator of the current state of soil loss to the lake. As erosion sites are remediated, if the repair is considered complete, the site can be assumed to add a negligible amount of soil to Lake Ivanhoe and be removed from the list of potential soil contributors. The soil loss estimates allow AWWA and the Round Pond Association to assess the amount of soil that was prevented from entering the lake by YCC and community remediation projects. This information is also useful for the WMP that is in progress. Information about soil loss can also be used to estimate the amount of nutrients of interest (phosphorus) being contributed by a particular site where erosion is happening. The total estimated soil entering Lake Ivanhoe from the sites identified by the volunteers was 42.21 tons per year.

The two land use categories estimated to contribute the largest amount of soil to the lake were both categories with only one site. One area near the lake where there is some type of a construction/logging operation was estimated to be sending 17.82 tons of soil per year to Lake Ivanhoe, silt fences and hay bales placed in the area were not properly installed. For a silt fence to effectively prevent soil from leaving an area it must be “toed in” below the area of erosion and maintained regularly. One improperly ditched town road with a culvert sending run off water directly into the lake was estimated to be contributing 11.4 tons of soil per year to Lake Ivanhoe. According to the estimates of the assessors who used Region 5 and WEPP modeling, large projects in the Lake Ivanhoe watershed aimed at remediating these two problem areas could potentially diminish the amount of soil entering Lake Ivanhoe by more than 29 tons per year. If road projects can be funded by grant money through the Clean Water Act then the town would not be overly burdened by costs of the repairs.

The estimated soil contribution of residential properties to Lake Ivanhoe is more than 11 tons per year. This demonstrates the significant opportunity that property owners have to protect the water quality of Lake Ivanhoe. It is important to arm these community members with good information about selecting and utilizing BMPs.

Access to the lake also seems to pose a problem for residential property owners and municipalities alike with a combined soil contribution of over 1.6 tons per year from boat and beach access points. This might demonstrate a need for education about techniques for accessing the lake that are safe and do not cause erosion.

Residential Areas

Volunteers identified 20 sites associated with residential areas. They estimated that 8 sites have low impact on water quality, 11 have medium impact, and 1 has high impact. Some of the most common problems and recommended conservation practices are pictured below.



Roof Runoff—Install stone-filled trenches along roof drip-line to help infiltrate runoff.



Problem— Roof runoff causing bare soils to erode.

Solution— Cover soil with erosion control mulch, plant grass and / or install drip-line trench.



Mulch—Place heavy-duty “erosion control mix” on bare soil.

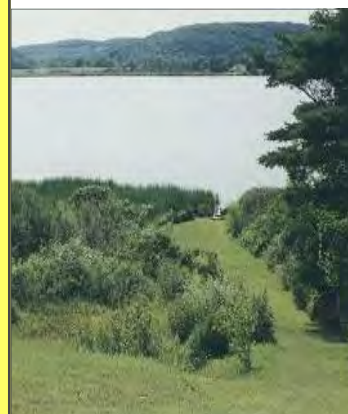


Waterbars—Place timbers or log “speed bumps” across paths to slow runoff and trap soil.



Problem—The lack of a buffer allows erosion to easily enter Lake Ivanhoe.

Solution— Plant a native buffer along shoreline to treat storm water runoff.



Buffers—Plant trees and shrubs along the shoreline or let them grow back naturally.

Residential areas were associated with the majority of the identified sources of polluted runoff. These problems pose a significant threat to lake water quality. Fortunately, most of these sites can be corrected with easy, low cost fixes.

Private Roads, Camp Roads, and Driveways

Some of the most common problems and recommended conservation practices associated with private roads and camp roads are pictured below.



Rubber Razors—Direct water off the driveway and into vegetation with rubber razors.



Problem— Moderate surface erosion with direct flow to the lake.

Solution— Reshape and crown, install runoff diverter, add new surface material.



Open Top Culverts—Direct water off the driveway with open top culverts.



Road Material—Add hard-packing, cohesive surface material to the driveway.



Problem— Severe road shoulder erosion.

Solution— Reshape the bank with a more gentle slope, armor the slope with rip rap, add plantings above slope as needed.



Ponding Areas—Create small ponding areas to trap sediment and infiltrate driveway runoff.

Preserve water quality and save time, money, and wear on your vehicle by having a lake-friendly camp road. Use adequate surface material, establish a crown, and add diversions to direct runoff into buffers.

Town Roads

There was 1 town road site identified during the survey. The volunteers estimated that the town road site has a high impact on water quality. Some of the most common problems associated with town roads and recommended conservation practices are pictured below.



Ditching—Create U-shaped ditches and armor them with rocks and/or grass.



Problem— Unstable road shoulder and culvert erode sediment into stream

Solution— Armor with stone riprap, vegetate and reshape road shoulder and ditch



Turnouts—Create openings along roads or ditches to direct water into vegetated areas.



Culverts—Armor culvert inlets and outlets with rock riprap. Create 'plunge pools' to protect the outlet and trap sediment.



Problem— Road shoulder erosion and inadequate armoring delivers sediment to lake

Solution— Reshape and vegetate road shoulders and ditch, install check dams in ditch to trap sediment



Crown—Grade the road so that water runs off the sides. Remove sand and grader berms from the edges of the road.

Roads are one of the biggest sources of pollution to New Hampshire lakes. Regular maintenance by road associations and town and state road departments is critical.

What Happens Next?

Remediating the erosion issues identified in this survey will require efforts by community members, the Round Pond Association, the Acton Wakefield Watersheds Alliance, road associations, and municipal officials.

Round Pond Association and Acton Wakefield Watersheds Alliance

- ☐ Send letter offering technical assistance to property owners, road associations, and towns with identified erosion problems and encourage them to make improvements.
- ☐ Make available copies of the survey report to property owners, road associations, and towns.
- ☐ Apply for grants to help fix erosion problems identified in the survey.
- ☐ Continue to promote the Lake Host, Weed Watch, and water quality monitoring programs by hosting workshops, encouraging landowners to have property evaluations, and good lake stewardship.
- ☐ Continue to increase and empower the association's membership, and provide educational materials and guidance to members of the Lake Ivanhoe watershed community.
- ☐ Continue to partner with NH DES, the Town of Wakefield, and others to seek funding and implement projects to protect lake water quality.
- ☐ Organize workshops and volunteers to start fixing identified erosion problems and teach citizens how to fix similar problems on their own properties.
- ☐ Educate municipal officials about lake issues and work cooperatively to find solutions.

Individual Landowners

- ☐ Consider repairing areas of your property where you see erosion happening. Please contact AWWA for technical assistance and or educational materials about BMPs.
- ☐ Contact AWWA about getting involved with the Lake Host, Weed Watch, and water quality monitoring programs.
- ☐ Stop mowing and raking your shoreline and parts of your property. Let lawn and raked areas revert back to natural plants. Deep shrub and tree roots help hold the soil.
- ☐ Avoid exposing bare soil. Seed and mulch bare areas.
- ☐ Call the Town of Wakefield Zoning and Shoreland Compliance Officer or the Acton code enforcement officer before doing any tree cutting or soil disturbance projects.
- ☐ Visit www.pwd.org/news/publications.php#Brochures to learn more about conservation practices you can do yourself.
- ☐ Maintain septic systems properly. Pump septic tanks (every 2 to 3 years for year round residences; 4-5 years if seasonal) and upgrade marginal systems.
- ☐ Join the Round Pond Association and get involved with their activities.

Municipal Officials

- ☐ Enforce shoreland zoning and other ordinances to ensure protection of Lake Ivanhoe.
- ☐ Conduct regular maintenance on town roads in the watershed, and fix town road problems identified in this survey.
- ☐ Participate in and support long term watershed management projects.
- ☐ Promote training for road crews, boards, commissions, and other decision-makers.

Forming Road Associations

Effective maintenance of camp roads is a pivotal step in the ongoing protection of Great East Lake.

What is a road association?

- Simply put, a road association is a way for landowners on a private camp road to share responsibility, make decisions and split costs for road maintenance and repairs.
- There are three types of road associations: Informal, Statutory and Nonprofit Corporation. Each type of road association varies in the formation time, complexity and legal standing.
- While some small roads make do with informal associations, more and more roads are becoming statutory associations. Once formed, statutory associations are run through a straight-forward, democratic process and have the ability to collect dues and receive some legal protections.

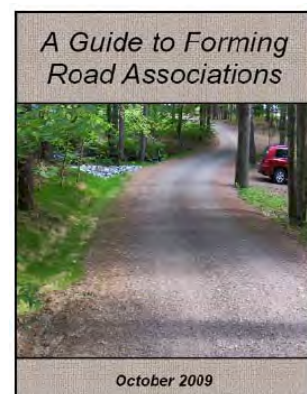
Why form a road association on Great East Lake?

- 14 of the high and medium impact sites identified during the watershed survey are private camp roads. Maintaining these camp roads through a road association would help to protect Great East Lake from the negative impacts of soil erosion.
- A road association provides an avenue for you and other private camp road users to formally manage your road in a fair, organized and cost-effective manner.
- Road associations help to reduce the maintenance costs over time. The *Camp Road Maintenance Manual* estimates that \$1 spent on routine maintenance will save \$ 15 in capital repairs.

More information on road associations:

- The Maine DEP's 'Guide to Forming a Road Association' is available at the AWWA office or www.maine.gov/dep/blwq/docwatershed/roadassociation.htm. The manual describes the different types of road associations, legal issues, and steps to forming associations, including templates for bylaws and forms. While it is written for Maine there are many useful hints for forming road associations.
- For other resources about laws, maintenance, and the impact of poor camp roads on water quality, go to www.maine.gov/dep/blwq/docwatershed/camp/roads/index.htm

**Soil might be natural, but soil washing off camp roads is not.
Protect Lake Ivanhoe by forming a road association and working
together to fix the problems.**



Conservation Practices for Homeowners

After reading this report you probably have a general idea about how to make your property more lake-friendly. However, making the leap from concept to construction may be a challenge.

The Maine DEP and Portland Water District offer a series of fact sheets that answer many common how-to questions. The fact sheets profile 20 common conservation practices and include detailed instructions, diagrams and color photos about installation and maintenance. The series includes the following fact sheets:

Construction BMPs	Erosion Control Mix	Native Plant Lists
Dripline Trench	Infiltration Steps (2)	(6)
Drywells	Infiltration Trench	Open-Top Culverts

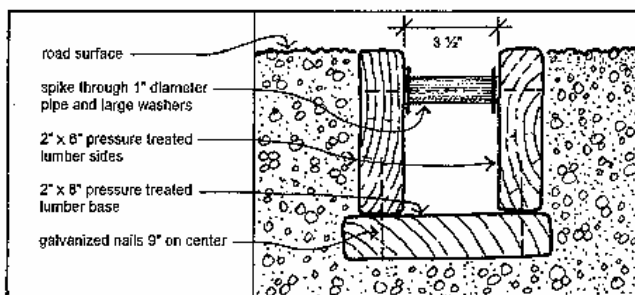
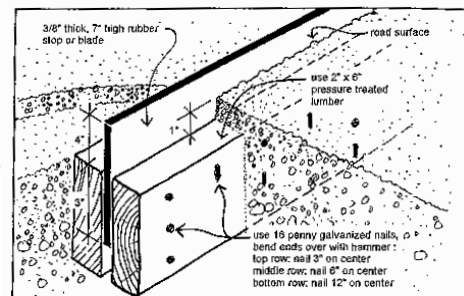
The series also includes four native plant lists. Each one is tailored to different site conditions (e.g., full sun and dry soils). The lists include plant descriptions from the DEP's *Buffer Handbook* and small color photos of each plant to make plant selection easier.



Fact sheets are available to help you install conservation practices on your property

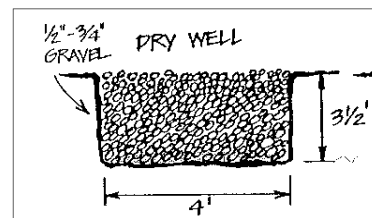
Download at <http://www.maine.gov/dep/blwq/docwatershed/materials.htm>.

Rubber Razor Blade: Use this structure in a gravel driveway or camp road. It can be plowed over only if the plow operator is aware of its presence and lifts the plow blade slightly. Place it at a 30 degree angle to the road edge and direct the outlet toward a stable vegetated area.



Open Top Culvert: Use this structure in a gravel driveway or camp road that does not get plowed in the winter. Place it at a 30 degree angle to the road edge and point the outlet into stable vegetation. Remove leaves and debris as needed.

Drywell: Use a drywell to collect runoff from roof gutter downspouts. Drywells can be covered with sod, or left exposed for easy access and cleanout. Drywells and infiltration trenches work best in sandy or gravelly soils.

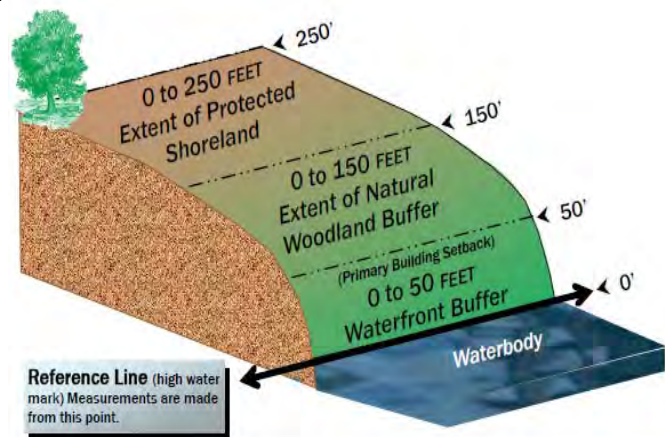


Permitting ABC's for New Hampshire

Protection of New Hampshire's watersheds is ensured through the goodwill of lake residents and through laws and ordinances created and enforced by the State of New Hampshire and local municipalities. The following explains laws and ordinances regarding permits for activities adjacent to wetlands and water bodies.

THE COMPREHENSIVE SHORELAND PROTECTION ACT (CSPA) was enacted in 1992 to protect the water quality of larger water bodies by setting minimum requirements for the development and use of all land within 250 feet of the Reference Line (the high water mark - at right). Within this area, called the Protected Shoreland (at right), there are setbacks and restricted use areas that you need to know about. Effective July 1, 2008, a state shoreland permit is required for many construction, excavation or filling activities within the protected shoreland.

WETLANDS BUREAU JURISDICTION—All projects involving dredge, fill or the placement of structures in, or within the banks (*the transitional slope immediately adjacent to the edge of a surface water body, the upper limit of which is usually defined a break in slope*) of surface waters require a permit from the Department of Environmental Services Wetlands Bureau. The NH Code of Administrative Rules Env-Wt 100-800 under which the Wetlands Bureau operates, require that impacts to jurisdictional areas be avoided whenever possible and minimized where they cannot be avoided. In keeping with this requirement, Env-Wt 404 requires the applicant to use the least intrusive stabilization method, with vegetative stabilization being the least impacting alternative, followed by riprap, then retaining wall construction, which is considered to have the greatest environmental impact.



The Protected Shoreland showing setbacks and areas of restricted use.

No Shoreland or Wetlands Permit is needed when:

The stormwater management techniques included in the **NH Homeowner's Guide to Stormwater Management**, are allowed without a permit if the work is done using only hand tools and is conducted above the bank of the lake or river. For a complete list of all activities in the protected shoreland that do not require a permit go to: <http://des.nh.gov/organization/divisions/water/wetlands/cspa/categories/faq.htm#faq7>

All other activities within the Shoreland Zone:

Depending on the location and scope of the project a Wetlands and/or Shoreland permit will be required.

- If the activity will take place in the water or within the bank follow the guidelines for a Wetlands permit:
<http://des.nh.gov/organization/commissioner/pip/factsheets/wet/documents/wb-11.pdf>
- If the activity will take place within 250 feet of the reference line follow the guidelines for a Shoreland permit:
<http://des.nh.gov/organization/divisions/water/wetlands/cspa/categories/forms.htm>

For all information about permitting in the protected shoreland contact NHDES:

NH Department of Environmental Services, Wetlands Bureau, 29 Hazen Drive, Concord, NH 03302



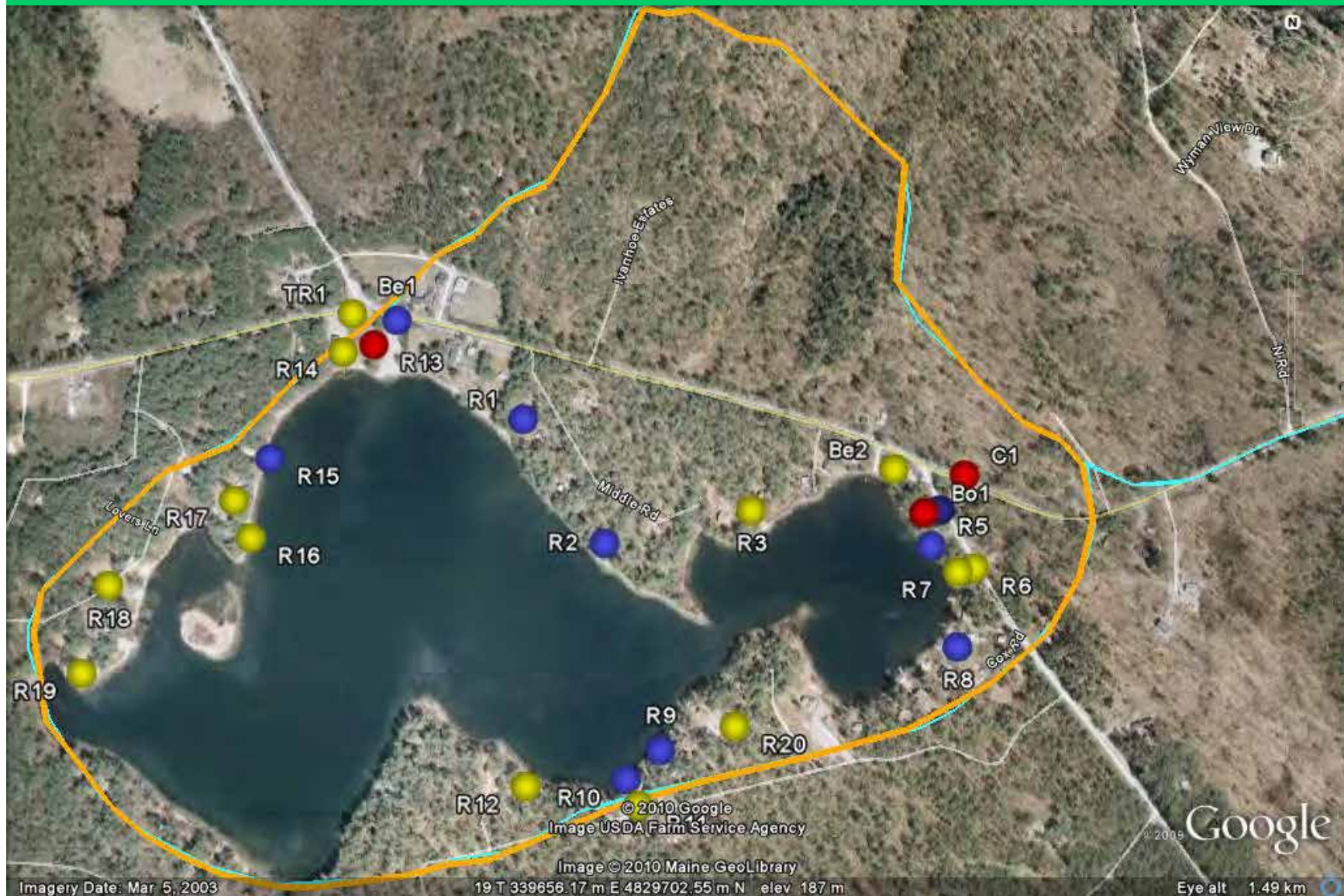
Example of erosion from wave action on Lake Waukegan that eroded the shoreline at Lake Waukegan Park.

The Town of Meredith received a permit to stabilize 45 feet of shoreline with additional boulders and stone and the Lake Conservation Corps planted 125 feet of vegetation above the bank which did not require a permit.



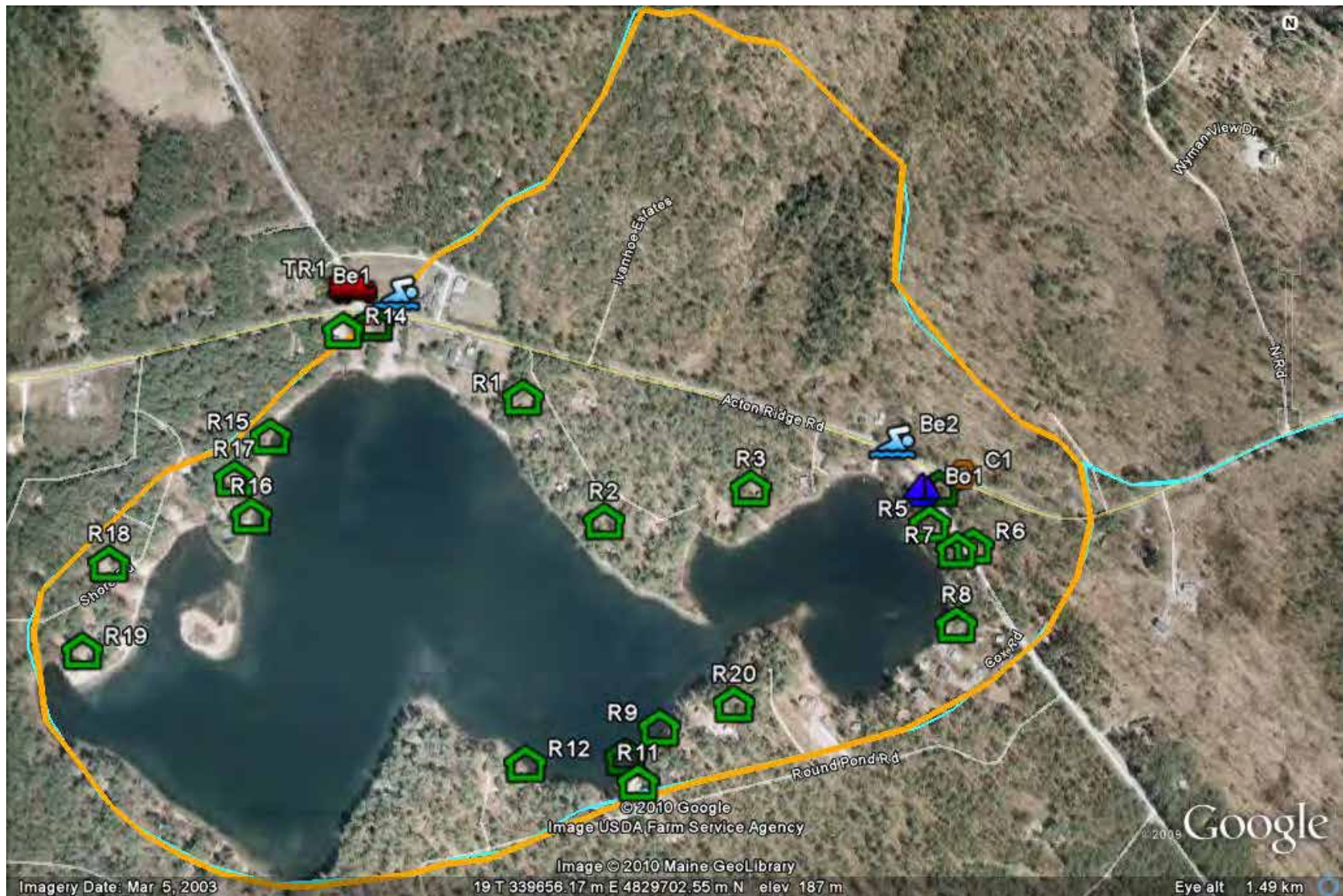
Photos Courtesy of the NH Lakes Association

Appendix A: Lake Ivanhoe Watershed Maps



The map shows the Lake Ivanhoe Watershed boundary in orange, with major road ways in yellow. The sites with erosion issues identified by the volunteers are marked on this map by severity of impact to the lake.

Blue Points— Low Impact Sites
Yellow Points— Medium Impact Sites
Red Points— High Impact Sites



The map shows the Lake Ivanhoe Watershed boundary in blue, with major road ways in yellow. The sites with erosion issues identified by the volunteers are marked on this map by land use type.

Green house = Residential
 Blue Swimmer = Beach Access
 Blue Boat = Boat Access

Yellow Circle = Driveway
 Purple Truck = Private Road
 Red Truck = Town Road

Appendix B: Erosion Site Descriptions

Site #	Land Use Activity	Surface Erosion	Issues	Recommendations	YCC Site?	Impact	Cost
10-01	Beach Access	Moderate	Slight Road Shoulder Erosion, Sandy Beach, Lack of Shoreline Vegetation	Define Foot Path, Install Runoff Diverter, Establish buffer	Yes	Low	Low
10-02	Residential	Moderate	Bare Soil	Mulch/Erosion Control Mix, Perched Beach	Yes	Low	Low
10-03	Residential	Slight	Bare Soil, Undercut Shoreline, Shoreline Erosion	Stabilize Foot Path, Install Runoff Diverter, Add to Buffer, No Raking	Yes	Low	Low
10-04	Residential		Boat Launch Erosion	Gravel, Install Runoff Diverters, Open Top Culvert, Mulch/Erosion Control Mix	Yes	Medium	Medium
10-05	Beach Access	Moderate	Clogged Culvert, Medium Road Shoulder Erosion, Bare Soil	Remove Clog, Install Runoff Diverter, Mulch/Erosion Control Mix, Infiltration Trench	Yes	Medium	Medium
10-06	Construction Site	Moderate	Clogged Ditch, Moderate-Severe Road Shoulder Erosion, Bare Soil	Remove Clog, Gravel, Reshape (Crown), Vegetate Shoulder, Waterbar, Mulch, Seed/Hay, Mulch/Erosion Control Mix, Water Retention Swales	No	High	High
10-07	Residential		Bare Soil, Lack of Shoreline Vegetation	Waterbar, Infiltration Trench @ roof dripline, Rain Barrel, Mulch/Erosion Control Mix, Add to Buffer	Yes	Low	Low
10-08	Boat Access- Ramp	Severe	Bare Soil, Undercut Shoreline, Shoreline Erosion, Unstable Lake Access	Add New Surface Material, Install Runoff Diverters, Infiltration Trench	No	High	High
10-09	Residential		Bare Soil, Inadequate Shoreline Vegetation	Install Runoff Diverters, Waterbar, Mulch/Erosion Control Mix	Yes	Low	Low
10-10	Residential		Bare Soil, Shoreline Erosion, Extensively Undercut Shoreline	Waterbar, Mulch/Erosion Control Mix, Add to Buffer, Rebuild Wall	Yes	Medium	Medium
10-11	Residential	Slight	Bare Soil, Lack of Shoreline Vegetation	Infiltration Steps, Install Runoff Diverter, Mulch/Erosion Control Mix, Add to Buffer	Yes	Medium	Low
10-12	Residential	Slight	Bare Soil	Mulch/Erosion Control Mix	No	Low	Low
10-14	Residential, Commercial		Lack of Shoreline Vegetation, Shoreline Erosion	Mulch/Erosion Control Mix, Establish Buffer	Yes	Medium	Low

Appendix B: Erosion Site Descriptions

Site #	Land Use Activity	Surface Erosion	Issues	Recommendations	YCC Site?	Impact	Cost
10-15	Residential	Slight	Lack of Shoreline Vegetation, Shoreline Erosion	Mulch/Erosion Control Mix, Infiltration Steps	Yes	Low	Low
10-16	Residential	Slight	Bare Soil, Lack of Shoreline Vegetation, Retaining Wall Being Repaired	Define foot path, Mulch/ECM, Establish Buffer, No Raking, Reseed bare and thinning grass	Yes	Low	Medium
10-17	Residential	Moderate	Lack of Shoreline Vegetation, Shoreline Erosion, Unstable Lake Access	Reshape (Crown), Infiltration Trench @ roof dripline, Mulch/Erosion Control Mix, Infiltration Trench, Establish Buffer, No Raking	Yes	Medium	Medium
10-18	Residential	Moderate	Bare Soil, Inadequate Shoreline Vegetation	Install Runoff Diverter, Mulch/Erosion Control Mix, Establish Buffer	Yes	Medium	Low
10-19	Residential	Slight	Bare Soil, Undercut Shoreline, Erosion of Clay Fill at Shoreline	Mulch/Erosion Control Mix, Add to Buffer, No Raking, Reseed bare soil & thinning grass	Yes	High	Medium
10-30	Residential		Culvert Depositing Sand	Install Plunge Pool	Yes	Medium	Low
10-31	Town Road	Moderate	Moderate Ditch and Road Shoulder Erosion, Bare Soil	Install Plunge Pool, Reshape Ditch, Vegetate ditch, armor with stone	No	Medium	Low
10-32	Residential	Slight	Roof Runoff Erosion, Shoreline Erosion	Infiltration Trench @ roof dripline (on right- need an infiltrator trench at cement edge), Install Runoff Diverter, Mulch/Erosion Control Mix	Yes	Low	Low
10-33	Residential	Moderate	Bare Soil, Shoreline Erosion	ECM, Infiltration Trench (above wall), *level beach in front of wall & build up wall so sand doesn't run over wall	Yes	Medium	Low
10-34	Residential	Moderate	Bare Soil, Shoreline Erosion	Infiltration Trench @ roof dripline, Mulch/Erosion Control Mix, define foot path, infiltration steps, *perch the beach level steps mulch above	Yes	Medium	Low
10-35	Residential	Slight	Bare Soil, Shoreline Erosion	Install runoff diverter, Mulch/Erosion Control Mix, Rain Garden, Infiltration Trench	Yes	Medium	Medium
10-36	Residential	Moderate	Bare Soil, Shoreline Erosion	Perch Beach, Minimize beach, Define foot path, Mulch/ECM, Rain Garden, Establish Buffer, Reseed bare and thinning grass	Yes	Medium	Medium

Where Do I Get More Information?

Round Pond Association

President, David Giunta 603-522-3592 roundpond@ourlakehouse.net

Town of Wakefield

Arthur Capello, Code Enforcement Officer 603-522-6205

Acton Wakefield Watersheds Alliance

Linda Schier, Executive Director 603-473-2500 info@awwatersheds.org

Tech. Director 603-473-2500 techdirector@awwatersheds.org

New Hampshire Department of Environmental Services, Portsmouth Office

Watershed Assistance Section

For technical assistance, grant program information, outreach materials, and general water quality information

Sally Soule 603-559-0032 ssoule@des.state.nh.gov

Wetlands & Shoreland Protection

For permitting, enforcement, and general information about NH wetlands regulations

NH DES Wetlands Bureau 603-271-2147 wetmail@des.nh.gov

Publications:

Camp Road Maintenance Manual: A Guide for Landowners. Kennebec County SWCD and Maine DEP. 2000. 54 pgs. www.maine.gov/dep/blwq/docwatershed/camroad.pdf

Conservation Practices for Homeowners. Maine DEP and Portland Water District. 2006. 20 fact sheets. <http://www.maine.gov/dep/blwq/docwatershed/materials.htm>.

A Guide to Forming Road Associations. Maine DEP. October 2009. 21 pgs. www.maine.gov/dep/blwq/docwatershed/roadassociation.htm

Maine Shoreland Zoning—A Handbook for Shoreland Owners. Maine DEP. 2008. 42 pgs. www.maine.gov/dep/blwq/docstand/sz/citizenguide.pdf

Summary of the 2008 NH Shoreland Protection Act. NHDES 2008. http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/cspa_brochure.pdf

LOVELL LAKE WATERSHED SURVEY REPORT



photo courtesy of www.lovelllake.org

LOVELL LAKE ASSOCIATION
ACTON WAKEFIELD WATERSHEDS ALLIANCE
NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES
MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

SEPTEMBER 2008

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Introduction

This report serves to compile, summarize, and analyze the data collected during the Lovell Lake watershed survey conducted in September 2008 and is intended for residents, landowners, and town officials within the Lovell Lake watershed. This survey is one aspect of a larger project to develop a Watershed Based Management Plan (WBMP) for the entire Salmon Falls headwaters watershed including Great East Lake, Horn Pond, Lake Ivanhoe, Lovell Lake and Wilson Lake. All of these lakes are considered high quality waters. The purpose of the WBMP project is to preserve the high quality waters status by identifying current problems, predicting future problems and recommending solutions.

Watershed surveys provide a snapshot of the condition of the watershed at the time the survey was conducted and document all evidence of sediment erosion. The information gathered during the Lovell Lake survey will be used by the Lovell Lake Association, the Acton Wakefield Watersheds Alliance, and the Town of Wakefield to guide future efforts to preserve the lake's pristine quality for future generations to enjoy.

Lovell Lake's Water Quality

Lovell Lake is approximately 554 acres in size. The maximum water depth is 40 feet, with an average depth of 18 feet. Lovell Lake has been identified by the State of New Hampshire as a high-quality waterbody based on its water quality parameters.

According to the UNH Center for Fresh Water Biology, the water in Lovell Lake is remarkably clear, with an average Secchi disc reading in 2007 of approximately 20 feet (6.3 meters). This high transparency is the result of various factors. While brief intense storm events and periods of prolonged runoff such as spring snowmelt contribute to short-term increased turbidity and lowered transparency, little chronic sediment erosion persists

throughout the watershed to compromise water clarity. Additionally, a rocky lake bottom provides a poor substrate for vegetation and is not easily stirred up by boat activity or wave action. Lack of vegetation also prevents the release of tannins into the water that can compromise clarity. The lake is spring-fed so most of the water that feeds the lake has been filtered as groundwater rather than entering the lake as possibly polluted river or stream surface water.



Lovell Lake has a slightly low flushing rate which can make it sensitive to pollution. It takes 1.4 years for water to flush through the Lovell Lake system. The average Maine and NH lake flushes once a year.

Lovell Lake has an average phosphorus concentration of 6.5 ppb. Phosphorus is a nutrient that can encourage algae growth and affect lake health. This low phosphorus concentration is reflected in a low chlorophyll reading of 3.6 ppb. The lack of chlorophyll indicates very little algae in the lake.

Lovell Lake is classified as an oligotrophic lake. Oligotrophic lakes are characterized as being nutrient-poor, having rocky substrates and shorelines, deeper water, limited algae and aquatic plant growth, and an abundance of dissolved oxygen, except in the deepest waters. This profusion of dissolved oxygen in the surface waters is crucial for a productive warm water fish habitat. The low dissolved oxygen concentration near the lake bottom prevents the establishment of a cold water fishery.

The Lovell Lake Association (LLA) has been effective in recruiting volunteers in all capacities of monitoring and ensuring the health and vitality of the lake. A dedicated water quality monitoring group has participated with the UNH Lakes Lay Monitoring program for 20 years. The volunteers collect samples for testing water quality parameters in order to maintain and keep current the substantial water quality database of the lake. A weed watcher program has also been established to monitor the presence and distribution of aquatic vegetation and to be on the lookout for invasive aquatic species. Additionally, a very successful Lake Host program exists to monitor boat access to the lake, inform boaters about lake health and water quality, and inspect boats for foreign and possibly invasive species which can enter the lake and disrupt the fragile aquatic ecosystem.

The Lovell Lake Association and the Town of Wakefield have also supported the efforts of the Acton Wakefield Watersheds Alliance (AWWA) and its Youth Conservation Corps (YCC). AWWA provides technical assistance to landowners with erosion problems and educates them regarding the use of best management practices (BMPs). The AWWA YCC committee and technical director select sites based on specific criteria as YCC project sites with the youth crew installing the recommended BMPs. Landowners participating in the program supply the necessary materials while the YCC's labor has been provided free of charge.

Threats To Lovell Lake

Lovell Lake has a number of issues threatening its water quality. The primary threat to the lake is polluted runoff, or nonpoint source (NPS) pollution. Whenever surface water is allowed to flow directly into the lake, it carries with it whatever it has picked up along its path, including nutrients, pollutants, metals, sediment, heat, and bacteria. In an undeveloped, forested watershed, runoff is slowed by the uneven forest floor and is allowed to infiltrate into the ground. The earth provides the easiest and most effective filtration of runoff.



In developed watersheds, stormwater does not always receive the filtering treatment that the forest provided. Rain water picks up speed as it flows across impervious surfaces like rooftops, compacted soil, gravel camp roads and pavement, and it becomes a destructive force.

Future development may place a serious strain on the lake. Wakefield is expected to grow by approximately 35% by the year 2025, inevitably reducing forest land and increasing impervious surfaces.

Runoff from residential properties can adversely affect water quality. Erosion on these sites carries sediment,

chemicals, and fertilizers into the water. Sediment increases phosphorus loading, chemicals can be poisonous, and fertilizers feed the lake excess nutrients, all leading to compromised water quality. The recent amendments to the State's Comprehensive Shoreline Protection Act have are intended to reduce the negative impacts of development on water quality.

Why is Runoff a Problem?

The problem is not necessarily the water itself. It is the sediment and nutrients in the runoff that can be bad news for New England lakes. Studies have shown that runoff from developed areas has 5 to 10 times the amount of phosphorus compared to runoff from forested areas.

The nutrient, phosphorus, is food for algae and other plants and is found in soils, septic waste, pet waste and fertilizers. In natural conditions, the scarcity of phosphorus in a lake limits algae growth. However, when a lake receives extra phosphorus, algae growth increases dramatically. Sometimes this growth causes choking blooms, but more often it results in small changes in water quality that, over time, damage the ecology, aesthetics and economy of lakes.



Soil is the biggest source of phosphorus to New Hampshire lakes. As every gardener knows, phosphorus and other nutrients are naturally present in the soil. So, runoff is essentially "fertilizing" Lovell Lake with the soil that erodes from our driveways, roads, ditches, pathways, and beaches.

Many of the camps that surround the lake are many decades old and some may have ineffective septic systems. Leaching of these systems can release excess nutrients and dangerous bacteria into the lake.

Camp roads pose another risk to water quality. Many of the roads along the east and north sides of the lake are unpaved and only seasonally maintained. Camp roads are subject to frequent wash-outs during periods of heavy precipitation and spring thaws. Wash-outs can transport significant quantities of sediment and gravel into the lake increasing the nutrient levels and turbidity.

Lovell Lake Watershed

A watershed is defined as all of the land that drains or “sheds” into a given waterbody. Activity in any part of the watershed can affect the quality of the waterbody as a result of the flow from rivers, streams, surface runoff, and groundwater. This is why protection of Lovell Lake must be addressed on a watershed level rather than simply focusing on shoreline activity. See Lovell Lake Watershed Map in Appendix A, map 1.

The area of the lake itself is 554 acres (0.87 square miles) while the area of the entire watershed is approximately 4.7 square miles. The lake is located entirely in the town of Wakefield, NH. The shoreline is highly developed with only a handful of undeveloped lots. Downtown Sanbornville at the west end of the lake is the site of the highest concentration of development. Route 109, a heavily traveled state road running along the south side of the watershed, contributes sediments, road salt, and other pollutants as stormwater runs off the pavement. The lake is spring fed and the major outlet is at the west end of the lake. This outlet is dam controlled and the outflow becomes the Branch River. A public beach is located immediately adjacent to the dam, and public boat access is just north of the dam at the beginning of Witchtrot Road. Lovell Lake is part of a larger watershed along with Great East Lake, Horn Pond, Lake Ivanhoe, and Wilson Lake as the headwaters of the Salmon Falls River, which serves as the border between New Hampshire and Maine. The Salmon Falls River converges with the Cocheco River to become the Piscataqua River and then empties into the Gulf of Maine.

Why Should We Protect Lovell Lake?

Lovell Lake's pristine conditions make it a valuable asset to the community on numerous levels: economic, recreational, ecological, and cultural.

Economically: A 1996 study by the University of Maine found that water quality is directly related to property values. The report estimated that a 3-foot decline in water clarity could reduce property values as much as 20%. The majority of the town's revenue is derived from waterfront property taxes, a figure that is based upon property value. Therefore, maintaining a clean, clear lake is crucial to the town's financial viability as well as protecting the investments of property owners. Additionally, it is much cheaper, easier, and more practical to maintain and protect a high quality lake than to clean and restore an impaired one. Prevention is much less expensive than remediation.

Recreationally: The lake draws in anglers and boaters from across the region. Lovell Lake is one of the first lakes one encounters traveling north on Route 16 from major cities to the south. The convenient location thus draws weekenders from out of state who flock to the area to pursue leisurely activities. Fishing is a popular activity thanks to the abundance of fish species including:

- ☐ smallmouth bass
- ☐ largemouth bass
- ☐ chain pickerel
- ☐ hornpout
- ☐ rainbow trout
- ☐ white perch
- ☐ walleye

The long, narrow shape of the lake makes it a popular site for powerboat activities, especially waterskiing, wakeboarding, and tubing.

Likewise, the lake is ideal for sailing, canoeing, and kayaking. Easy access to the lake makes boating the primary use of the lake.



Ecologically: In addition to the numerous fish species, bald eagles and other large birds of prey utilize the lake habitat for hunting, nesting, and breeding. Loons are a frequent site and have become a symbol of the region. Well-oxygenated water with a large littoral zone is essential for viability of numerous aquatic species. Natural and uninterrupted shoreline and adjacent water is both the most productive and most fragile area of the lake and is critical for biodiversity. Pristine freshwater ecosystems are becoming ever more rare with the pressing encroachment of human development. This makes the preservation of Lovell Lake even more important.

Culturally: A clean lake with clear water is perceived as being a community asset. Healthy lakes are regarded as being more valuable and desirable. The lake becomes a source of community pride to its users and fosters a sense of stewardship.

Purpose of the Lovell Lake Survey

The purpose of the survey was to gain an in-depth understanding of the current conditions of the watershed in terms of surface sediment erosion through exhaustive direct observation.

The watershed survey is used for the following purposes:

- ☐ Identify and prioritize existing sources of polluted runoff, particularly soil erosion sites in the Lovell Lake watershed.
- ☐ Raise public awareness about the connection between land use and water quality, and the impact of soil erosion on Lovell Lake and to inspire people to become active watershed stewards.
- ☐ Provide the basis to obtain funding to assist in fixing identified erosion sites.
- ☐ Use the information gathered as one component of a long term lake protection strategy. The survey strengthens the WBMP because every parcel of property is physically inspected and all sediment erosion that reaches the lake is documented. The WBMP thus has a real-world perspective with hard data collected from first-hand observation.
- ☐ Make general recommendations to landowners for fixing erosion problems on their properties.
- ☐ Identify sites for future Youth Conservation Corps projects.

The purpose of the survey was NOT to point fingers at landowners with problem spots, nor was it to seek enforcement action against landowners not in compliance with ordinances. It is the hope that the LLA and AWWA will work together with landowners to solve erosion problems on their property through technical assistance visits and YCC projects.

Local citizen participation was essential in completing the watershed survey and will be even more important in upcoming years. With the leadership of the LLA and assistance from AWWA and others concerned with lake water quality, the opportunities for stewardship are limitless.

The Survey Method

The survey was conducted by volunteers with the help of trained technical staff from Maine Department of Environmental Protection, NH Department of Environmental Services, York County Soil & Water Conservation District, and AWWA. 24 volunteers were trained in survey techniques during a two hour classroom workshop on September 13, 2008. Following the classroom training, the volunteers and technical staff spent the remainder of the day documenting erosion on the roads, properties, driveways, and shorelines in their assigned sectors using cameras and standardized forms. The teams worked together over the following few weeks to complete their sectors. Technical staff conducted follow-up examinations of sites over the following month to verify data accuracy.

All information collected was entered into a computerized spreadsheet to create a database of the raw data. This data was standardized and sorted into appropriate categories, and prioritized based on rankings of their impact to the lake, technical ability required to fix the problems, and estimated cost of remediation. The documented erosion sites were then plotted on maps using GIS software.

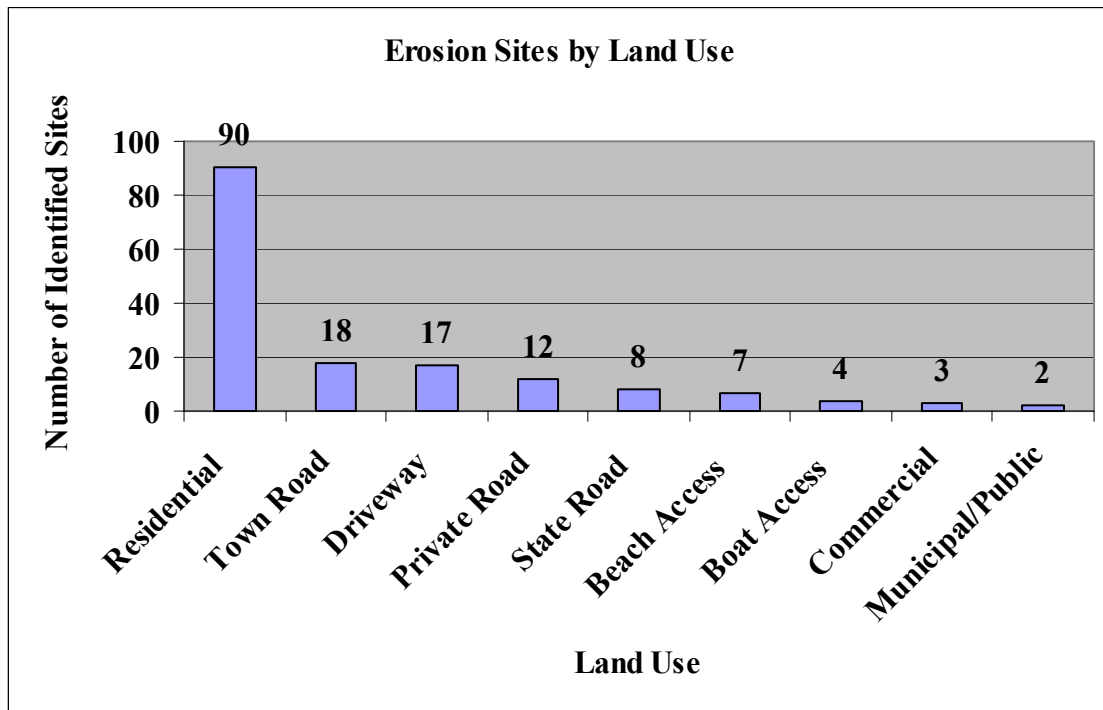
A description of sites and associated rankings are discussed in the next section of this report. Maps of the erosion sites are located in Appendix A, and a spreadsheet with data from the documented sites is located in Appendix B. Contact LLA or AWWA for additional site information.



Summary of the Lovell Lake Survey

Volunteers and technical staff identified 161 sites in the watershed survey that were either impacting or had the potential to impact water quality.

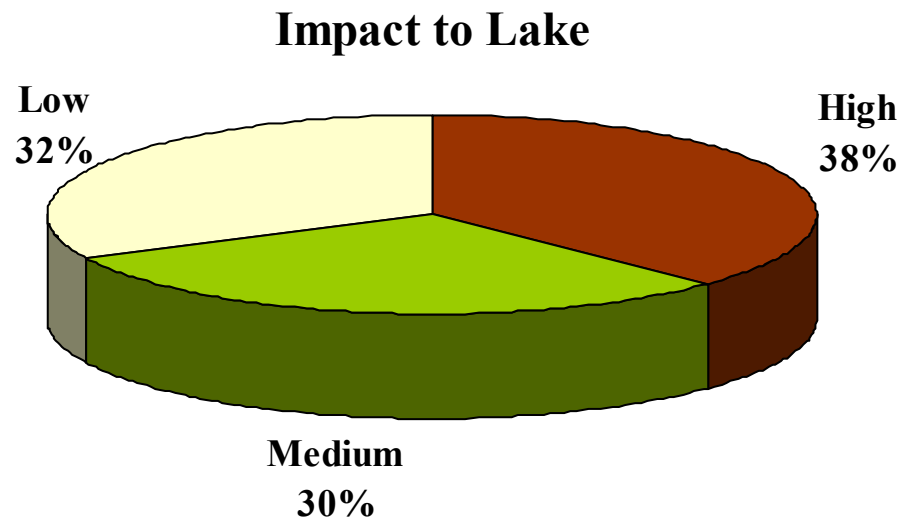
- ❑ 90 of the identified sites (57%) were found on residential properties. Most of these sites have a low impact on water quality and will be inexpensive to fix (less than \$500) with little technical expertise required. These tend to be simple fixes that can be done by the landowners themselves.
- ❑ 38 of the sites identified (24%) are associated with roads: State, town, and private. These sites tend to have a more severe impact on the lake with higher associated costs (greater than \$2500) and required technical knowledge. Also, the procedures involved with remediating these sites are more time and resource consuming.
 - Route 109 poses a serious problem for the lake. This paved road produces a large amount of surface runoff during periods of precipitation. The road is also pitched in such a way as to shed the majority of this runoff towards the lake. Winter sand, road salt, oil and gas, heavy metals, and other pollutants wash off the road and are carried into the lake, creating a water quality hazard. The buffer between the road and the lake is severely limited. In some areas only a few feet separate the two.
 - Private and local camp roads were identified as 12 of the sites (7%). Many of the camp roads are pitched towards the lake. Additionally, these roads are almost exclusively gravel roads whose surface materials often end up in the lake along with the surface runoff. Road associations are an important mechanism to handle the difficulty of properly maintaining private roads. Functioning road associations should focus attention on erosion prevention. When necessary, new associations should be formed. Road maintenance crews should be trained in camp road BMPs and should work closely with road associations.
- ❑ Driveways accounted for 18 of the sites identified (11%). Often driveways are placed for the most direct access to the property without planning for the effects of stormwater. Subsequently, many driveways are washed-out and then repaired in the same manner, only to be washed-out again, creating a large delta of sediment in the lake. Driveways should be designed with the same attention to stormwater as roads. It may be strategically and economically wise for adjacent properties to share a common driveway so impervious surfaces are limited.
- ❑ 9 different land uses were identified in the survey. Thus, no single source is responsible for pollution of the lake, and all parties need to be involved in protecting the water quality. Every land use has aspects that can be improved and there are numerous resources to aid in this improvement. Town officials, individual landowners, state and local agencies, the LLA, and AWWA must all play a role and work together for the benefit of Lovell Lake.



Land Use Activity	High Impact	Medium Impact	Low Impact	Total
Beach Access	1	3	3	7
Boat Access	2	1	1	4
Commercial	3	0	0	3
Driveway	6	5	6	17
Municipal/Public	0	2	0	2
Private Road	4	6	2	12
Residential	25	27	38	90
State Road	6	1	1	8
Town Road	13	4	1	18
Total	60	49	52	161

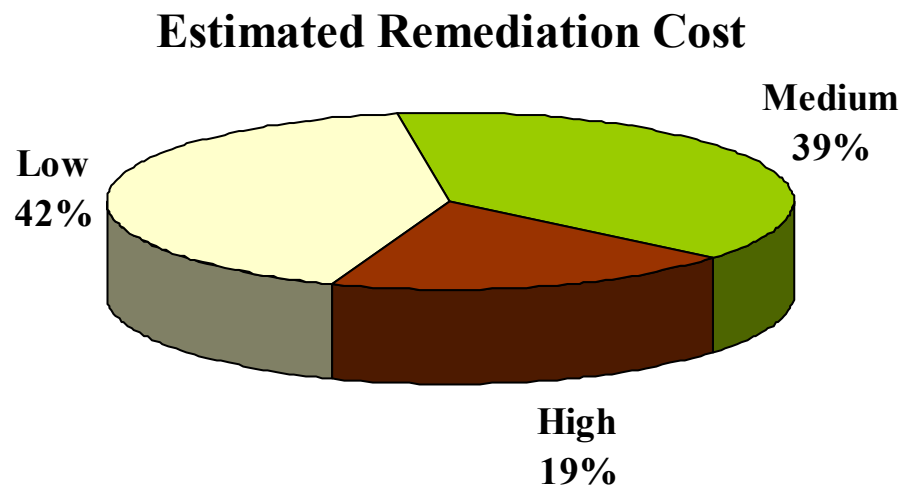
Impact to Lake: Each site was rated for its potential impact to the lake. Impact was based on slope, soil type, amount of soil eroding, proximity to water, existence of a buffer, and buffer size. The impact was almost evenly distributed between the three classifications, although more sites qualified as “high impact”.

- ☐ “Low” impact sites were those with limited soil transport off site and little or no visible gullies.
- ☐ “Medium” impact sites had some sediment transport off site with noticeable rills in the ground.
- ☐ “High” impact sites exhibited a large amount of sediment transported off site with significant gullies eroded into the ground.



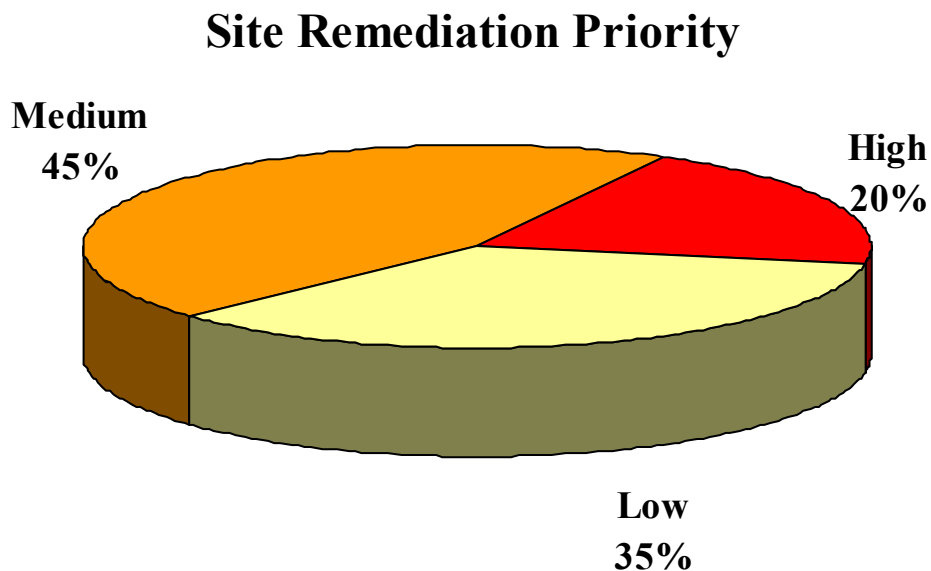
Estimated Remediation Cost: Recommendations were made for fixing each site and the associated cost of labor and materials was estimated. Most sites were classified as low cost, indicating that the fixes would be affordable for the average landowner.

- ☐ “Low” cost sites were estimated to have labor and materials cost less than \$500
- ☐ “Medium” cost sites were estimated to cost between \$500 and \$2500
- ☐ “High” cost sites were estimated to cost in excess of \$2500



Site Remediation Priority: Severity of site impact to lake, estimated remediation cost, and speculation as to whether the site should be considered a YCC project were given numerical values and then totaled to score each site. The priority designation will help the LLA, AWWA and the Town develop the remediation plan for the identified sites. 20% of the sites were given “high priority” indicating that effort should be focused on these sites first when conducting remediation.

- ❑ “Low” priority sites were those that generally had high associated cost, low impact to the lake, and would not be viable YCC projects.
- ❑ “Medium” priority sites tended to be those that had both medium impact and cost and could possibly serve at YCC projects.
- ❑ “High” priority sites were typically those that had high impact to the lake, low associated cost, and would make good YCC projects.



Next Steps - Where Do We Go From Here?

Fixing the sites identified in this survey will require efforts by individuals, the Lovell Lake Association, the Acton Wakefield Watersheds Alliance, road associations, and municipal officials.

Lovell Lake Association and Acton Wakefield Watersheds Alliance

- ☐ Send letter offering technical assistance to property owners, road associations, and towns with identified erosion problems and encourage them to make improvements.
- ☐ Make available copies of the survey report to property owners, road associations, and towns.
- ☐ Apply for grants to help fix erosion problems identified in the survey.
- ☐ Continue to promote the Lake Host, Weed Watch, and water quality monitoring programs by hosting workshops, encouraging landowners to have property evaluations, and good lake stewardship.
- ☐ Continue to increase and empower the association's membership, and provide educational materials and guidance to members of the Lovell Lake watershed community.
- ☐ Continue to partner with NH DES, the Town of Wakefield, and others to seek funding and implement projects to protect lake water quality.
- ☐ Organize workshops and volunteers to start fixing identified erosion problems and teach citizens how to fix similar problems on their own properties.
- ☐ Educate municipal officials about lake issues and work cooperatively to find solutions.

Individual Landowners

- ☐ Look in the report or contact the LLA to see if you have a identified erosion problem. If so, try to start fixing it. Call AWWA or NH DES for free advice about how to get started.
- ☐ Contact the Lovell Lake Association about getting involved with the Lake Host, Weed Watch, and water quality monitoring programs.
- ☐ Stop mowing and raking your shoreline and parts of your property. Let lawn and raked areas revert back to natural plants. Deep shrub and tree roots help hold the soil.
- ☐ Avoid exposing bare soil. Seed and mulch bare areas.
- ☐ Call the Town of Wakefield Zoning and Shoreland Compliance Officer and NH DES before doing any cutting or soil disturbance projects.
- ☐ Visit www.pwd.org/news/publications.php#Brochures to learn more about conservation practices you can do yourself.
- ☐ Maintain septic systems properly. Pump septic tanks (every 2 to 3 years for year round residences; 4-5 years if seasonal) and upgrade marginal systems.
- ☐ Join the Lovell Lake Association and get involved with their activities.

Municipal Officials

- ☐ Enforce shoreland zoning and other ordinances to ensure protection of Lovell Lake.
- ☐ Conduct regular maintenance on town roads in the watershed, and fix town road problems identified in this survey.
- ☐ Participate in and support long term watershed management projects.
- ☐ Promote training for road crews, boards, commissions, and other decision-makers.

Where Do I Get More Information?

Lovell Lake Association

Officers

Tim Sherrill, President	<i>tsherrill@andovercos.com</i>
John Hirsch, 1st VP	522-6908
Irene Martel, 2nd VP	522-8332
Pam & Paul Maguire, Secretary	522-8611
Alan Heacock, Treasurer	714-0250

Town of Wakefield

John Ciardi, Zoning and Shoreland Compliance Officer 522-6205 x310

Acton Wakefield Watersheds Alliance

Linda Schier, Executive Director	473-2500	<i>info@awwatersheds.org</i>
Adam Shoukimas, Tech. Director	473-2500	<i>techdirector@awwatersheds.org</i>

New Hampshire Department of Environmental Services, Portsmouth Regional Office Watershed Assistance Section

For technical assistance, grant program information, outreach materials, and general water quality information

Sally Soule	559-0032	<i>ssoule@des.state.nh.gov</i>
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Wetlands & Shoreland Protection

For permitting, enforcement, and general information about NH wetlands regulations

NH DES Wetlands Bureau	271-2147	<i>wetmail@des.nh.gov</i>
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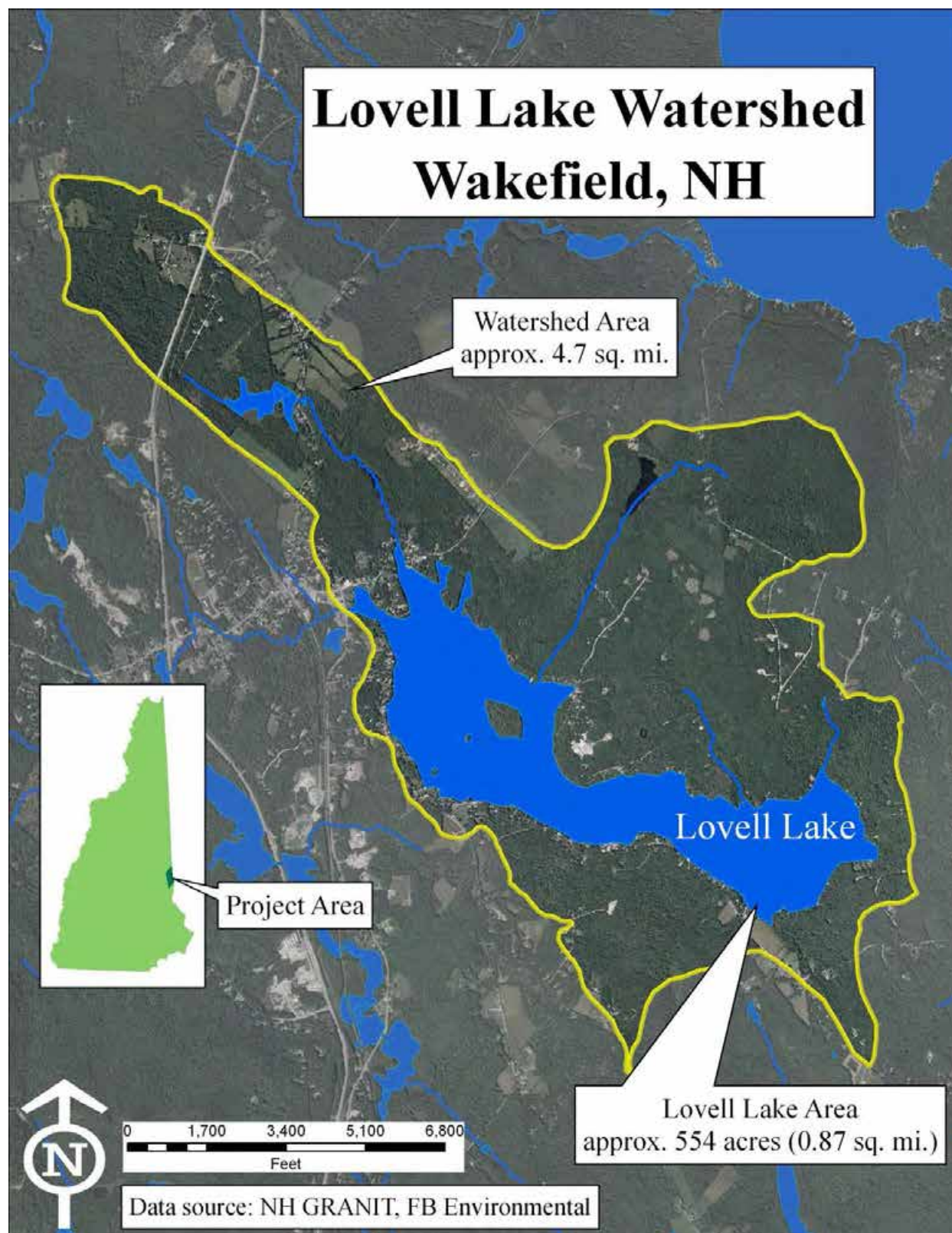
New Hampshire Fish and Game

For fishing, wildlife, and conservation officers

NH Fish and Game Region 2	744-5470	<i>reg2@wildlife.nh.gov</i>
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Appendix A: Project Maps

Map 1: Lovell Lake Watershed



Wilson Lake Watershed Survey Report



**Wilson Lake Association
Maine Department of Environmental Protection
Acton Wakefield Watersheds Alliance
York County Soil and Water Conservation District**

February 12, 2010

Acknowledgments

The following people and organizations were instrumental in the Wilson Lake Watershed Survey Project and deserve special recognition for their efforts:

Watershed Survey Volunteers

Jeanne Achille	Anne Marie Nadeau	Roberta Taylor
Philip Belanger	Dan Orino	Pat Theisen
Pauline Fontaine	Bill Pimental	Celia Thibodeau
Ed Hubbard	Teg Rood	Penny Voyles
Paula Ivey	Ron Sahatjian	Ed Walsh
Dick Johnson	Devin Schonefelt	Glenn Wildes
Carol Lafond	Bob Seekar	Betty Wildes
David Lewis	David Spahn	
John Nadeau	Diana Spahn	

Steering Committee

Jeanne Achille	Wilson Lake Association
Wendy Garland	Maine Department of Environmental Protection
Heather Germadnik	AmeriCorps, Maine DEP
Patrick Marass	AmeriCorps, Maine DEP
Linda Schier	Acton Wakefield Watersheds Alliance
Celia Thibodeau	Wilson Lake Association
Betty Wildes	Wilson Lake Association
Glenn Wildes	Wilson Lake Association

Technical Staff

Joe Anderson	York County Soil and Water Conservation District
Wendy Garland	Maine Department of Environmental Protection
Heather Germadnik	AmeriCorps, Maine DEP
Patrick Marass	AmeriCorps, Maine DEP
Rebecca Martin	AmeriCorps, Maine DEP
Deb Mayo	FB Environmental
Linda Schier	Acton Wakefield Watersheds Alliance
Adam Shoukimas	Acton Wakefield Watersheds Alliance
Sally Soule	New Hampshire Department of Environmental Services

Sponsored by

Wilson Lake Association

With Assistance from

Maine Department of Environmental Protection
Acton Wakefield Watersheds Alliance
York County Soil and Water Conservation District
New Hampshire Department of Environmental Services

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When combined with many other erosion sites throughout a watershed, even small sources such as this can have a significant impact on lake water quality.

Introduction

This report is specifically designed for citizens living in the Wilson Lake Watershed. It provides the results and analysis of a soil erosion survey conducted in the Wilson Lake Watershed in 2009. The survey was conducted in an effort to take a proactive approach to protecting water quality with the desire to preserve the lake's natural beauty for future generations to enjoy.

Wilson Lake's Water Quality

Volunteers have been testing the water quality of Wilson Lake since 1977. According to this data, Wilson Lake's water quality is considered to be average, and the potential for nuisance algae blooms is low to moderate. The average secchi disk transparency is about 18 feet, which is the average for a Maine lake.

Despite the average clarity, the bottom waters of the lake experience high oxygen depletion in late summer months creating a high potential for phosphorus to leave the bottom sediments and feed algae in the water column (internal loading). This oxygen depletion indicates that the pond is under stress, and if this worsens over time, the pond's coldwater fish habitat would also be impaired.

As a result of this monitoring data and the area's development trends, Wilson has been placed on the State's *NPS Priority Watersheds* list, which means that the lake is threatened or impaired by polluted runoff. It is also on the list of lakes *Most at Risk from New Development* under the Maine Stormwater Law.

POLLUTED RUNOFF

Also called NPS or nonpoint source pollution. Soil, fertilizers, septic waste, pet waste and other pollutants from diffuse sources across the landscape that are carried into the pond by rainfall.

Why is the Water Quality at Risk?

The largest threat to Maine lakes, including Wilson Lake, is **polluted runoff** or nonpoint source (NPS) pollution. Stormwater runoff from rain and snowmelt picks up soil, nutrients and other pollutants as it flows across the land, and washes into the lake.

In an undeveloped, forested watershed, stormwater runoff is slowed and infiltrated by tree and shrub roots, grasses, leaves, and other natural debris on the forest floor. It then soaks into the uneven forest floor and filters through the soil.



Runoff erodes sediment and carries it into Wilson Lake.

In a developed watershed, however, stormwater does not always receive the filtering treatment the forest once provided. Rain water picks up speed as it flows across impervious surfaces like rooftops, compacted soil, gravel camp roads and pavement, and it becomes a destructive erosive force.

Although much of Wilson Lake's watershed is still forested, the shoreline has been developed with 120 seasonal camps and year-round homes as well as an extensive network of roads. While these residences and roads convey the majority of the runoff to the lake, several beach and boat access points

were also found to be problematic.

Why is Runoff a Problem?

The problem is not necessarily the water itself. It's the sediment and nutrients in the runoff that can be bad news for Maine lakes. Studies have shown that runoff from developed areas has 5 to 10 times the amount of **phosphorus** compared to runoff from forested areas.

The nutrient, phosphorus, is food for algae and other plants and is found in soils, septic waste, pet waste and fertilizers. In natural conditions, the scarcity of phosphorus in a lake limits algae growth. Consequently, when a lake receives extra phosphorus, algae growth increases dramatically. Sometimes this growth causes choking blooms, but more often it results in small changes in water quality that, over time, damage the ecology, aesthetics and economy of lakes.



Excess **phosphorus** can “fertilize” a lake and lead to nuisance **algal blooms**.

Soil is the biggest source of phosphorus to Maine lakes. As every gardener knows, phosphorus and other nutrients are naturally present in the soil. So, we are essentially ‘fertilizing’ Wilson Lake with the soil that erodes from our driveways, roads, ditches, pathways and beaches.

Wilson Lake’s Watershed

The Wilson Lake watershed (right) covers 3.86 square miles entirely in the Town of Acton, Maine and is part of the larger Salmon Falls River watershed that eventually empties into New Hampshire’s Great Bay. All of the precipitation that falls in the watershed drains directly into the lake through a network of streams, ditches and overland flow.

WATERSHED

All the land that surrounds a lake that drains or sheds its water into the lake through streams, ditches, over the land or through groundwater.

Activities in this entire area—not just the shoreline areas—affect Wilson Lake’s water quality. Long-term protection of Wilson Lake will require coordinated stewardship in the entire watershed.



Why should we protect Wilson Lake from polluted runoff?

- Once a lake has declined, it can be difficult or impossible to restore. Prevention is the key.
- The lake contains valuable habitat for fish, birds and other wildlife. Wilson Lake is known for the continuous presence of Loons in the spring and summer. Declining water quality can lead to decreased fish stocks which could force these majestic birds to find a different and healthier water body to call home.
- Wilson Lake provides excellent recreational opportunities to local residents and to visitors. It is an important contributor to the local economy all year round.
- A 1996 University of Maine study found that lake water quality affects property values. For every 3-foot decline in water clarity, shorefront property values can decline as much as 10 to 20%! Declining property values affect individual landowners as well as the entire community.
- Sediment deposited into the lake from erosion creates the ideal environment for invasive aquatic plants to thrive.



What is being done to protect Wilson Lake?

- The Wilson Lake Association (WLA) and its members work with agencies, town officials and watershed residents to promote lake protection. WLA volunteers have tested water quality in the pond for over 30 years as part of the Maine Volunteer Lake Monitoring Program (VLMP).
- In April 1994, WLA volunteers conducted the lake's first watershed survey and identified 33 erosion sites. By 1999, the WLA's 'Road Warriors' had worked with the Maine DOT, York County SWCD and local residents to successfully fix 14 of these sites, including high priority sites on Eagle Road, Route 109, Garvin Road and several logging roads.
- The WLA purchases phosphorus free fertilizer every year and provides it free to members. The WLA can also purchase erosion control mulch (ECM) for members to use for helping to prevent storm water runoff.
- Volunteers monitor the lake for invasive aquatic plants in partnership with the VLMP. A courtesy boat inspector program is also being considered. These programs can be run by volunteers or paid inspectors who look for invasive plant species at public boat ramps and prevent contamination of our local lakes.
- The Acton Wakefield Watersheds Alliance (AWWA) has been working on Wilson Lake since 2006. AWWA's technical director has provided technical assistance to five landowners with erosion problems, and AWWA's Youth Conservation Corps has installed conservation practices on three sites around the lake.

The Purpose of the Watershed Survey

Although a watershed survey was conducted around Wilson Lake in 1994, the WLA determined that it would be worthwhile to update the survey to meet the following goals:

- ◆ Identify and prioritize existing sources of polluted runoff, particularly soil erosion sites, in the Wilson Lake Watershed.
- ◆ To inspire people to become active watershed stewards. Raise public awareness about the connection between land use and water quality, and the impact of soil on Wilson Lake.
- ◆ Provide the basis to obtain grant funds to assist in fixing some of the more expensive identified erosion sites.
- ◆ Identify sites to nominate for AWWA's Youth Conservation Corps.
- ◆ Use the information gathered as one component of a long term lake protection strategy.
- ◆ Make general recommendations to landowners for fixing erosion problems on their properties.
- ◆ Use the information from Wilson's watershed survey to partner with the implementation of AWWA's watershed management action plan.

The purpose of the survey was NOT to point fingers at landowners with problem spots, nor was it to seek enforcement action against landowners not in compliance with ordinances. It is the hope that through future projects, the WLA can work together with landowners to solve erosion problems on their property, or help them learn how best to accomplish solutions on their own.

Local citizen participation was essential in completing the watershed survey and will be even more important in upcoming years. With the leadership of the WLA and assistance from AWWA, YCSWCD and DEP, the opportunities for stewardship are limitless.

The Survey Method

The survey was conducted by volunteers with the help of trained technical staff from the Maine DEP, New Hampshire DES, AWWA and YCSWCD. 30 volunteers were trained in survey techniques during a two hour classroom workshop on April 25, 2009. Following the classroom training, the volunteers and technical staff spent the remainder of the day documenting erosion on the roads, properties, driveways, and trails in their assigned sectors using cameras and standardized forms. Most of the watershed survey was completed on the day of the training, but a few teams worked together throughout the spring to complete their sectors. Technical staff conducted follow-up examinations of sites in May and June, 2009 to verify data accuracy.

The collected data was entered into an Excel spreadsheet, and the documented erosion sites were plotted on maps. The sites were broken out into categories (driveways, roads, private residences) and ranked based on their impact on the lake, the technical ability needed to fix the problem, and the estimated cost of fixing the problem.

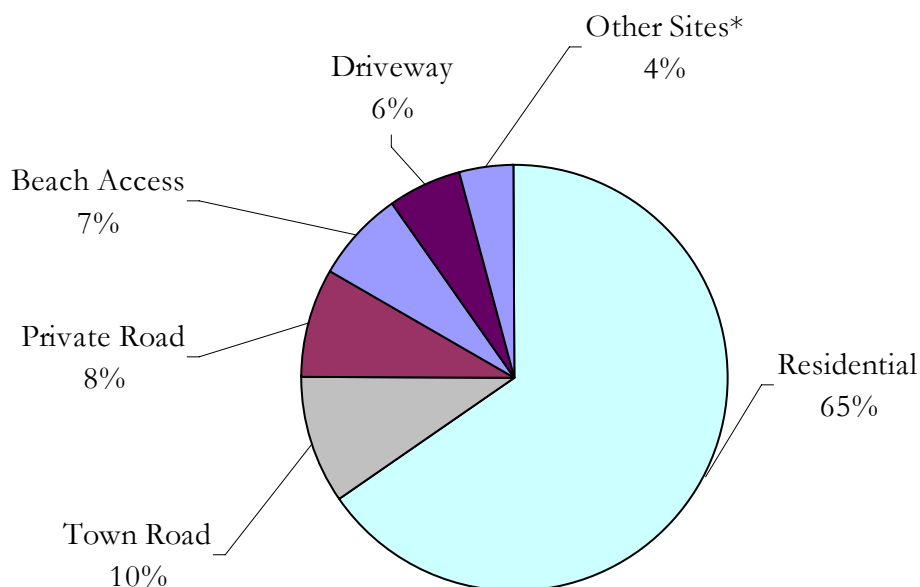
A description of sites and associated rankings are discussed in the next section of this report. Maps of the erosion sites are located in Appendix A, and a spreadsheet with data from the documented sites is located in Appendix B. Contact WLA or Maine DEP for additional site information.

Summary of Watershed Survey Findings

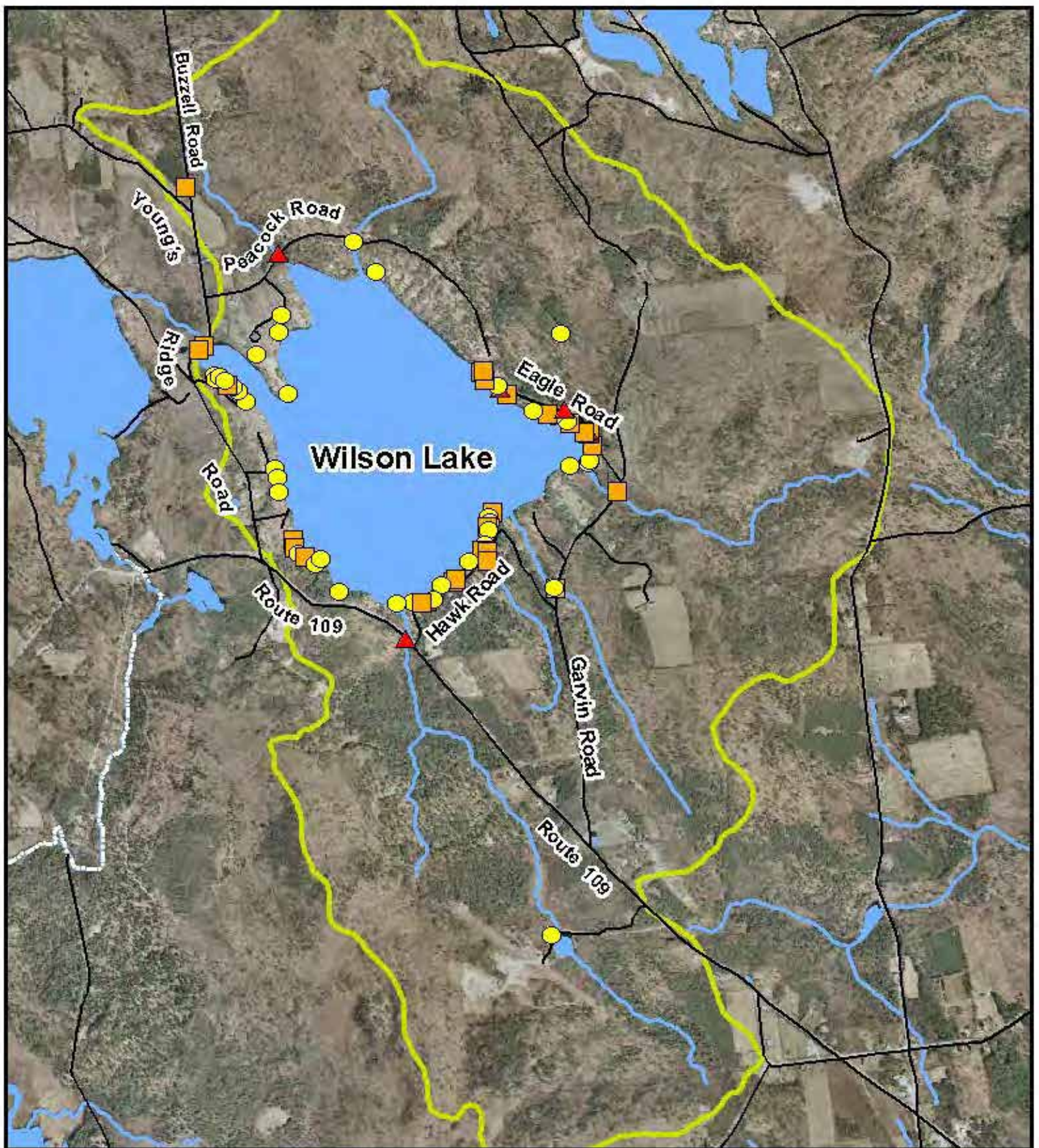
Volunteers and technical staff identified 72 sites in the Wilson Lake Watershed that are impacting or have the potential to impact water quality. Some key conclusions include:

- 47 of the identified sites (65%) were found on residential areas. These sites tend to have less severe erosion and can be fixed easily with low cost. Individual landowners can play a big role in helping address these problems.
- A significant percentage of the remaining erosion sites (24%) were associated with roads (town and private roads and driveways). These sites tend to be larger erosion problems with greater lake impacts.
- Most sites can be fixed with low to moderate labor and materials cost. In fact, only 10 of the 72 sites (14%) were rated with a high cost of materials and labor (over \$2500).
- Erosion sites were identified all around the watershed and on seven different types of land uses. As such, everyone has a role to play in lake protection. The Town of Acton, property owners, road associations, lakefront landowners, Maine DOT and even people living far from the lake can all take measures to reduce lake pollution.

Figure 1. Erosion Sites by Land Use



* Other includes one state road, one boat launch and one ATV trail site.



Legend

- | | | |
|--|-----------------------|-----------------|
| | High Impact Site | R Residential |
| | Medium Impact Site | P Private Road |
| | Low Impact Site | D Driveway |
| | Streams | BA Beach Access |
| | Roads | BL Boat Launch |
| | Lakes | S State Road |
| | Wilson Lake Watershed | T Town Road |



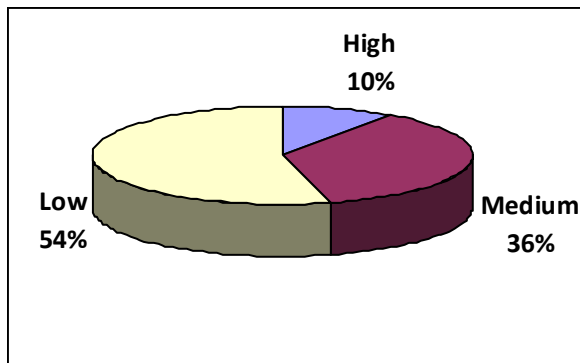
0 200 400 800 1,200 1,600 Meters

Data Source: Maine Office of GIS
 Coordinate System: NAD83, UTM Zone 19N, Meters
 Date: June 18, 2009 by H. Germadnik

Table 1. Breakdown of site by land use categories and impact to lake.

Category	High Impact	Medium Impact	Low Impact	Total
Residential	1	15	31	47
Town Road	1	4	2	7
Private Road	2	2	2	6
Beach Access	0	3	2	5
Driveway	2	1	1	4
State Road	1	0	0	1
Boat Launch	0	1	0	1
ATV Trail	0	0	1	1
Total	7	26	39	72

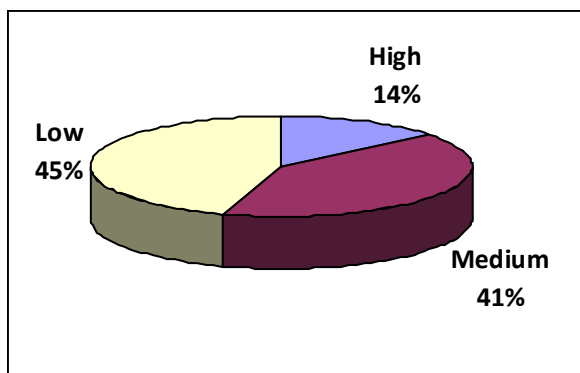
Impact to Lake—Each site was rated for its potential impact to the lake. Only 10% (7 of 72 sites) were deemed to have a high impact.



Impact was based on slope, soil type, amount of soil eroding, proximity to water or buffer, and buffer size.

- “Low” impact sites are those with limited soil transport off-site.
- At “Medium” impact sites, sediment is transported off-site, but the erosion doesn’t reach a high magnitude.
- “High” impact sites are large sites with significant erosion that flows directly into a stream or the lake.

Cost of Materials to Fix Sites—Recommendations were made for fixing each site, and the associated cost of labor and materials were estimated. Only 6% (or 8 sites) entail a high cost. As shown below, most can be fixed inexpensively with low-cost materials like mulch and stone.



Cost is an important factor in planning for restoration. The cost of labor and materials to fix each site was rated as follows.

- “Low” cost sites were estimated to cost less than \$500.
- An estimate of \$500 to \$2,500 was rated “Medium”.
- If the estimated cost to fix a site exceeded \$2,500, a “high” rating was assigned.

Residential Areas

Of the 47 sites associated with residential areas, 31 were low impact, 15 were medium impact, and 1 was high impact. 29 of the 47 sites can be fixed with low cost. Some of the most common problems and recommended conservation practices are pictured below.



Roof Runoff—Install stone-filled trenches along the roof dripline to help infiltrate runoff.



Problem— Roof runoff causing bare soils to erode.

Solution— Cover soil with erosion control mulch, plant grass and / or install drip-line trench.



Mulch—Place heavy-duty “erosion control mix” on bare soil.

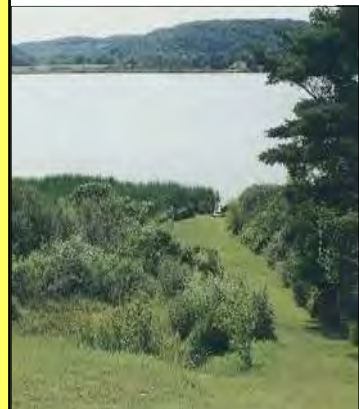


Waterbars—Place timbers or log “speed bumps” across paths to slow runoff and trap soil.



Problem—The lack of a buffer allows erosion to easily enter Wilson Lake.

Solution— Plant a native buffer along shoreline to treat storm water runoff.



Buffers—Plant trees and shrubs along the shoreline or let them grow back naturally.

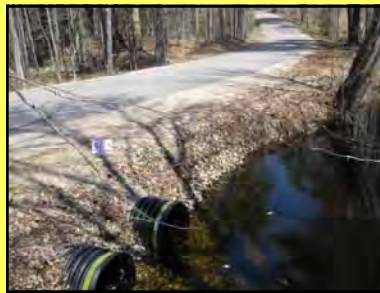
Residential areas were associated with almost two-thirds of the identified sources of polluted runoff. These problems pose a significant threat to lake water quality. Fortunately, most of these sites can be corrected with easy, low cost fixes.

Town Roads

7 town road sites were identified during the survey. Only 1 site was considered to be of high impact, 4 were medium impact and 2 were low impact. Unfortunately, only 1 of the sites can be fixed with low cost, while 2 are medium cost sites and 4 are high cost. Some of the most common problems and recommended conservation practices are pictured below.



Ditching—Create U-shaped ditches and armor them with rocks and/or grass.



Problem— Unstable road shoulder and culvert erode sediment into stream

Solution— Armor with stone riprap



Problem— Road shoulder erosion and inadequate armoring delivers sediment directly into stream

Solution— Reshape and vegetate road shoulders and ditch; Install check dams in ditch to trap sediment



Turnouts—Create openings along roads or ditches to direct water into vegetated areas.



Culverts—Armor culvert inlets and outlets with rock riprap. Create 'plunge pools' to protect the outlet and trap sediment.



Crown—Grade the road so that water runs off the sides. Remove sand and grader berms from the edges of the road.

Roads are one of the biggest sources of pollution to Maine lakes. Regular maintenance by road associations and town and state road departments is critical.

Private Roads

6 private road sites had documented erosion problems. 2 of these had a high impact, 2 had medium impact and 2 had low impact. 2 of the 6 sites can be fixed at a medium cost (\$500-\$2500) and the remaining 4 are rated at a high cost to fix (over \$2500). Some of the most common problems and recommended conservation practices are pictured below.



Rubber Razors—Direct water off the driveway and into vegetation with rubber razors.



Open Top Culverts—Direct water off the driveway with open top culverts.

Problem— Moderate surface erosion with direct flow to the lake.

Solution— Reshape and crown, install runoff diverter, add new surface material.

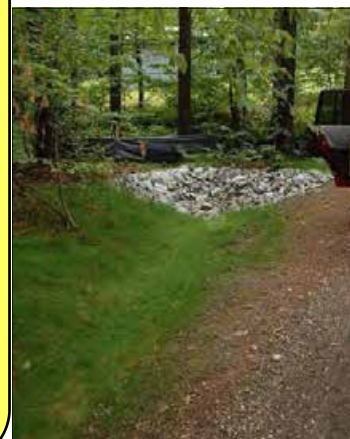


Problem— Culvert clogged and severe road shoulder erosion.

Solution— Remove debris, armor inlet/outlet, replace existing culvert with a larger one.



Road Material—Add hard-packing, cohesive surface material to the driveway.



Ponding Areas—Create small ponding areas to trap sediment and infiltrate driveway runoff.

Preserve water quality and save time, money and wear on your vehicle by having a lake-friendly camp road. Use adequate surface material, establish a crown, and add diversions to direct runoff into buffers.

Next Steps ~ Where Do We Go From Here?

Fixing the sites identified in this survey will require efforts by individuals, the Wilson Lake Association, road associations and municipal officials.

Wilson Lake Association

- Distribute copies of the survey report to property owners, road associations and towns with identified erosion problems and encourage them to make improvements.
- Apply for DEP and other grants to help fix erosion problems identified in the survey. Nominate residential sites for AWWA's YCC program.
- Continue to increase and empower the association's membership, and provide educational materials and guidance to members of the Wilson Lake watershed community.
- Organize workshops and volunteer "work parties" to start fixing identified erosion problems and teach citizens how to fix similar problems on their own properties.
- Educate municipal officials about lake issues and work cooperatively to find solutions
- Encourage and assist with the formulation of road associations around Wilson Lake.

Individual Landowners

- Look in the report or contact the WLA to see if you have a identified erosion problem. If so, try to start fixing it. Or call YCSWCD or AWWA for free advice about how to get started.
- Work with your neighbors to fix problems identified on your road. If you don't have a road association, talk to your neighbors about starting one.
- Stop mowing and raking your shoreline and parts of your property. Let lawn and raked areas revert back to natural plants. Avoid exposing bare soil. Seed and mulch bare areas.
- Read "Permitting ABCs" on page 13 and call the Town Code Enforcement Officer and DEP before starting any cutting or soil disturbance projects.
- Maintain septic systems properly. Pump septic tanks (every 2 to 3 years for year round residences; 4-5 years if seasonal) and upgrade marginal systems.
- Join the Wilson Lake Association and get involved with their activities.

Town of Acton

- Enforce shoreland zoning and other ordinances to ensure protection of Wilson Lake.
- Conduct regular maintenance on town roads in the watershed, and fix town road problems identified in this survey.
- Participate in and support long term watershed management projects.
- Promote training for road crews, boards, commissions, and other decision-makers.
- Provide support to help formal private road associations fix water quality problems.
- Review road sanding and salting procedures. Look into possibility of renting a vacuum sweeper during the spring time to use along roads that impact watersheds in Town.

State of Maine

- Periodically maintain and inspect sites on Route 109.

A Major Step ~ Forming A Road Association

Effective maintenance of camp roads is a pivotal step in the ongoing protection of Wilson Lake

What is a Road Association?

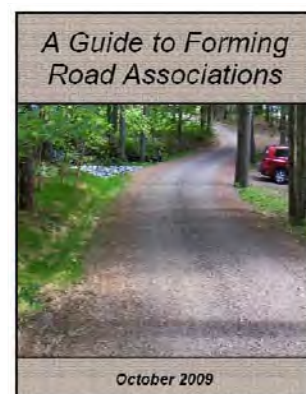
- Simply put, a road association is a way for landowners on a private camp road to share responsibility, make decisions and split costs for road maintenance and repairs.
- There are three types of road associations: Informal, Statutory and Nonprofit Corporation. Each type of road association varies in the formation time, complexity and legal standing.
- While some small roads make do with informal associations, more and more roads are becoming statutory associations. Once formed, statutory associations are run through a straight-forward, democratic process and have the ability to collect dues and receive some legal protections.

Why form a Road Association on Wilson Lake?

- 35% of the high impact sites identified in the Watershed Survey are private camp roads without road associations. Maintaining these camp roads through a road association would help to protect Wilson Lake from the negative impacts of soil erosion.
- A road association provides an avenue for you and other private camp road users to formally manage your road in a fair, organized and cost-effective manner.
- Road associations help to reduce the maintenance costs over time. The *Camp Road Maintenance Manual* estimates that \$1 spent on routine maintenance will save \$ 15 in capital repairs.
- Acton's own Senator Richard Nass sponsored a new provision in the Private Ways Law that now allows municipalities to use public funds to assist in the maintenance of private roads if such work contributes to the protection or restoration of a "great pond." As a result, all of the private roads surrounding Wilson Lake would therefore be eligible if they formed a formal road association (either statutory and nonprofit corporation). Acton's Road Committee has been working to implement this provision and encourage residents to form associations.

More Information on Road Associations:

- The DEP's 'Guide to Forming a Road Association' is available at the YCSWCD office or www.maine.gov/dep/blwq/docwatershed/roadassociation.htm. The manual describes the different types of road associations, legal issues, and steps to forming associations, including templates for bylaws and forms.
- For other resources about laws, maintenance, and the impact of poor camp roads on water quality, go to www.maine.gov/dep/blwq/docwatershed/camp/roads/index.htm



Soil might be natural, but soil washing off camp roads is not. Protect Wilson Lake by forming a road association and working together to fix the problems.

Conservation Practices for Homeowners

After reading this report you probably have a general idea about how to make your property more lake-friendly. However, making the leap from concept to construction may be a challenge.

The Maine DEP and Portland Water District offer a series of fact sheets that answer many common how-to questions. The fact sheets profile 20 common conservation practices and include detailed instructions, diagrams and color photos about installation and maintenance. The series includes the following fact sheets:

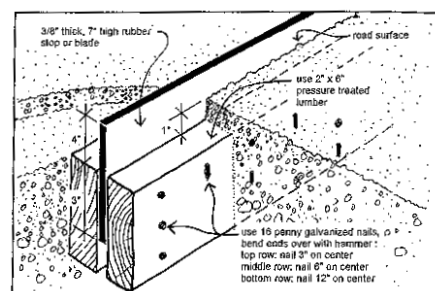
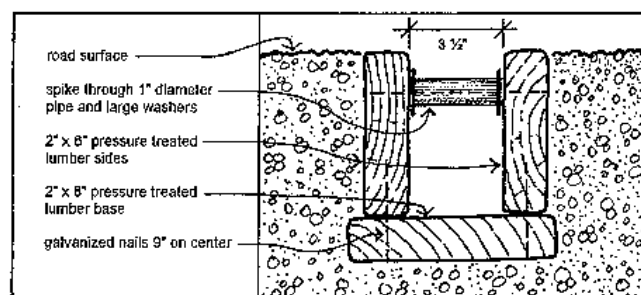
Construction BMPs	Infiltration Trench	Rain Barrels
Dripline Trench	Native Plant Lists (6)	Rain Gardens
Drywells	Open-Top Culverts	Rubber Razors
Erosion Control Mix	Paths and Walkways	Turnouts
Infiltration Steps (2)	Permitting	Waterbars



The series also includes four native plant lists. Each one is tailored to different site conditions (e.g., full sun and dry soils). The lists include plant descriptions from the DEP's *Buffer Handbook* and small color photos of each plant to make plant selection easier.

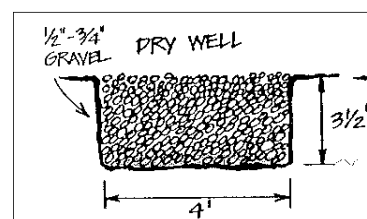
Fact sheets are available to help you install conservation practices on your property
Download at <http://www.maine.gov/dep/blwq/docwatershed/materials.htm>.

Rubber Razor Blade: Use this structure in a gravel driveway or camp road. It can be plowed over only if the plow operator is aware of its presence and lifts the plow blade slightly. Place it at a 30 degree angle to the road edge and direct the outlet toward a stable vegetated area.



Open Top Culvert: Use this structure in a gravel driveway or camp road that does not get plowed in the winter. Place it at a 30 degree angle to the road edge and point the outlet into stable vegetation. Remove leaves and debris as needed.

Drywell: Use a drywell to collect runoff from roof gutter downspouts. Drywells can be covered with sod, or left exposed for easy access and cleanout. Drywells and infiltration trenches work best in sandy or gravelly soils.



Permitting ABC's

Protection of Maine's watersheds is ensured through the goodwill of lake residents and through laws and ordinances created and enforced by the State of Maine and local municipalities. The following laws and ordinances require permits for activities adjacent to wetlands and water bodies.

Shoreland Zoning Law—Construction, clearing of vegetation and soil movement within 250 feet of lakes, ponds, and many wetlands, and within 75 feet of most streams, falls under the Shoreland Zoning Act, which is administered by the Town through the Code Enforcement Officer and the Planning Board.

Natural Resources Protection Act (NRPA) - Soil disturbance & other activities within 75 feet of the lakeshore or stream also falls under the NRPA, which is administered by the DEP.

Contact the DEP and Town Code Enforcement Officer if you have any plans to construct, expand or relocate a structure, clear vegetation, create a new path or driveway, stabilize a shoreline or otherwise disturb the soil on your property. Even if projects are planned with the intent of enhancing the environment, contact the DEP and town to be sure.

How to apply for a Permit by Rule with DEP:

To ensure that permits for small projects are processed swiftly, the DEP has established a streamlined permit process called **Permit by Rule**. These one page forms (shown here) are simple to fill out and allow the DEP to quickly review the project.

- Fill out a notification form before starting any work. Forms are available from your town code enforcement officer, Maine DEP offices, or online at <http://www.state.me.us/dep/blwq/docstand/nrpa/pbrform.pdf>
- The permit will be reviewed by DEP within 14 days. If you do not hear from DEP in 14 days, you can assume your permit is approved and you can proceed with work on the project.
- Follow all standards required for the specific permitted activities to keep soil erosion to a minimum. It is important that you obtain a copy of the standards so you will be familiar with the law's requirements.

5/2005

DEPARTMENT OF ENVIRONMENTAL PROTECTION
PERMIT BY RULE NOTIFICATION FORM
(For use with DEP Regulation, Chapter 305)

PLEASE TYPE OR PRINT IN BLACK INK ONLY

Name of Applicant: (owner)	Sandy Waters		Applicant Mailing Address:	123 Blueberry Lane	
Town/City:	Brunswick		State:	Maine	
Zip Code:	04011	Daytime Telephone No. (include area code)	(207) 555-1234	Project Location: (town)	New Gloucester
County:	Cumberland	Map #:	20	Lot #:	50
Name of Agent:			Name of Wetland or Waterbody: (include area code)	Sabbathday Lake	
Detailed Directions to Site: 121 Outlet Road, Rte 26 North, turn right onto Outlet Road, 121 Outlet Road is on the left 4th 5 houses before Barefoot Beach.					
Description of Project: Installation of a drywell to allow infiltration of roof runoff.					
Part of a larger project? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>					

(CHECK ONE) This project: does ☐ does not ☒ involve work below mean low water.

I am filing notice of my intent to carry out work which meets the requirements for Permit by Rule (PBR) under DEP Rules, Chapter 305. I and my agents, if any, have read and will comply with all of the standards in the Sections checked below:

<input checked="" type="checkbox"/> Sec. (2) Act. Adjacent to Protected Natural Res.	<input type="checkbox"/> Sec. (8) Shoreline Stabilization	<input type="checkbox"/> Sec. (14) REPEALED
<input type="checkbox"/> Sec. (3) Intake Pipes	<input type="checkbox"/> Sec. (9) Utility Crossing	<input type="checkbox"/> Sec. (15) Public Road Ramps
<input type="checkbox"/> Sec. (4) Replacement of Structures	<input type="checkbox"/> Sec. (10) Stream Crossing	<input type="checkbox"/> Sec. (16) Coastal Sand Dune Projects
<input type="checkbox"/> Sec. (5) REPEALED	<input type="checkbox"/> Sec. (11) State Transportation Facilities	<input type="checkbox"/> Sec. (17) Transfers/Permit Extension
<input type="checkbox"/> Sec. (6) Movement of Rocks or Vegetation	<input type="checkbox"/> Sec. (12) Restoration of Natural Areas	<input type="checkbox"/> Sec. (18) Maintenance Dredging
<input type="checkbox"/> Sec. (7) Outfall Pipes	<input type="checkbox"/> Sec. (13) F&W Creation/Enhancement/Water Quality Improvement	

I authorize staff of the Departments of Environmental Protection, Inland Fisheries & Wildlife, and Marine Resources to access the project site for the purpose of determining compliance with the rules. I also understand that this permit is not valid until approved by the Department or 14 days after receipt by the Department, whichever is less.

I have attached the following required submittals. NOTIFICATION FORMS CANNOT BE ACCEPTED WITHOUT THE NECESSARY ATTACHMENTS:

- ☒ Attach a check for \$55 (non-refundable) made payable to: "Treasurer, State of Maine".
- ☒ Attach a U.S.G.S. topo map or Maine Atlas & Gazetteer map with the project site clearly marked.
- ☒ Attach all other required submittals as outlined in the PBR Sections checked above.

By signing this Notification Form, I represent that the project meets all applicability requirements and standards in the rule and that the applicant has sufficient title, right, or interest in the property where the activity takes place.

Signature of Agent or Applicant:	Sandy Waters	Date:	3/4/06
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NOTE: If 100% or more of permit: Send the form with attachments via certified mail to the Maine Dept. of Environmental Protection at the appropriate regional office listed below. The DEP will send a copy to the Town Office as evidence of the DEP's receipt of notification. No further authorization by DEP will be issued after receipt of notice. Permits are valid for two years. Work carried out in violation of any standard is subject to enforcement action.

OFFICE USE ONLY	CL#	DATE	ACC. DATE	DATE	OTHER
PBR #	PP				

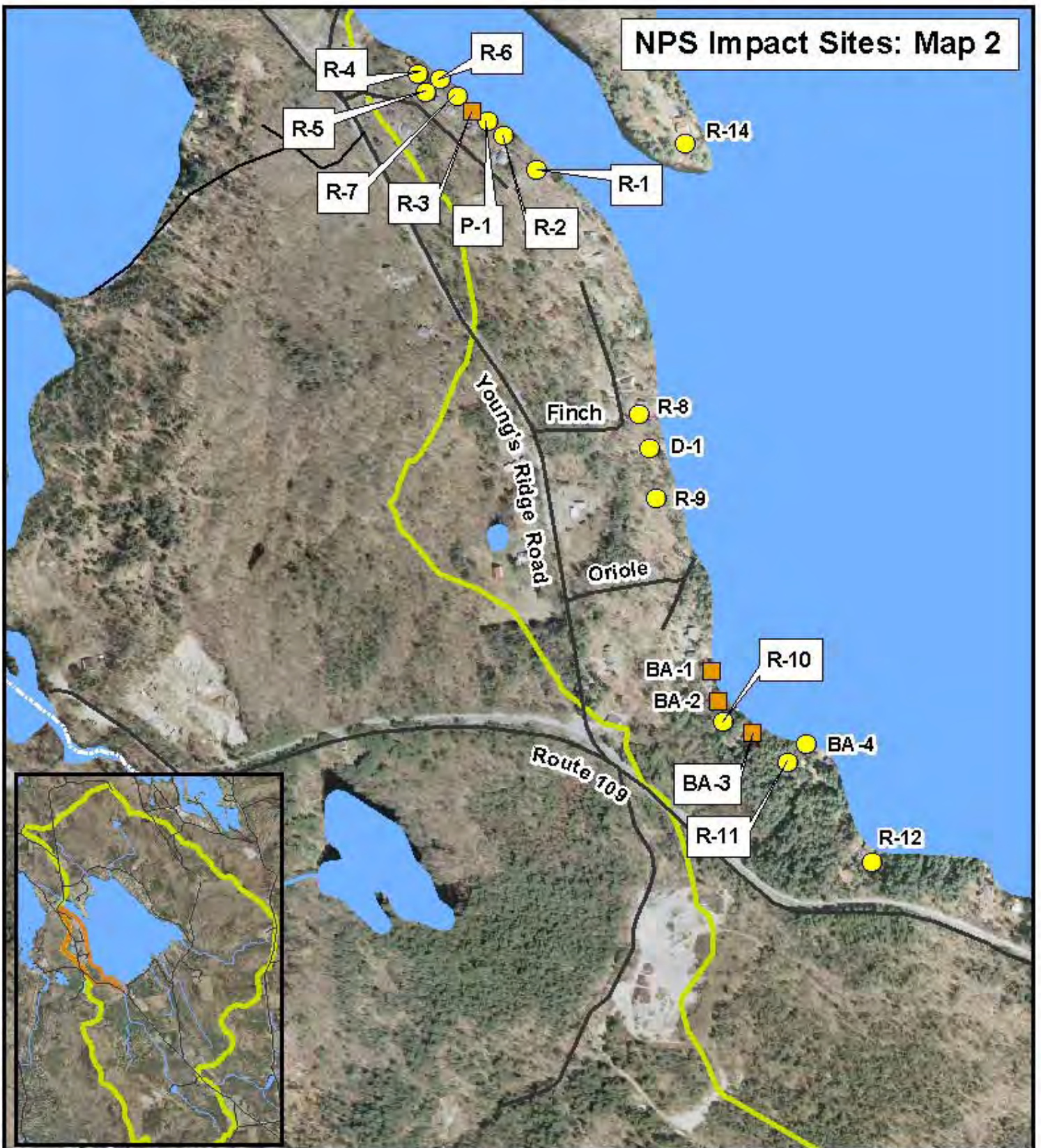
DEPLW0005-0205

AUGUSTA DEP STATE HOUSE STATION 11 AUGUSTA, ME 04333-0017 (207) 623-2111	PORTLAND DEP 312 CANCO ROAD PORTLAND, ME 04103 (207) 623-6300	BANGOR DEP 105 HOGAN ROAD BANGOR, ME 04401 (207) 941-4870	PRESQUE ISLE DEP 1235 CENTRAL DRIVE PRESQUE ISLE, ME 04769 (207) 764-0477
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NPS Impact Sites: Map 1



NPS Impact Sites: Map 2



Legend

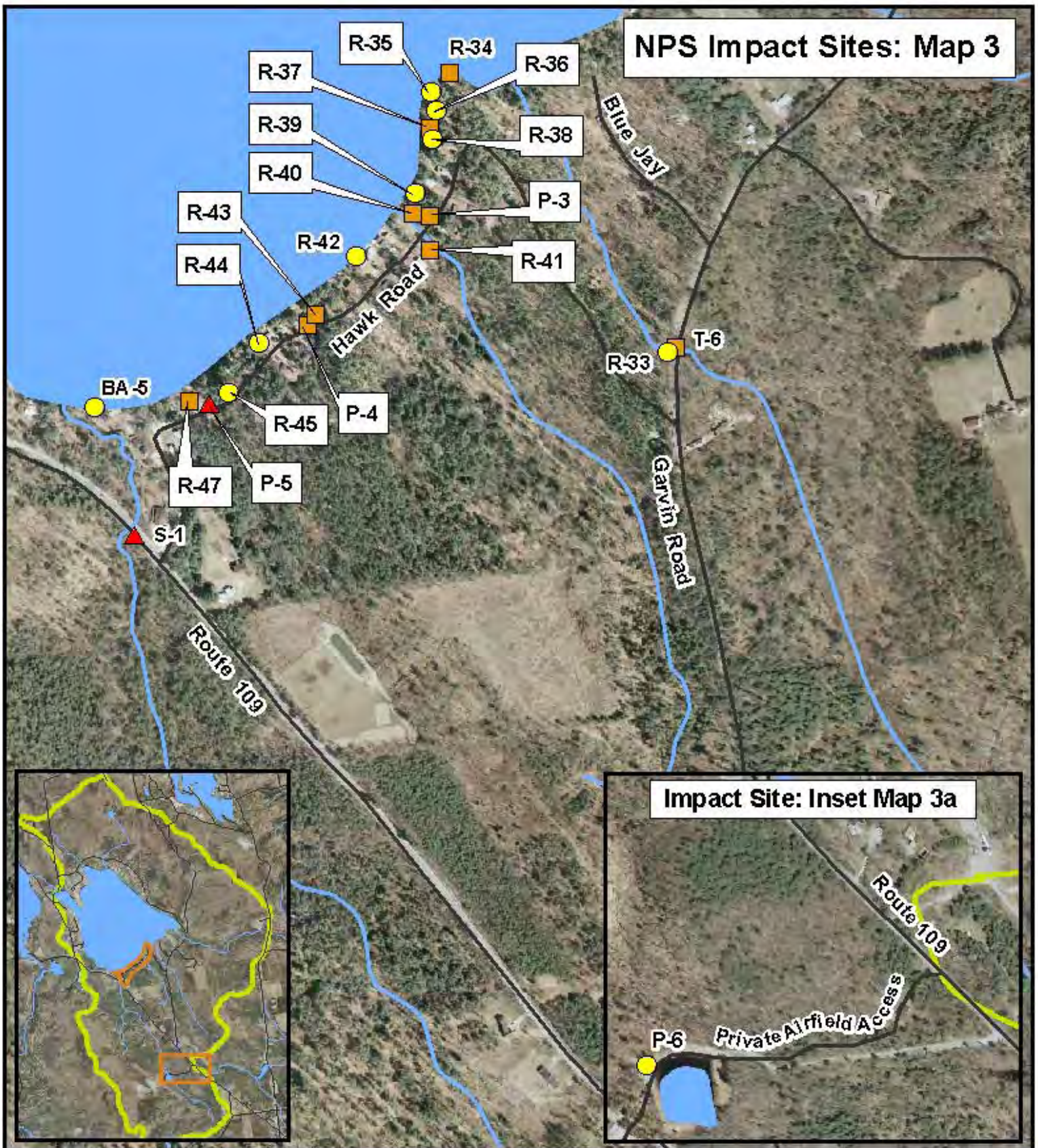
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| | High Impact Site | R Residential |
| | Medium Impact Site | P Private Road |
| | Low Impact Site | D Driveway |
| | Streams | BA Beach Access |
| | Roads | BL Boat Launch |
| | Lakes | S State Road |
| | Wilson Lake Watershed | T Town Road |



0 50 100 200 300 400 Meters

Data Source: Maine Office of GIS
 Coordinate System: NAD83, UTM Zone 19N, Meters
 Date: June 18, 2009 by H. Germadnik

NPS Impact Sites: Map 3



Legend

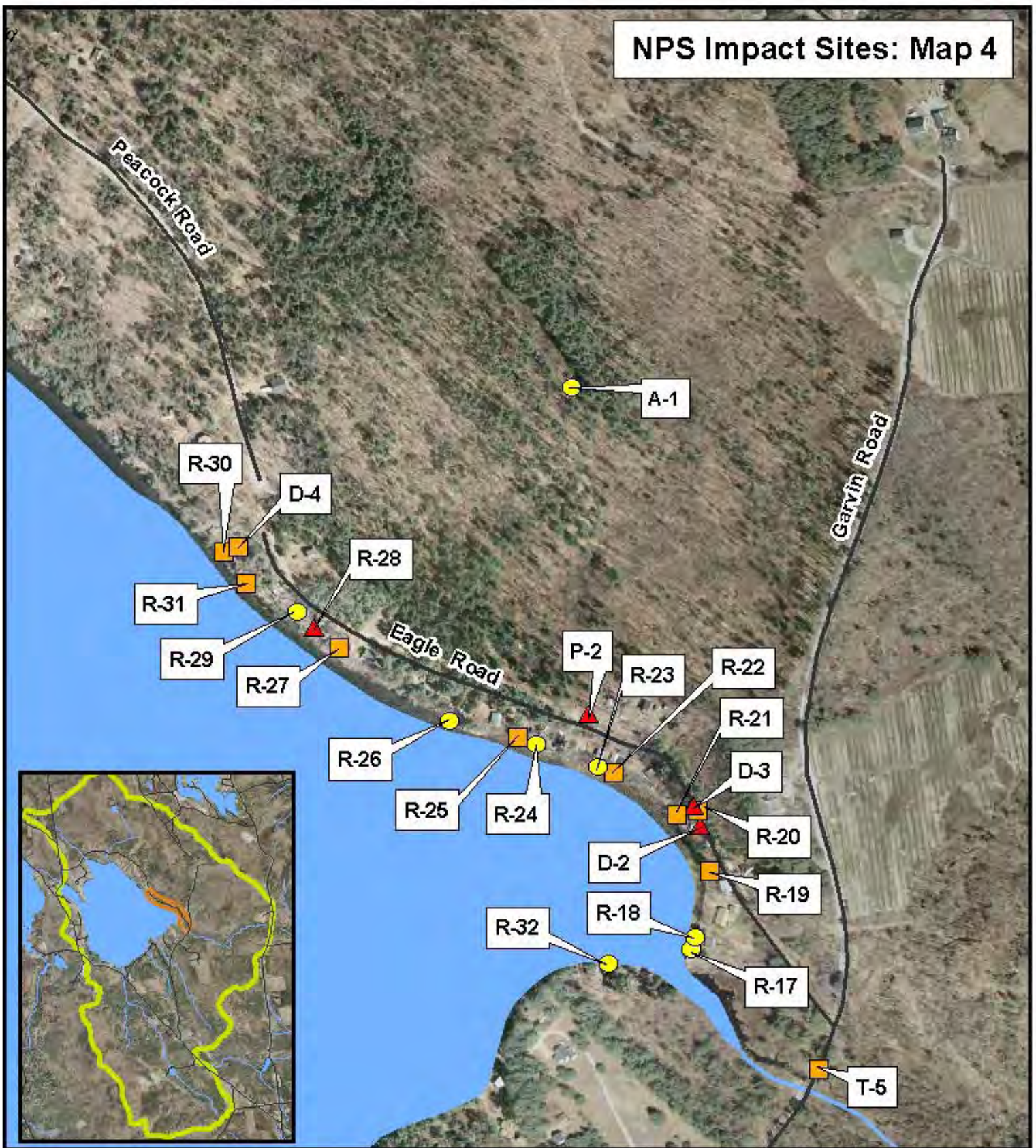
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|--|-----------------------|-----------------|
| | High Impact Site | R Residential |
| | Medium Impact Site | P Private Road |
| | Low Impact Site | D Driveway |
| | Streams | BA Beach Access |
| | Roads | BL Boat Launch |
| | Lakes | S State Road |
| | Wilson Lake Watershed | T Town Road |



0 50 100 200 300 400 Meters

Data Source: Maine Office of GIS
 Coordinate System: NAD83, UTM Zone 19N, Meters
 Date: June 18, 2009 by H. Germadnik

NPS Impact Sites: Map 4



Legend

- | | | |
|--|-----------------------|-----------------|
| | High Impact Site | R Residential |
| | Medium Impact Site | P Private Road |
| | Low Impact Site | D Driveway |
| | Streams | BA Beach Access |
| | Roads | BL Boat Launch |
| | Lakes | S State Road |
| | Wilson Lake Watershed | T Town Road |



0 50 100 200 300 400 Meters

Data Source: Maine Office of GIS
 Coordinate System: NAD83, UTM Zone 19N, Meters
 Date: June 18, 2009 by H. Germadnik

Appendix B - Wilson Lake Watershed Survey

Map ID	Location	Land Use	Problem	Area (feet)	Recommended Actions	Impact	Cost
A-1	In woods behind Eagle road	ATV Trail	Severe surface erosion, rutted trail, exposed roads, extreme disturbance	15x15	Investigate degree of connection to stream and wetland.	Low	Low
BA-1	In between Oriole Rd and Young's Ridge Rd	Beach Access	Moderate surface erosion, Bare soil, Unstable access	15x10	Infiltration steps, ECM, Establish buffer	Medium	Medium
BA-2	Falcon Rd	Beach Access	Bare soil, Inadequate shoreline vegetation	15x10	Infiltration steps, ECM, Establish buffer	Medium	Medium
BA-3	Falcon Rd	Beach Access	Bare soil	30x15	Define footpath, ECM, Add to buffer, Install catch basin for perimeter drain, cease dumping sand	Medium	Medium
BA-4	Chickadee Rd	Beach Access	Bare soil, Unstable access	5x12	Retrofit infiltration steps	Low	Medium
BA-5	end of Pheasant Road	Beach Access	Moderate beach erosion, Bare soil, Delta in lake	20x5	Establish & add to buffer, Timber at top of beach	Low	Low
BL-1	Boat launch	Boat Access	Moderate surface erosion, Moderate road shoulder erosion, Delta in Stream/Lake	1000 sq ft	Remove grader/Plow berm, Vegetate shoulder, *needs engineer*	Medium	Medium
D-1	Young's Ridge Rd	Driveway	Slight surface erosion, bare soil, Inadequate shoreline vegetation		Install runoff diverters, Establish buffer	Low	Low
D-2	Eagle Rd	Driveway	Severe surface erosion	7x80	Rain garden, No raking, Reseed bare soil & thinning grass	High	Medium
D-3	Eagle Rd	Driveway	Moderate surface erosion, Slight road shoulder erosion, Bare soil	50x25	Add new surface material, ECM, No raking, Reseed bare soil & thinning grass	High	Medium
D-4	Eagle Rd	Driveway	Moderate surface erosion	220x12	Reshape ditch, Install check dams, Remove debris/sediment from ditch, Install sediment pool, Add new surface material, Reshape (crown), Install rubber razor	Medium	Medium
P-1	Hummingbird Road	Private Road Right-of-Way	Moderate surface erosion		Add new surface material (gravel), Reshape/Crown, Install runoff diverters	Low	Medium
P-2	Eagle Rd	Private Road	Unstable culvert inlet/outlet, clogged culvert, Severe road shoulder erosion, Delta in stream	1400x12	Culvert: Armor inlet/outlet, Remove clog, Replace, Enlarge, Install plunge pool. Ditch: Armor with stone, Reshape, Install turnouts & check dams, Remove debris/sediment. Road: Remove grader/Plow berm, Add new material, Reshape (crown), Install runoff diverters	High	High
P-3	in front of right of way	Private Road	Moderate surface erosion, Severe road shoulder erosion	150x15	Replace culvert, Install ditch, Reshape (crown) road, *engineer needed*	Medium	High

Appendix B - Wilson Lake Watershed Survey

Map ID	Location	Land Use	Problem	Area (feet)	Recommended Actions	Impact	Cost
P-4	Hawk Rd	Private Road	Moderate/severe surface erosion, Severe road shoulder erosion	20x15	Install culvert & plunge pool, Build up road material, Rain garden	Medium	High
P-5	Hawk Rd	Private Road	Unstable culvert inlet/outlet, Undersized ditch with severe erosion, Moderate road shoulder erosion, Winter sand	100x15	Armor culvert inlet/outlet, Reshape ditch and armor with stone, Install ditch turnout behind parking lot, Remove winter sand	High	High
P-6	Airfield access road	Private Road	Slight surface erosion, Moderate ditch erosion, Slight road shoulder erosion	300x15	Install culvert, Armor ditch with stone, Clean-out/maintain turn-out	Low	Medium
R-1	Hummingbird Rd	Residential	Slight surface erosion, Bare soil, Delta in stream, Lack of Shoreline Vegetation	30x6	Define Footpath at Bottom, Stabilize Footpath, Erosion Control Mulch, Establish Buffer, Reseed Bare Soil & Thinning Grass	Low	Low
R-2	Hummingbird Rd	Residential	Moderate surface erosion, Inadequate shoreline veg, Exposed tree roots, Undefined footpath	70x2	Define & stabilize footpath, Install runoff diverter (waterbar), Add to buffer	Low	Low
R-3	Hummingbird Rd	Residential	Moderate surface erosion, Delta in lake, Roof runoff erosion, Inadequate shoreline vegetation	27x15	Define footpath, Infiltration steps, Install runoff diverter (waterbar), ECM, Add to buffer	Medium	Medium
R-4	Hummingbird Rd	Residential	Slight surface erosion, bare soil, Inadequate shoreline vegetation	50x10	Define & stabilize footpath, Add to buffer	Low	Medium
R-5	Hummingbird Rd	Residential	Bare soil, sparse grass	100x100	Define footpath, Establish buffer, No raking, Reseed bare soil & thinning grass	Low	Low
R-6	Youngs Ridge Rd	Residential	Moderate surface erosion, Bare soil, Inadequate shoreline vegetation	30x20	Stabilize footpath, Infiltration steps, ECM, Establish buffer	Low	Low
R-7	Finch Rd	Residential	Moderate surface erosion, Bare soil, Roof runoff erosion		Gutters, Define footpath, Infiltration trench @ dripline, ECM	Low	Low
R-8	Finch Rd	Residential	Slight surface erosion, Some bare soil		Define footpath, ECM	Low	Low
R-9	Young's Ridge Rd	Residential	Bare soil, Lack of shoreline vegetation	15x20	Define footpath, Infiltration steps, ECM	Low	Low
R-10	Falcon Rd	Residential	Bare soil under deck overhanging lake	20x40	ECM heavily under deck	Low	Low
R-11	Chickadee Rd	Residential	Slight surface erosion, Bare soil	100x50	Define footpath, ECM, Add to buffer, No raking	Low	Low
R-12	Route 109	Residential		30x10	much of problem has been addressed since survey. Monitor rocks along shoreline after ice out.	low	low
R-13	Point Rd	Residential	Slight surface erosion, Roof runoff erosion	10x10	Drywell @ gutter downspout	Low	Low

Appendix B - Wilson Lake Watershed Survey

Map ID	Location	Land Use	Problem	Area (feet)	Recommended Actions	Impact	Cost
R-14	Point Rd	Residential	Slight surface erosion, Bare soil, Roof runoff erosion	200x200	ECM	Low	Low
R-15	Point Rd	Residential	Slight surface erosion, Bare soil, Roof runoff erosion	200x200	ECM bare soil next to house	Low	Low
R-16	Peacock Road	Residential	Slight surface erosion, Bare soil	25x7	Install runoff diverters (waterbar), ECM	Low	Low
R-17	Garvin Rd	Residential	Lack of shoreline vegetation, Shoreline erosion	75x10	Repair or replace retaining wall, Establish buffer	Low	Medium
R-18	Eagle Road	Residential	Lack of shoreline vegetation, Shoreline erosion	75x10	Establish buffer	Low	Low
R-19	Eagle Rd	Residential	Moderate surface erosion, Bare soil	20x75	Install runoff diverter, ECM, Rain garden, No raking, Reseed bare soil & thinning grass	Medium	Medium
R-20	Eagle Rd	Residential	Moderate surface erosion, Moderate road shoulder erosion, Bare soil, Roof runoff erosion	20x70 & 3x25	Infiltration trench @ roof dripline, Install runoff diverter, ECM, Reseed bare soil & thinning grass	Medium	Medium
R-21	Eagle Rd	Residential	Slight surface erosion, Lack of shoreline vegetation	30x10	Define foot path, ECM, Establish buffer, Reseed bare soil & thinning grass	Medium	Medium
R-22	Eagle Rd	Residential	Slight surface erosion, Bare soil, Lack of shoreline vegetation	15x50	Define foot path, ECM, Establish buffer, Infiltration trench @ roof dripline	Medium	Low
R-23	Eagle Rd	Residential	Slight surface erosion, Bare soil, Lack of shoreline vegetation	15x10	ECM, Establish buffer, Reseed bare soil & thinning grass	Low	Medium
R-24	Eagle Rd	Residential	Slight surface erosion, Clogged foundation drain	10x10	Install runoff diverter, ECM, Establish buffer, Unclog drain, Move to a rain garden	Low	Medium
R-25	Eagle Rd	Residential	Severe surface erosion, Bare soil		Define foot path, Infiltration steps, ECM, Establish buffer	Medium	Medium
R-26	Eagle Rd	Residential	Moderate surface erosion, Bare soil, Roof runoff erosion, Lack of shoreline vegetation	10x20	Define foot path, Infiltration steps, ECM, Establish buffer, Infiltration trench @ roof dripline	Low	Medium
R-27	Eagle Rd	Residential	Moderate surface erosion, Bare soil		Define foot path, Infiltration steps, ECM, Add to buffer	Medium	Medium
R-28	Eagle Rd	Residential	Failing retaining wall, Severe surface erosion, Bare soil		*Needs Engineer*	High	High
R-29	Eagle Rd	Residential	Moderate surface erosion, Bare soil	10x40	Define foot path, Infiltration steps, ECM, Add to buffer	Low	Medium
R-30	Eagle Rd	Residential	Moderate surface erosion on paths and from under house, Inadequate shoreline vegetation	75x10	Define foot path, Infiltration Steps, Infiltration trench @ roof dripline, Add to buffer, Install timber @ top of bank-base of driveway, Close off path @ top of driveway or install infiltration steps	Medium	Medium

Appendix B - Wilson Lake Watershed Survey

Map ID	Location	Land Use	Problem	Area (feet)	Recommended Actions	Impact	Cost
R-31	Eagle Rd	Residential	Moderate surface erosion, Bare soil, Roof runoff erosion, Lack of shoreline vegetation	100x5	Reset timber at top of bank, Define foot path, Infiltration steps, Install runoff diverter, Infiltration trench @ roof dripline, ECM, Establish & Add to buffer	Medium	Medium
R-32	Wren Rd	Residential	Slight surface erosion, Bare soil, Roof runoff erosion	20x30	Infiltration trench @ roof dripline	Low	Low
R-33	Hawk Rd	Residential	Slight surface erosion	5x5	Define foot path, Establish buffer	Low	Low
R-34	Hawk Rd	Residential	Slight surface erosion, bare soil, Inadequate shoreline vegetation	75x35	Install runoff diverters, Infiltration trench @ roof dripline, ECM, Establish buffer	Medium	Low
R-35	Hawk Rd	Residential	Slight surface erosion, Roof runoff erosion, Lack of shoreline vegetation	15x15 & 10x20	Establish buffer, Replace timber, Crushed stone under deck	Low	Low
R-36	Hawk Rd	Residential	Moderate surface erosion	75x10	Define footpath, Install runoff diverter	Low	Low
R-37	Hawk Rd	Residential	Moderate surface erosion, Bare soil, Roof runoff erosion, Lack of shoreline vegetation	10x15 & 25x5	Stabilize footpath, Infiltration trench @ roof dripline, Drywell @ gutter downspout, Install runoff diverter, Establish buffer	Medium	Low
R-38		Residential	Slight surface erosion	25x4	Timbers on both sides of concrete steps	Low	Low
R-39	Hawk Rd	Residential	Moderate surface erosion, Bare soil	15x15 & 10x20	Install timbers, reseed thinning grass, Reduce size of beach area	Low	Low
R-40	Hawk Rd	Residential	Moderate surface erosion, Inadequate stream bank vegetation	50x5	Enlarge & armor culvert inlet/outlet, Stabilize road shoulders	Medium	Medium
R-41	Hawk Rd	Residential	Roof runoff erosion, Lack of stream bank vegetation	40x15	Infiltration trench @ roof dripline, Establish buffer along stream	Medium	Low
R-42	Hawk Rd	Residential	Severe surface erosion, Lack of shoreline vegetation	40x10	Infiltration trench @ roof dripline, Rain garden	Low	Low
R-43	Hawk Rd	Residential	Moderate ditch erosion, Bare soil	50x3	Stabilize ditch & install checkdams, Rain garden	Medium	Medium
R-44	Hawk Rd	Residential	Slight surface erosion, Bare soil, Lack of shoreline vegetation	50x25	Timber at top of bank, Drywell @ gutter downspout, Establish buffer, Add to buffer	Low	Low
R-45	Hawk Rd	Residential	Slight surface erosion, Inadequate shoreline vegetation	12x25	Waterbar (timber) to enclose parking area, Establish buffer	Low	Low
R-46	Hawk Rd	Residential	Slight surface erosion, Lack of shoreline vegetation	40x10	ECM on driveway, Establish buffer, Landscape timber at base of driveway	Low	Low
R-47	Pheasant	Residential	Slight surface erosion, Bare soil, Lack of stream bank vegetation	100x15	Drywell @ gutter downspout, ECM, Infiltration trench along bottom of driveway or Water retention swales, Establish buffer along stream, Crushed stone under deck	Medium	Medium

Appendix B - Wilson Lake Watershed Survey

Map ID	Location	Land Use	Problem	Area (feet)	Recommended Actions	Impact	Cost
S-1	Route 109	State Road	Severe surface erosion, clogged culvert with unstable inlet/outlet, clogged settling pool	700'x 50'	Armor culvert inlet/outlet, Clean sediment from settling pool, enlarge culverts, Reshape ditch, Install check dams, Remove debris, Armor ditch, Install turnout, Remove grader/plow berms	High	High
T-1	Stream crossing on Point Road	Town Road	Slight surface erosion, Slight road shoulder erosion, Bare soil	200x200	Reshape ditch, Install turnouts, Stone (armor) shoulder	Low	Low
T-2	Stream crossing on Peacock Road	Town Road	Severe surface erosion, Unstable culvert inlet/outlet, Severe road shoulder erosion	500x10	Armor culvert inlet/outlet, Install plunge pool, Add new surface material	High	Medium
T-3	Dam on Young's Ridge Road	Town Road	Bare soil, Lack of shoreline vegetation, Shoreline erosion, Roadside plow/Grader berm	1000 sq ft	Install ditch turnouts, Remove grader/Plow berm, Vegetate shoulder, *needs engineer*	Medium	Medium
T-4	Peacock Road	Town Road	Culvert: Slight surface erosion, Slight road shoulder erosion, Bare soil	600x12	Remove grader/Plow berm, Vegetate shoulder, Build up, Reshape (crown)	Low	High
T-5	Intersection of Garvin Rd & Garvin Brook	Town Road	Unstable culvert inlet/outlet, Culvert installed at incorrect angle, Bare soil, Winter sand	40	Install culvert at the correct angle, Armor inlet/outlet, Stabilize road shoulders	Medium	High
T-6	Intersection of Garvin Rd & Lord Brook near Bluejay Lane	Town Road	Unstable culvert inlet/outlet, Moderate road shoulder erosion	15	Enlarge & armor culvert inlet/outlet, Stabilize road shoulders	Medium	High
T-7	Buzzell Rd	Town Road	Culvert: Unstable inlet/out, Clogged. Ditch: Severe erosion, Bank failure, Undersized. Moderate road shoulder erosion	500x6	Armor culvert inlet/outlet & install plunge pool, Reshape ditch & Remove debris/sediment	Medium	High

Where Do I Get More Information?

Contacts

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Acton Wakefield Watersheds Alliance

Linda Schier, Executive Director, (603) 473-2500, info@awwatersheds.org

York County Soil and Water Conservation District

Joe Anderson, Project Manager, (207) 324-0888 x 208, janderson@yorkswcd.org

Town of Acton

Kenneth Paul, Code Enforcement Officer, (207) 636-3497 x410, ceo@actonmaine.org

Maine Department of Environmental Protection, Watershed Management Division

For technical assistance, 319 grant information, outreach materials

Wendy Garland, (207) 822-6320, wendy.garland@maine.gov

Maine Department of Environmental Protection, Field Services Section

For permitting and enforcement

Jeff Kalinich, (207) 822-6325, jeffrey.c.kalinich@maine.gov

Publications

Camp Road Maintenance Manual: A Guide for Landowners. Kennebec County SWCD and Maine DEP. 2000. 54 pgs. www.maine.gov/dep/blwq/docwatershed/camroad.pdf

Conservation Practices for Homeowners. Maine DEP and Portland Water District. 2006. 20 fact sheets. <http://www.maine.gov/dep/blwq/docwatershed/materials.htm>.

A Guide to Forming Road Associations. Maine DEP. October 2009. 21 pgs. www.maine.gov/dep/blwq/docwatershed/roadassociation.htm

Maine Shoreland Zoning—A Handbook for Shoreland Owners. Maine DEP. 2008. 42 pgs. www.maine.gov/dep/blwq/docstand/sz/citizenguide.pdf

<p>Remember—the long term health of Wilson Lake depends on you.</p>
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Appendix C: Water Quality Reports



Appendix D: Youth Conservation Corps Season Reports



*Acton
Wakefield
Watersheds
Alliance*

Youth Conservation Corps 2007 Season Report

**By Adam Shoukimas
AWWA YCC Technical Director**

Staff

Crew: Nigel St. Pierre
Anthony Stanton
Rockie Hunter
Ned Walsh

Crew Alternate: Craig Hill

Crew Leader: Emily DiFranco

Technical Director: Adam Shoukimas

AWWA YCC Board of Directors:

Linda Schier	President
Carol Lafond	Vice President
Don Chapman	Treasurer
Pat Theisen	Secretary

Steve Dagley,	Dick DesRoches,
Chuck Hodsdon,	Ken Jeffery,
Marge Kimball,	Dan Orino,
Beth Swindell,	Penny Voyles,
Glenn Wildes	



Additional assistance was provided by the following individuals and organizations:

Pat Baldwin	Acton Shapleigh Youth Conservation Corps
Wendy Garland	Maine Department of Environmental Protection
Natalie Landry	New Hampshire Department of Environmental Services
Julia Peterson	UNH Cooperative Extension/Sea Grant
Jeff Schloss	UNH Cooperative Extension
Duane Snyder	Acton Shapleigh Youth Conservation Corps
Jared Teutsch	New Hampshire Lakes Association
Directors	New Hampshire Corporate Watershed Restoration Project
Nancy Spencer Smith	Alden Young Trust
Gary Miller	Miller Ford of Sanford



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Phosphorus & Water Quality

(This section reprinted with permission from *Mousam Lake Youth Conservation Corps Final Report 2001* by Abraham Rushing and Duane Snyder)

Phosphorus, a naturally occurring element necessary for plant growth, is a relatively scarce in lake water. The growth of algae in lakes is naturally held in check by this scarcity. Phosphorus, however, is generally abundant on land. It is present in soil, ground water, and living and dead plant and animal material. Road dust, septic wastes, fertilizers, and some detergents also contain phosphorus.

In undisturbed watersheds, phosphorus is conserved and recycled within the forest system along with water and other nutrients and materials needed to sustain the living community. Water is stored in depressions on the uneven forest floor, where it eventually seeps into the ground. In this way, a great deal of water from precipitation is prevented from running over the land surface and exporting valuable nutrients from the system.

Land development changes the natural landscape in ways that alter the normal recycling of phosphorus. The removal of vegetation, smoothing of the land surface, creation of impervious surfaces, maintenance of closely cropped lawns, and the compaction of soils reduce the amount of precipitation stored and retained on-site. In turn, the amount of water flowing across the land surface as runoff dramatically increases.

Stormwater flowing over the land surface picks up phosphorus and transports it to lakes in a soluble form or attached to eroded soil particles. Increased phosphorus in lake water leads to a proportionate increase in algal growth. If the phosphorus supply is great enough, the resulting cycle of increased algal growth, death, and decomposition can lead to oxygen depletion in the bottom portion of the lake. When lake-bottom oxygen is gone, a chemical change occurs that allows phosphorus previously locked in the bottom sediments to be re-released into the lake waters. This "internal recycling" of phosphorus continues the downward spiral in lake quality.

The subsequent algae blooms cloud the water and lead to decreased property values and recreational enjoyment. For every meter of clarity lost in a lake, it is estimated that waterfront property values drop 10 to 20 percent. The oxygen depletion in the bottom portion of the lake suffocates cold-water fish, such as trout and landlocked salmon. Many other native aquatic species would suffer as well. Once these degradations begin taking place, it could take years to recover, if recovery is possible at all.

All land disturbance and development increases phosphorus export to lakes. Although some impact must be accepted as the inevitable and unavoidable effect of development, a variety of measures can substantially reduce phosphorus export to lakes and help preserve water quality.

Watershed

The AWWA YCC focused its efforts on the Salmon Falls and Ossipee River watersheds within the towns of Acton, Maine and Wakefield, New Hampshire. Within these watersheds are 10 lakes and ponds – Balch Lake, Belleau Lake, Horn Pond, Great East Lake, Lake Ivanhoe, Lovell Lake, Pine River Pond, Province Lake, Wilson Lake, and Woodman Lake.

Problem

The AWWA YCC will address the problem of Non-Point Source (NPS) pollution associated with erosion and stormwater runoff on private and public properties within the targeted watersheds. The stormwater carries sediment and nutrients into the waterbodies and destabilizes the shoreline by eroding fragile soils. Erosion results in shallow areas that promote weed growth and nutrients accelerate the eutrophication process. Vegetated buffers, shoreline stabilization, infiltration systems, rain gardens, waterbar diverters, and other Best Management Practices will be installed to control stormwater runoff and minimize soil erosion.

Mission

AWWA's mission is to preserve and protect Acton and Wakefield's water resources that lie within the Ossipee and Salmon Falls watersheds through scientific study, outreach and education efforts and remediation of impairments

The members of AWWA include representatives of local lake associations, members of Town committees including Conservation Commissions, and local residents. Our partners include UNH and UME Cooperative Extensions, Maine DEP, New Hampshire DES, Mousam Lake Youth Conservation Corps, the NH Lakes Association and the Natural Resources Outreach Coalition.

Season Overview

2007 marked the second year of the Acton Wakefield Watersheds Alliance (AWWA) Youth Conservation Corps (YCC). Following the success of the 2006 season, our mission was to continue that momentum with an increase in the number of YCC project sites. We were able to secure funding for weekend projects during the months of June and September with a focus of providing assistance on municipal sites in both Wakefield and Acton. We provide free landscape design to lakefront homeowners within the Salmon Falls and Ossipee River Watersheds. Among these sites, projects that meet the following criteria are chosen as YCC project hosts:

1. Sites will be chosen from all requests for participation.
2. They must of an appropriate size and difficulty for the YCC, which uses hand tools only.
3. Sites will be selected that have a relatively high impact to water quality, using sediment load estimates where possible.
4. Each Erosion Control project represents an example of a Best Management Practice (BMP). Therefore, efforts will be made to choose sites whose solutions will provide examples of a wide variety of different BMPs.
5. Efforts should be made to include at least one project on each lake in the service area.
6. All other factors being equal, the projects should be visible and accessible to the public for inspection, to more fully raise awareness of erosion from storm water runoff and encourage other property owners to participate in the solutions.
7. Board members will not vote if they have a potential conflict of interest in a particular site.

Over an eight-week full-time period and seven-week part-time period, the YCC completed 20 projects on the lakes in Acton, ME and Wakefield, NH. This report will outline the projects the crew worked on as well as the erosion issues prevalent on the site and some of the challenges the project offered.

In addition to the 20 YCC projects completed this season, the technical director also completed 25 technical assistance designs. This report will outline and map the technical assistance designs.

2007 YCC Projects

The following projects were completed by the YCC during the 2007 season arranged by water body.

Great East Lake

1. Helen Cummings	85 North Shore Drive	East Wakefield, New Hampshire
2. Charlene Gottlieb	333 Veazey Point Road	Sanbornville, New Hampshire
3. Paul Shannon	291 Veazey Point Road	Sanbornville, New Hampshire
4. Lennie McKinley	325 Veazey Point Road	Sanbornville, New Hampshire
5. Municipal Lot*	Canal Road (on GEL Canal)	Acton, Maine
6. Municipal Lot*	Robinson Road (on GEL canal)	Acton, Maine

Lovell Lake

7. Lovell Lake Boat Ramp*	Witchtrot Road	Sanbornville, New Hampshire
8. Patrick Golden	Lovell Lake Road at Golden Way	Sanbornville, New Hampshire
9. Barbara & Gil Binette	46 North Roberts Cove Road	Sanbornville, New Hampshire
10. Martha Ortiz	39 Cemetery Road	Sanbornville, New Hampshire
11. Alan Heacock	298 Brackett Road	Sanbornville, New Hampshire
12. Tom & Jillian Darling	322 Brackett Road	Sanbornville, New Hampshire

Balch Pond

13. Stephen Gregorio	62 Thoreau Trail	East Wakefield, New Hampshire
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Belleau Lake

14. Joseph Arnone	641 Belleau Boulevard	East Wakefield, New Hampshire
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Wilson Lake

15. Marion Sundgaard	245 Eagle Road	Acton, Maine
16. Jeanne Achille	94 Peacock Road	Acton, Maine

Province Lake

17. Municipal Lot*	Bonnyman Road	East Wakefield, New Hampshire
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Branch River

18. St. Anthony's Church*	Meadow Street	Sanbornville, New Hampshire
19. Municipal Lot*	White Mountain Highway	Sanbornville, New Hampshire

Horn Pond

20. Municipal Lot*	New Bridge Road	Acton, Maine
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* Municipal Project Site

The following are individual descriptions of each of the YCC projects in chronological order.

Wakefield Municipal Projects

1. Bonnyman Road Municipal Lot

Province Lake, East Wakefield, New Hampshire

Large pine trees have been removed from this site by the town and the site itself had been misused. A tremendous amount of sand and sediment was being eroded from the site and washed into the lake. There was no barrier preventing road runoff from flowing over the lot and carrying sediment into the lake. There was a wide open area covered in sand at the top of the site that needed to be stabilized. Also, there existed a lot of local vegetation adjacent to the property to where runoff could easily be diverted. The hill leading down to the lake had gullies from erosion and there was no good access to the lake that did not cross other peoples' properties. The gullies were packed and stabilized with riprap rock, preventing further erosion. A set of infiltration steps was constructed on the hill providing access to the lake. The large sandy area was covered with erosion control mix. Three timber waterbars were installed. Each diverted runoff to a drywell that would capture and slowly release water into the adjacent vegetation. At the edge of the property along the road, an infiltration trench was dug to capture water from the road, preventing fast moving water from slamming into the site. Native vegetation was planted along the road side of the property where local vegetation was especially sparse. The native plants also helped to define a meandering path leading to the infiltration steps. This site offered a multitude of difficulties, many of which have yet to be resolved due to the crew's limitations and the relatively narrow breadth of the organization's jurisdiction. Future remediations are likely to be needed before this site is adequately resuscitated.



Bonnyman Road Property Before



Bonnyman Road Property After

Days to Complete Project: 3.5 days

Labor Provided: Crew leader x 3.5 days
4 crew member x 3.5 days

BMPs Installed:

- Infiltration Steps
- Timber Waterbars
- Erosion Control Mix
- Riprap Stabilization
- Paths & Walkways
- Infiltration Trench
- Drywells
- Native Vegetation

Sediment Loss Estimate: Sheet Erosion: could not measure

Gully Erosion: 3.4 tons/year

Cost to Town for all projects: \$1,993.13

2. St. Anthony's Church

Branch River, Sanbornville, New Hampshire

This property was surrounded by a short, steep drop leading directly to the Branch River. The church had a very large parking lot around it that was pitched toward the river. Surrounding the parking lot, right above the drop to the river, was a small asphalt berm with breaks periodically cut into it where water could escape. The driveway thus created a large amount of runoff that was concentrated at these breaks where it could erode a considerable amount of sediment as well as carry away the sand that had been spread over the winter on the driveway itself. However, the breaks also focused the water into specific areas, making BMP placement a lot easier. At two of the breaks, where there was enough space before the drop and the river, rain gardens were installed to capture and filter the concentrated runoff from the parking lot. Along the front of the driveway, water was rushing down, carrying across a large sandy area, and diving into the river. Along the side of the sloped driveway, an infiltration trench was installed to capture the runoff pitched towards it. This helped to collect a significant amount of water before it reached the river.



St. Anthony's Church Before



St. Anthony's Church Rain Gardens After

Days to Complete Project: 2 days

Labor Provided: Crew leader x 2 days
4 crew member x 2 days

BMPs Installed:

- Rain Gardens
- Infiltration Trench

Sediment Loss Estimate: Sheet Erosion: could not measure
Gully Erosion: 1.2 tons/year

Cost to Landowner: \$XXX.XX

3. Lovell Lake Boat Ramp

Lovell Lake, Sanbornville, New Hampshire

This property was a thin strip of land with a moderate slope between Lovell Lake and Witchtrot Road. Cars often parked along the top of the property to use the boat ramp at the lower part of the lot. Water coming off of the road would cut across the top of the property and pick up sediment, washing it into the lake. The area where cars would park was well packed to almost impervious conditions and there was only bare soil exposed. The only vegetation on the site was grass on the lower part of the property. A timber waterbar was installed at the top of the site to divert as much water from the road as soon as possible to prevent it from spreading further down on the site. The waterbar led to a rain garden to collect the runoff before it could enter the lake. Along the road side of the property where cars had parked, erosion control mix was spread above a long line of timber waterbars. The erosion control mix served to stabilize the exposed soil and soak up water. Native vegetation was planted in the area as well to help absorb water and discourage parking in the area.



Lovell Lake Boat Ramp Before



Lovell Lake Boat Ramp After

Days to Complete Project: 2 days

Labor Provided: Crew leader x 2 days
4 crew member x 2 days

BMPs Installed:

- Timber Waterbars
- Erosion Control Mix
- Rain Garden
- Native Vegetation

Sediment Loss Estimate: Sheet Erosion: could not measure
Gully Erosion: 0.4 tons/year

4. White Mountain Highway at Mobil Station

Branch River, Sanbornville, New Hampshire

This property was right along the White Mountain Highway behind the Mobil station. Runoff was coming from the highway, concentrating to a single channel, and eroding a deep gully down the property. The runoff was eroding sediment and carrying it into the Branch River below. Riprap rock was packed into the gully, stabilizing it and preventing further erosion. Considerable vegetation existed on the site to adequately control the runoff that now flowed over the site with less severity.



White Mtn Highway Before



White Mtn Highway Riprap After

Days to Complete Project:	0.5 days
Labor Provided:	Crew leader x 0.5 days 4 crew member x 0.5 days
BMPs Installed:	<ul style="list-style-type: none">• Riprap Stabilization
Sediment Loss Estimate:	Gully Erosion: 0.4 tons/year

Residential Projects

1. Helen Cummings

Great East Lake Sanbornville, New Hampshire

The roof of the landowner's camp sloped and drained very close to the shore of the land. A significant amount of runoff was cascading off of the roof, collecting on the ground, and washing into the lake along with a considerable amount of sediment. The sheet erosion here was able to be controlled through the installation of a dripline trench. The trench collects the roof runoff and prevents its immediate flow into the lake and stops any velocity that contributes to excess sediment erosion. The installation of the dripline trench was an effective solution to the



Cummings Property Before YCC Work



Cummings Rain Garden After YCC Work

Days to Complete Project: 1

Labor Provided: Crew leader x 1 day
4 crew members x 1 day

BMPs Installed:

- Dripline Trench

Sediment Loss Estimate: Sheet erosion: could not be measured.

Cost to Homeowner: \$70.00

2. Marion Sundgaard

Wilson Lake, Acton, Maine

The homeowner was experiencing a significant amount of erosion due to her neighbor's driveway. The neighbor had paved his portion of the street and driveway uphill of the property. During events of even light precipitation, a deluge of water would run down the paved area and make a direct line through the property towards the house. Fortunately, there was enough of the landowner's property to install a means of diverting the water away from the house and off into nearby vegetation. An infiltration trench was dug at the top of the property, originating where the water first enters the property. At this spot, the trench was made extra wide and deep to serve as a collection area where the water would first enter the trench and have the opportunity to be absorbed into the ground. The trench snaked through a vegetated area before terminating at another large bowl on the side of the house where runoff could slowly seep out into local vegetation. At one point the crew needed to return to the site to improve the

design by relining the trench with an impervious material because water was being absorbed into the ground and seeping to the house foundation. After the remediation, the seeping stopped and the trench worked as designed.



Sundgaard Property Before



Sundgaard Infiltration Trench After

Days to Complete Project: 5

Labor Provided: Crew leader x 5 days
4 crew members x 5 days

BMPs Installed:

- Infiltration Trench

Sediment Loss Estimate: Sheet erosion: could not be measured

Cost to Homeowner: \$XXX.XX

3. Joseph Arnone

Belleau Lake, East Wakefield, New Hampshire

This homeowner was experiencing a significant amount of sheet run-off coming from the road and flowing over his driveway and eventually through his property and into the lake. The driveway is very long and wide and a significant amount of water from upland properties eventually finds its way to his property. The homeowner lives at the property year round so a diverter that would hinder plowing could not be installed in the driveway. Runoff from the roof of the garage was also causing some erosion. In order to capture the runoff on the driveway, an open-top culvert was installed across the vast expanse of the driveway's width. This carried water down to the side of the driveway to a vegetated area where a large drywell was installed to collect the runoff and slowly released it into the vegetation. A dripline trench was installed along the side of the garage. Further down the driveway, another open-top culvert was installed across a narrowed section. This culvert led to an infiltration trench running down the side of the driveway, terminating at a drywell where the runoff would finally be slowly released to water the lawn. The design worked rather well, although the open-top culverts will need to be cleaned often to remove the sediment that runoff washes into them.



Arnone Driveway Before



Arnone Open-top Culvert After

Days to Complete Project: 4 days

Labor Provided: Crew leader x 4 days
4 crew members x 4 days

BMPs Installed:

- Open-top Culverts
- Dripline Trench
- Infiltration Trench
- Drywells

Sediment Loss Estimate: Sheet erosion: could not be measured
Gully erosion: 0.8 tons/year

Cost to Homeowner: \$525.00

4. Stephen Gregorio

Balch Pond, East Wakefield, New Hampshire

The homeowner had a significant amount of driveway runoff. Very large and long gullies had formed along the length of the driveway leading down to the house. The lower part of the driveway was flanked by a retaining wall on one side and a hill on the other, making diverting of water difficult. Three open-top culverts were installed along the length of the driveway. Along the base of the retaining wall, an infiltration trench was installed to collect water from the driveway and transport it down to the lowest open-top culvert where it will be cast across the driveway into local vegetation. Leading from the house down to the lakefront beach was a long series of paved stairs. A considerable amount of runoff flowed down these stairs and carved a deep gully across the beach. This runoff carried an incredible amount of sand into the lake. An infiltration trench was installed along the bottom of the stairs to collect this runoff and transport it along the top of the beach to deposit the runoff into nearby vegetation where it will be absorbed. Because of the pitch of the driveway and the stairs, the open-top culverts and infiltration trenches should be cleaned of sediment regularly to ensure property drainage and flow of water.



Gregorio Property Before



Gregorio Infiltration Trench After

Days to Complete Project: 5

Labor Provided: Crew leader x 5 days
4 crew members x 3 days
3 crew members x 2 day

BMPs Installed:

- Open-top Culverts
- Infiltration Trenches

Sediment Loss Estimate: Sheet erosion: could not be measured
Gully erosion: 2.3 tons/year

Cost to Homeowner: \$550.00

5. Charlene Gottlieb

Great East Lake, Sanbornville, New Hampshire

The homeowner had a very steep paved driveway where runoff from the road above ran incredibly fast down to the house with a large amount of sediment that eventually mounded up where the runoff finally slowed down as the property levels off by the lake. Fortunately, the driveway was not a straight-shot, and as the driveway turned, there was opportunity to dig a series of turnouts where water could escape into the vegetation along the driveway. Also, at the top of the driveway, there was a small piece of the property that the runoff flowed over before hitting the driveway and flying downhill. On this portion of property, a large drywell was installed to collect the initial road runoff and slowly releasing it so that not all of the water coming from the road would flow down the driveway. Also, the water that escaped and did go down the driveway would not do so at maximum velocity. Because the driveway was paved, we were presented with a challenge for diverting the water from the driveway surface to the side where the turnouts were dug. This problem was solved with the use of donated used fire hose filled with sand. The hoses were laid across the driveway and worked very well. In fact, the hoses and turnouts were so effective that the water that was diverted off the driveway found its way onto the neighbors' property, resulting in another project for the crew later in the season.



Gottlieb Property Before



Gottlieb Property After

Days to Complete Project: 2 days

Labor Provided: Crew leader x 2 days
4 crew members x 2 days

BMPs Installed:

- Drywell
- Turnouts
- Fire Hose Diverters

Sediment Loss Estimate: Sheet erosion: could not measure

Cost to Homeowner: \$XXX.XX

6. Jeanne Achille

Wilson Lake, Acton, Maine

The homeowner had moderate runoff coming from the roof and driveway, flowing down over the lawn and eventually going into the lake. The lakefront was the area most in need of remediation as most of the vegetation was gone and a considerable amount of bare soil remained. There was also poor access to the lake due to the slope of the terrain. Waterbars were installed to divert runoff from the driveway. A crushed stone path was created to provide access down to the lake. At the lakefront, infiltration steps were constructed and surrounded by buffer plantings and erosion control mix to prevent any runoff from making its way into the lake. This project proved to be one of the most significant transformations of the summer.



Achille Property Before



Achille Stabilized Shorefront After

Days to Complete Project: 5 days

Labor Provided: Crew leader x 5 days
4 crew members x 5 day

BMPs Installed:

- Waterbars
- Paths and Walkways
- Erosion Control Mix
- Infiltration Steps
- Buffer Vegetation

Sediment Loss Estimate: Sheet erosion: could not measure

Cost to Homeowner: \$905.38

7. Patrick Golden

Lovell Lake, Sanbornville, New Hampshire

The homeowner had a significant amount of gully erosion. The site was a beach lot situated tightly between Lovell Lake Road and Lovell Lake itself. Because of that, an incredible amount of runoff was coming off of the road and eroding deep gullies across the beach. Tremendous amounts of sand had been washed into the lake. A barrier between the road and the beach had to be created in order to prevent the beach from being eroded entirely into the lake. A long timber waterbar was installed that led to a vegetated area on the side of the property where a drywell was placed. Another timber waterbar was installed across the bottom of a parking area leading to another drywell in a vegetated area on the other side of the property. Between the two waterbars a stone-lined path was created to provide access to the dock. Erosion control mix was spread in front of the long waterbar and to the side of the beach behind the waterbar to stabilize the sand here that was not used as a beach. Also, beside the beach in the mulched area, plants were added to additionally stabilize the soil. Crushed stone was spread in front of the shorter waterbar to stabilize the parking area. Since the BMPs were installed, the gullies have not yet returned.



Golden Property Before



Golden Waterbar and Erosion Control Mix After

Days to Complete Project: 4 days

Labor Provided: Crew leader x 4 days
4 crew members x 4 days

BMPs Installed:

- Waterbars
- Drywells
- Erosion Control Mix
- Buffer Vegetation

Sediment Loss Estimate: Gully Erosion: 7.0 tons/year

Cost to Homeowner: \$XXX.XX

8. Gil Binette

Lovell Lake, Sanbornville, New Hampshire

This property had been a YCC project in 2006. Because of the road situation in the area, this property received an incredible amount of runoff coming across it even during minor precipitation events. Last year, the crew needed to return to the property a few times to improve the site designs that the runoff constantly strained. This year, the crew returned for a last time to make final improvements to the site by retrofitting an infiltration trench, adding filters to the drywell and infiltration trench to prevent clogging, and improving a path by replacing the pea stone with a heavier and coarser crushed stone. Aside from these necessary improvements, the rest of the design from the previous year worked very effectively, including the rain garden and rubber razor.



Binette Drywell and Infiltration Trench Before



Binette Drywell and Trench with Filters

Days to Complete Project: 1 day

Labor Provided: Crew leader x 1 day
4 crew members x 1 day

BMPs Installed:

- Paths & Walkways
- Infiltration Trench

Sediment Loss Estimate: Sheet erosion: could not be measured

Cost to Homeowner: \$XXX.XX

9. Paul Shannon

Great East Lake, Sanbornville, New Hampshire

This property experienced gully runoff down an old boat ramp as well as sheet erosion occurring over a retaining wall and across the driveway. The owner no longer needed the boat ramp so we laid timber waterbars along the very top of the boat ramp to divert water from the road off the path and into existing vegetation. Below this, we constructed a retaining wall using concrete blocks from the landowner's replaced lakefront wall. This new wall was constructed in line with the existing railroad tie retaining wall. We spread ECM between the diverters and planted vegetation on top of the new wall. An additional tier was added on to the lowest level of the existing timber retaining wall. Above this wall was a natural basin where road runoff collected and eventually breached the wall to flow down towards the lake. A rain garden was planted here with native vegetation. Behind the rain garden, a small soil berm was created. The rain garden, soil berm, and additional tier on the retaining wall all combined to prevent the washing of runoff over the wall. They collectively manage the water effectively.



Shannon Property Before



Shannon Retaining Wall and Waterbars After

Days to Complete Project:	3.5 days
Labor Provided:	Crew leader x 3.5 days 4 crew member x 3.5 days
BMPs Installed:	<ul style="list-style-type: none"> • Retaining Wall • Erosion Control Mix • Waterbars • Rain Garden
Sediment Loss Estimate:	Sheet Erosion: could not measure. Gully Erosion: 2.3 tons/year
Cost to Homeowner:	\$769.00

10. Martha Ortiz

Lovell Lake, Sanbornville, New Hampshire

This property was on a very long sloping hill leading to the lake. Due to the mature pine trees shading the property, there was little to no ground vegetation. Few barriers existed to stop or even slow runoff streaming down the hill from entering the lake. Much of the pine needles had washed away leaving bare soil exposed. Runoff from the roof was also contributing to the problem. It was decided that the best approach to this very broad problem was to cover as much of the property with strategically place timber waterbars and erosion control mix. The erosion control mix covered and stabilized the bare soil and the timber waterbars diverted runoff into nearby vegetation. Dripline trenches controlled roof runoff and prevented it from washing into the lake. Finally, a vegetated buffer strip was installed along the shore of the lake where, ordinarily, water running down the bare slope would directly enter the lake with its sediment load.



Ortiz Property Before



Ortiz Waterbar and Erosion Control Mix After

Days to Complete Project:	2.5 days
Labor Provided:	Crew leader x 2.5 days 4 crew member x 2.5 days
BMPs Installed:	<ul style="list-style-type: none"> • Erosion Control Mix • Buffer Vegetation • Waterbars • Dripline Trenches
Sediment Loss Estimate:	Sheet Erosion: could not measure
Cost to Homeowner:	\$1171.00

11. Lennie McKinley

Great East Lake, Sanbornville, New Hampshire

This landowner had runoff coming onto her property due to a previous project the YCC had done earlier in the season. Water was rushing through the woods and coming onto the side of the driveway and eventually down to the lake. A long, multi-leveled timber waterbar was installed along the edge of the woods in order to keep the water in the vegetation and guide the runoff into a flat area where it could be properly absorbed and controlled. Water was also coming from the road and running down the considerably steep driveway, carving gullies and bringing sediment into the lake. Because the driveway was gravel and the house was used very little if at all in the winter, two rubber razors were installed across the driveway. Also, an infiltration trench was installed along the lower pitched side of the driveway. The rubber razors divert water into the infiltration trench where it is guided down to the end of the driveway where the infiltration trench terminates in a flat area of local vegetation where the runoff is managed and prevented from entering the lake.



McKinley Property Before



McKinley Rubber Razors and Trench After

Days to Complete Project: 3 days

Labor Provided: Crew leader x 3 days
4 crew member x 3 days

BMPs Installed:

- Timber Waterbars
- Rubber Razors
- Infiltration Trench

Sediment Loss Estimate: Gully Erosion: 0.9 tons/year

Cost to Homeowner: \$XXX.XX

12. Alan Heacock

Lovell Lake, Sanbornville, New Hampshire

This property had a long gravel driveway leading from a paved, well used road. A considerable amount of runoff was coming from the road and flowing down the driveway, carving deep gullies in the driveway surface. Sediment from the driveway was being washed into the lake. The landowner did not use the driveway in the winter and it would not be plowed. A series of rubber razors were installed to periodically divert water off the driveway into vegetation where it could be absorbed and controlled.



Heacock Upper Rubber Razors After



Heacock Lower Rubber Razors After

Days to Complete Project: 2 days

Labor Provided: Crew leader x 2 days
4 crew member x 2 days

BMPs Installed:

- Rubber Razors

Sediment Loss Estimate: Gully Erosion: 1.3 tons/year

Cost to Homeowner: \$XXX.XX

13. Tom & Jillian Darling

Lovell Lake, Sanbornville, New Hampshire

This property was experiencing a lot of runoff coming from the paved road and flowing down the driveway and over wooded area, all bringing sediment into the lake. Also, a series of impervious stairs led to the lake that runoff simply washed over. Turnouts along the side of the driveway were dug to allow water running over the driveway surface areas to escape into the lower lying vegetation where the water would be prevented from getting to the lake. Timber waterbars were installed in the wooded area below and to the side of the driveway in order to divert and slow the runoff in this area. Also, a waterbar was installed below the driveway where it could divert water into the woods. The two highest stairs leading to the lower lawn and the lake were retrofitted into infiltration steps by removing the impervious material of the step and backfilling it with crushed stone that will absorb the water flowing over it. Finally, at the base of the steps, a rain garden was installed to capture any remaining water that might make it into the lake.



Darling Impervious Steps



Darling Retrofit Infiltration Steps After

Days to Complete Project: 2 days

Labor Provided: Crew leader x 2 days
4 crew member x 2 days

BMPs Installed:

- Retrofit Infiltration Steps
- Timber Waterbars
- Turnouts
- Rain Garden

Sediment Loss Estimate: Gully Erosion: 0.5 tons/year

Cost to Homeowner: \$420.00

Acton Municipal Sites

1. Canal Road Parking Area at Robinson Road Great East Lake Canal, Acton, Maine

This property had a lot of road runoff traveling across it, picking up sediment, and running down a steep slope into the canal. Without the capability of repitching the entire parking area, the crew had to prevent the water that was coming onto the site from reaching the canal. Also, the design could not be located anywhere that it would be in the way of plowing activities. Therefore, a rock waterbar was installed along the edge of the site, immediately above the slope leading to the canal. The waterbar diverted water to a drywell further down the slope to an area where it leveled off enough to allow the construction of a drywell.



Canal Road Before



Canal Road Waterbar and Drywell After

Days to Complete Project: 1 day

Labor Provided: Crew leader x 1 day
3 crew member x 1 day

BMPs Installed:

- Rock Waterbar
- Drywell

Sediment Loss Estimate: Sheet Erosion: could not measure

Cost to Town: \$0.00

2. Robinson Road Great East Lake Canal, Acton, Maine

This property had a lot of runoff from Robinson Road. A trench on the side of the road terminated before leading water anywhere that it could be controlled. The water was spreading over the site and eventually flowing down into the canal with enough velocity to carve a gully into the terrain, resulting in sediment being washed into the water. Extending the infiltration trench and leading it to a drywell controlled the runoff and prevented it from washing directly into the canal.



Robinson Road Before



Robinson Road Infiltration Trench After

Days to Complete Project: 2 days

Labor Provided: Crew leader x 2 days
4 crew member x 2 days

BMPs Installed:

- Infiltration Trench
- Drywell

Sediment Loss Estimate: Sheet Erosion: could not measure
Gully Erosion: 0.6 tons/year

Cost to Town: \$0.00

3. New Bridge Road Parking Area

Horn Pond, Acton, Maine

This property was situated between the road and the lake. Runoff from the road ran across the site, picked up sediment, and flowed into the lake. There was no significant vegetation to prevent any erosion or absorb any of the water. A rock waterbar was constructed across the property to act as a barrier, preventing the washing of water and sediment into the lake.



New Bridge Road Before



New Bridge Road Waterbar After

Days to Complete Project: 1 day

Labor Provided: Crew leader x 1 day

2 crew member x 1 day

BMPs Installed:

- Rock Waterbar

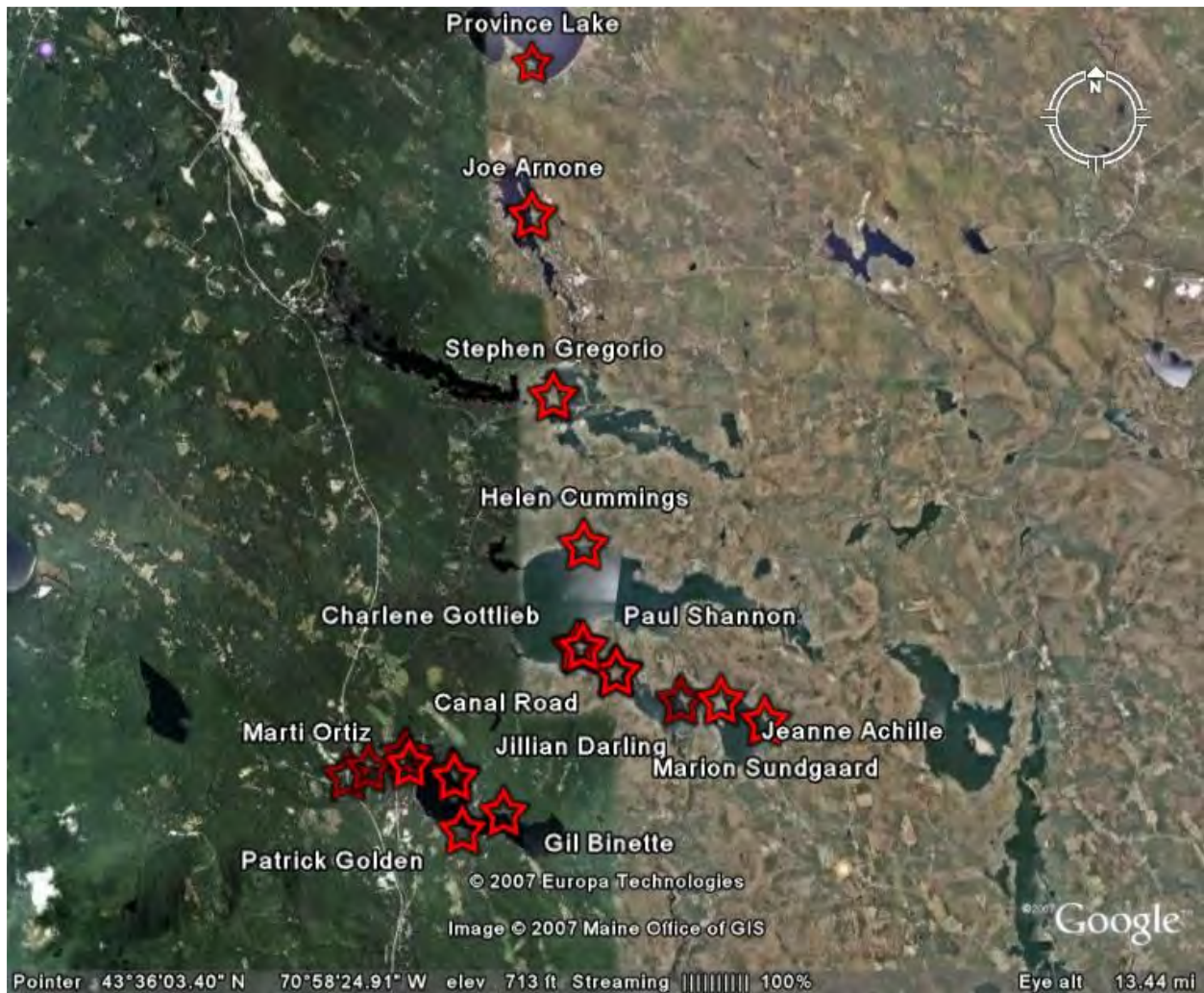
Sediment Loss Estimate:

Sheet Erosion: could not measure

Cost to Town:

\$0.00

Map of Distribution of 2007 AWWA YCC Project Sites:



2007 Technical Assistance Visits

Technical assistance designs were provided to a total of 25 homeowners on 8 lakes – 17 properties were in New Hampshire and 8 properties were located in Maine. Most homeowners signed a pledge card stating they would complete at least one of the recommendations within 1 year of receiving the design plan. Homeowners were not pressured to sign the pledge card if they expressed concerns about the affordability of the plans or if they were feeling conflicted about a lack of support from the town in which they resided. The following is a list of property owners who received technical assistance categorized by lake.

Great East Lake

1. Paul Shannon	291 Veazey Point Road	Sanbornville, New Hampshire
2. Dee Kasprzak	74 Chipmunk Run	Acton, Maine
3. Robert & Marguerite Carrington	1239 Canal Road	Sanbornville, New Hampshire
4. Nancy Smith	378 Langley Shores Drive	Acton, Maine
5. Arnold Murray	389 Langley Shores Drive	Acton, Maine
6. Langley Shores Road Association	Langley Shores Drive	Acton, Maine
7. Joe & Maggie Nolan	1511 H Road	Acton, Maine

Balch Lake

8. Alan Blanner	99 Thoreau Trail	East Wakefield, New Hampshire
9. Sheila Kelley	122 Raccoon Road	Acton, Maine

Belleau Lake

10. Jesse Gasbarro	85 Lexington Drive	East Wakefield, New Hampshire
11. Karen McPherson	150 Fisher Road	East Wakefield, New Hampshire
12. Debra Adcock	150 Lexington Drive	East Wakefield, New Hampshire
13. Royal Doughty	430 Beverly Hills Drive	East Wakefield, New Hampshire
14. Joni O'Brien	137 Lexington Drive, CB42	East Wakefield, New Hampshire

Pine River Pond

15. Ken Jeffery	295 Sparhawk Terrace	East Wakefield, New Hampshire
16. Ken Cobb	71 Heron Cove Road	Sanbornville, New Hampshire
17. Rich Chiostri	100 Camp Road	Sanbornville, New Hampshire
18. Tom Kochan	119 Chandler Lane	East Wakefield, New Hampshire
19. Ron Stier	1 Windy Point Road South	East Wakefield, New Hampshire
20. Doug Stewart	131 Olde Pine Road	East Wakefield, New Hampshire

Horn Pond

21. Dan Paquette	42 West Street	Acton, Maine
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Wilson Lake

22. Mario Prisco	99 Hummingbird Road	Acton, Maine
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Woodman Lake

23. Brenda Collyns	288 Bonnyman Road	East Wakefield, New Hampshire
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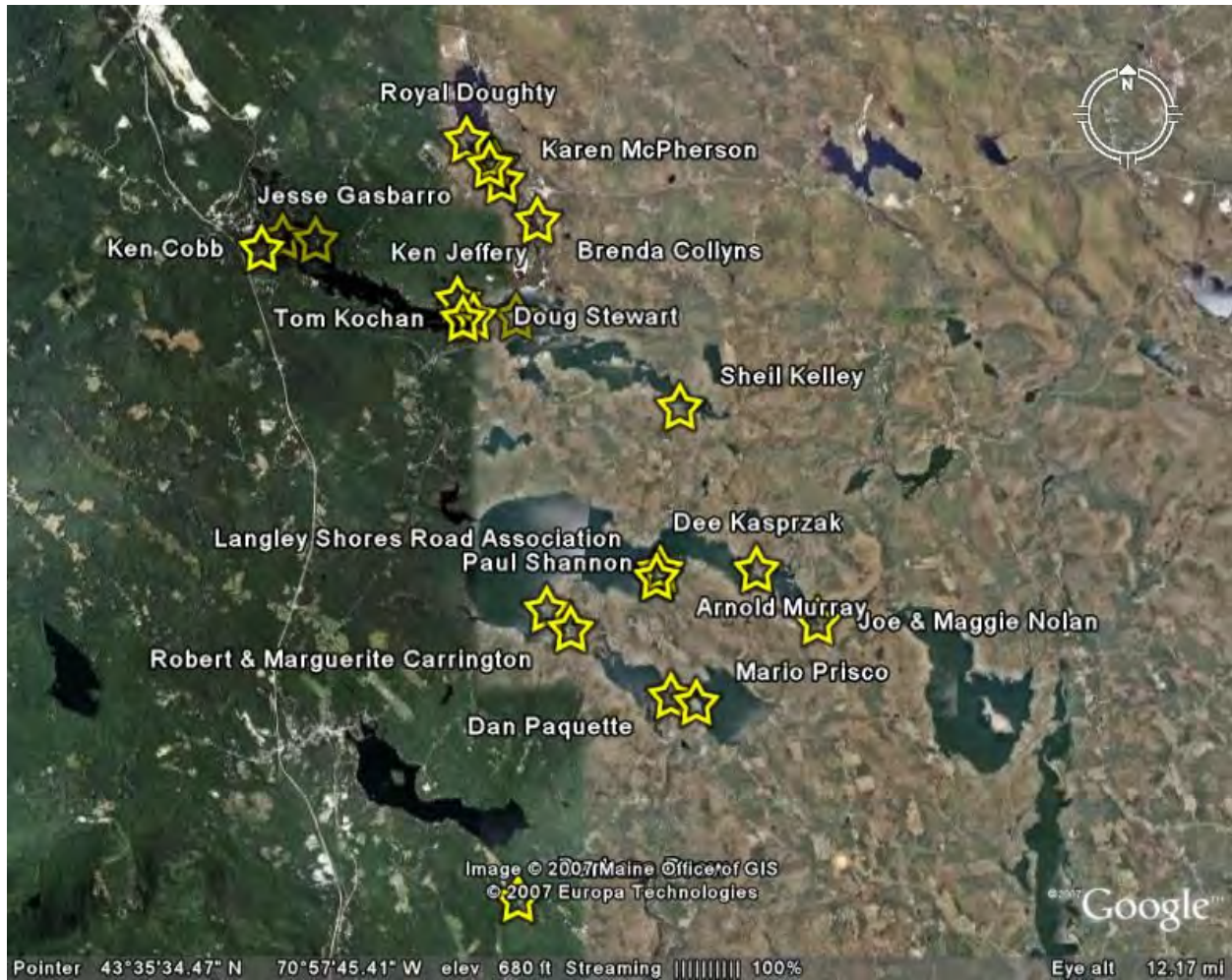
Other

24. Newfound Lake YCC
25. Barbara Drew

172 Walsh Road

Bristol, New Hampshire
Sanbornville, New Hampshire

Map of Distribution of 2007 AWWA Technical Assistance Sites:



Nonpoint Source Projects - Pollutants Controlled Report

New Hampshire Department of Environmental Services, Watershed Assistance Section

Adapted from State of Maine DEP-Bureau of Land and Water Quality Doc..# DEP LW 0689

Purpose of the Pollutants Controlled Report

EPA National 319 Program Guidelines require that all States report annual estimates of pollutant load reduction and resource protection accomplished through Nonpoint Source (NPS) Projects. This reporting is compiled in a National database - the EPA's Grant Records Tracking System (GRTS). To obtain this information, DES is now requiring project implementers to submit a Pollutants Controlled Report (PCR) for all NPS Projects involving BMP implementation. The PCR must be submitted to DES prior to December 31st of each year of the project period. Two types of information are needed: (1) pollutant load reduction estimates for NPS Sites treated with BMPs; and (2) acreage and/or lineal footage of wetlands, stream banks, and shoreline protected or restored.

Instructions

1. Pollutant Load Reduction Estimates. BMP implementation projects intended to control sediments and/or nutrients are required to have load reduction estimates for sediment (tons/year) and nutrients – phosphorus and/or nitrogen (lbs/year). This can be accomplished through the use of tools such as pollutant loading models or engineering calculations. For each NPS project: (a) identify the method(s) used to estimate NPS load reductions, and (b) estimate the amounts of pollutant load reduced for the year.

DES recommends using the methods described in the EPA "Region 5 Model" and/or the Water Erosion Prediction Project (WEPP) computer model to estimate NPS load reductions. These models are described at websites <http://it.tetrattech-ffx.com/step1/default.htm> and <http://forest.moscowfsl.wsu.edu/fswepp/>, respectively. Please contact your DES Project Leader to discuss alternate estimation methods that you plan to use.

- Step 1. Complete "Table 3 - List of NPS Sites & Methods Used". For each NPS site, list a very brief description of the site, the estimation method used; and the estimated pollutant load reduction for sediment and phosphorus. If the BMPs are intended to control nitrogen, also report nitrogen reduced.
- Step 2. Complete "Table 1 - Pollutant Load Reduction Estimates for NPS Sites Treated with BMPs". Report the total pollutant load reductions for the project for the year. Report the name of the waterbody. If the project is directed at more than one waterbody, then report the load reductions for each waterbody individually.

2. Resources Protected or Restored. Complete "Table 2 - Wetlands, Streambanks, Shoreline Protected or Restored During This Project". Provide quantitative information about work accomplished during the NPS project to create or restore wetlands, protect stream banks or shoreline, and stabilize stream channels. If documented field measurements are not available, this information may be estimated from scaled maps or photos.

3. Submitting the PCR Report. Please mail the PCR to your DES Project Leader. The PCR must be completed and received by DES no later than December 31st of each year through the completion and closeout of the project.

NPS Projects - Pollutants Controlled Report

New Hampshire Department of Environmental Services, Watershed Assistance Section

DES Project Number: B-06-C-02 Annual Report for the year: 2007

Project Title: Youth Conservation Corps

Grantee: Acton Wakefield Watersheds Alliance

Table 1. Pollutant Load Reduction Estimates for NPS Sites Treated with BMPs

Waterbody Name	Sediment tons per year	Phosphorus pounds per year	Nitrogen pounds per year
Lovell Lake	9.2	7.8	N/A
Great East Lake	3.2	2.7	N/A
Balch Pond	2.3	1.8	N/A
Province Lake	3.4	2.9	N/A
Branch River	1.6	1.4	N/A
Great East Lake Canal	0.6	0.5	N/A
Belleau Lake	0.8	0.7	N/A
Wilson Lake	0.7	0.6	N/A
Totals	21.4	18.0	N/A

Table 2. Wetlands, Streambanks, Shoreline Protected / Restored During This Project

Resource	Planned acres	Actual acres	Planned linear feet	Actual linear feet
Wetlands restored			not applicable	not applicable
Wetlands created			not applicable	not applicable
Streambank /shoreline protected	not applicable	not applicable		
Stream channel stabilized	not applicable	not applicable		

The estimations in this report were determined using the appropriate estimation model(s) and applied according to the procedures prescribed for the model. To the best of my knowledge these are reasonable estimates using appropriate methods. Documentation is kept on file by the grantee and is available for review by DES / EPA.

Submitted by (for Grantee): _____ on ____/____/____
Signature Printed Name

Reviewed by (for DES): _____ on ____/____/____
Signature Printed Name

<p align="center">NPS Projects - Pollutants Controlled Report</p> <p align="center">New Hampshire Department of Environmental Services, Watershed Assistance Section</p>

DES Project Number: B-06-C-02 Annual Report for the year: 2007

Table 3. List of NPS Sites and Methods Used

Site ID (name or # from site list)	Brief Description NPS Site	Estimation Method / Sub- Method Used	<u>Tons of Sediment This Year</u>	Pounds of Phosphorus This Year	Pounds of Nitrogen This Year
Jones Road	EXAMPLE..... Stabilize 500 feet of road drainage ditch	Region 5 / CEE	12.7	1.4	N/A
Province Lake Property	Waterbars, Drywells, Pathway, Infiltration Trench, Native Vegetative	Region 5/GEE	3.4	2.9	N/A
St. Anthony's Church Property	Rain Gardens, 120' Infiltration Trench	Region 5/GEE	1.2	1.0	N/A
Lovell Boat Ramp Property	Waterbars, Erosion Control Mix, Rain Garden, Native Vegetation	Region 5/GEE	0.4	0.4	N/A
White Mtn Highway Property	Riprap Stabilization	Region 5/GEE	0.4	0.4	N/A
Sundgaard Property	50' Infiltration Trench, Drywell	Region 5/GEE	0.7	0.6	N/A
Arnone Property	Open-top Culverts, Drywells, Infiltration Trench, Dripline Trench	Region 5/GEE	0.8	0.7	N/A
Gregorio Property	Open-top Culverts, Infiltration Trench, Drywells	Region 5/GEE	2.3	1.8	N/A
Golden Property	Waterbars, Drywells, Erosion Control Mix, Native Vegetation	Region 5/GEE	7.0	5.9	N/A
Shannon Property	Waterbars, Retaining Wall, Rain Garden, Erosion Control Mix	Region 5/GEE	2.3	2.0	N/A
McKinley Property	Rubber Razors, Infiltration Trench, Waterbar	Region 5/GEE	0.9	0.7	N/A
Heacock Property	Rubber Razors	Region 5/GEE	1.3	1.1	N/A
Darling Property	Waterbars, Infiltration Steps, Turnouts, Rain Garden	Region 5/GEE	0.5	0.4	N/A
Robinson Road Property	Infiltration Trench, Drywell	Region 5/GEE	0.6	0.5	N/A
Totals for the Year:			21.8	18.4	N/A

Pollutant Load Reduction Estimation Methods

1. Region 5 Model Refer to EPA website <http://it.tetrattech-ffx.com/step1/default.htm>
Go to the Region 5 Load Estimation Users Manual, “Michigan Method”.

Descriptors to use for Region 5 Model sub-methods:

Region 5 / GEE	Gulley Stabilization - uses Gulley Erosion Equation
Region 5 / CEE	Streambank / Ditchbank and Roadbank Stabilization - uses Channel Erosion Equation
Region 5 / Fields	Agricultural Fields - uses Revised Universal Soil Loss Equation (RUSLE), sediment delivery ratio and contributing drainage area.
Region 5 / Filter	Filter Strips - uses relative gross filter strip effectiveness
Region 5 / Feedlot	Feedlot Pollution Reduction - uses a 12 step method



2. WEPP Model. Refer to USFS website <http://forest.moscowfsl.wsu.edu/fswepp/>
Water Erosion Prediction Project (WEPP) computer model

Acton Wakefield Watersheds Alliance Youth Conservation Corps 2008 Season Report



Linda Schier
Adam Shoukimas
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PO Box 235
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Union, NH 03887

December 31, 2008

	<p>This project is supported by funds from the sale of the Conservation License Plate (Moose Plate) under the NH State Conservation Committee grant program</p>
	<p>Funding for the AWWA YCC program was provided by the New Hampshire Charitable Foundation – Lakes Region.</p>
	<p>Funding for the AWWA YCC program was provided in part by the Jane B Cook 1983 Charitable Trust</p>

Staff 08:

Crew:	Liam Pillsbury
	Zachary Pooler
	Anthony Stanton
	Sam Wilson
Crew Leader:	Patrick Jackson
Technical Director:	Adam Shoukimas
Executive Director:	Linda Schier

AWWA Board of Directors:

Carol Lafond	President
Jeanne Achille	Treasurer
Pat Theisen	Secretary
Don Chapman	Jennifer Craig
Dick DesRoches	Chuck Hodsdon
Ken Jeffery	Penny Voyles
Glenn Wildes	

**Additional assistance was provided by the following individuals and organizations:**

Wendy Garland	Maine Department of Environmental Protection
Sally Soule	New Hampshire Department of Environmental Services
Gary Miller	Miller Ford of Sanford
Julia Peterson	UNH Cooperative Extension/Sea Grant
Joe Anderson	York County Soil & Water Conservation District
Jared Teutsch	New Hampshire Lakes Association
Nancy Spencer Smith	Alden N Young Trust
Robin Frost	Town of Wakefield
	Springvale Nurseries
	Randall's Landscaping Materials
	Eagle Storage

Mission

The mission of the Acton Wakefield Watersheds Alliance is to protect and restore water quality through the prevention of nonpoint source pollution in the border region of Acton, Maine and Wakefield, NH.

The members of AWWA include representatives of local lake associations, members of Town committees including Conservation Commissions, and local residents. Our partners include UNH and UME Cooperative Extensions, Maine DEP, New Hampshire DES, the NH Lakes Association and York County Soil & Water Conservation District.

Watersheds

The AWWA YCC focuses its efforts on the Salmon Falls and Ossipee River watersheds within the towns of Acton, Maine and Wakefield, New Hampshire. Within these watersheds are 10 lakes and ponds – Balch Lake, Belleau Lake, Horn Pond, Great East Lake, Lake Ivanhoe, Lovell Lake, Pine River Pond, Province Lake, Wilson Lake, and Woodman Lake.

Youth Conservation Corps (YCC)

The 2008 AWWA YCC consisted of the Technical Director Adam Shoukimas; Crew Leader Patrick Jackson, and crew members Liam Pillsbury, Zachary Pooler, Anthony Stanton and Sam Wilson. The Technical Director met with interested landowners to discuss their erosion concerns and then created a site specific design solution for each property. YCC projects were selected from those technical assistance designs based on criteria set by the AWWA YCC Committee.

Problem

The AWWA YCC will address the problem of Non-Point Source (NPS) pollution associated with erosion and stormwater runoff on private and public properties within the targeted watersheds. The stormwater carries sediment and nutrients into the waterbodies and destabilizes the shoreline by eroding fragile soils. Erosion results in shallow areas that promote weed growth and nutrients accelerate the eutrophication process. Vegetated buffers, shoreline stabilization, infiltration systems, rain gardens, waterbar diverters, and other Best Management Practices will be installed to control stormwater runoff and minimize soil erosion.

Abraham Rushing and Duane Snyder did a great job explaining the problems associated with stormwater runoff and erosion in the *Mousam Lake Youth Conservation Corps Final Report 2001*:

Phosphorus, a naturally occurring element necessary for plant growth, is a relatively scarce in lake water. The growth of algae in lakes is naturally held in check by this scarcity. Phosphorus, however, is generally abundant on land. It is present in soil, ground water, and living and dead plant and animal material. Road dust, septic wastes, fertilizers, and some detergents also contain phosphorus.

In undisturbed watersheds, phosphorus is conserved and recycled within the forest system along with water and other nutrients and materials needed to sustain the living community.

Water is stored in depressions on the uneven forest floor, where it eventually seeps into the ground. In this way, a great deal of water from precipitation is prevented from running over the land surface and exporting valuable nutrients from the system.

Land development changes the natural landscape in ways that alter the normal recycling of phosphorus. The removal of vegetation, smoothing of the land surface, creation of impervious surfaces, maintenance of closely cropped lawns, and the compaction of soils reduce the amount of precipitation stored and retained on-site. In turn, the amount of water flowing across the land surface as runoff dramatically increases.

Stormwater flowing over the land surface picks up phosphorus and transports it to lakes in a soluble form or attached to eroded soil particles. Increased phosphorus in lake water leads to a proportionate increase in algal growth. If the phosphorus supply is great enough, the resulting cycle of increased algal growth, death, and decomposition can lead to oxygen depletion in the bottom portion of the lake. When lake-bottom oxygen is gone, a chemical change occurs that allows phosphorus previously locked in the bottom sediments to be re-released into the lake waters. This “internal recycling” of phosphorus continues the downward spiral in lake quality.

The subsequent algae blooms cloud the water and lead to decreased property values and recreational enjoyment. For every meter of clarity lost in a lake, it is estimated that waterfront property values may see up to a 20% decrease. The oxygen depletion in the bottom portion of the lake suffocates cold-water fish, such as trout and landlocked salmon. Many other native aquatic species would suffer as well. Once these degradations begin taking place, it could take years to recover, if recovery is possible at all.

All land disturbance and development increases phosphorus export to lakes. Although some impact must be accepted as the inevitable and unavoidable effect of development, a variety of measures can substantially reduce phosphorus export to lakes and help preserve water quality.

2008 Season Overview

2008 marked the third complete season of the AWWA Youth Conservation Corps program. The intended outcome of the AWWA YCC program is the reduction of pollution caused by stormwater runoff and other non-point sources to the lakes, ponds, rivers and streams of the Wakefield, New Hampshire/Acton, Maine region. One facet of this work is the implementation of best management practices (BMPs) through YCC projects and technical assistance designs. An addition, the AWWA Board and staff conduct education and outreach activities to raise stakeholder awareness of the relationship between land use and water quality in order to highlight conservation practices that can reduce non-point source pollution.

One goal of the 2008 season was to continue the success of the previous two seasons by applying our acquired knowledge and experience to implement more sophisticated and technically advanced best management practices (BMPs) in order to increase the pollution reduction efficiency. A portion of this season involved returning to previous project host sites to repair previously installed BMPs that had either failed, needed improvements, or required maintenance.

New BMPs were installed where additional erosion control measures were needed. The remaining projects utilized a wide variety BMPs to solve isolated erosion issues as well as amend entire landscapes.

Raising public awareness was a critical objective of the project. The success of AWWA is directly dependent on the public holding a stake in the health of the lakes and utilizing us as a resource in that interest. Since our inception, AWWA has been a reputed name in the community and synonymous with water quality conservation. Outreach has increased on a yearly basis and the 2008 season was filled with numerous outreach endeavors including press releases; presentations at local events, town meetings, and lake associations; volunteer education sessions; seminars with state agencies; and signage and uniforms with AWWA and partners' logos.

Sixteen total projects were completed on eight waterbodies during the YCC's seven week-long season. During this period, 39 BMPs were installed. Pollutant Load reduction estimates were performed using the Region 5 Model, and these estimates indicated a sediment load reduction of 13.4 tons per year and a phosphorus load reduction of 11.9 pounds per year as a result of the BMPs installed on the 2008 YCC project sites [Appendix 1].

Technical assistance designs were also created during the YCC season. 39 landowners received some sort of technical assistance, and every lake in the region was represented. Valuable information was made available to interested parties who wished to address the erosion issues without the aid of the YCC. Recipients of technical assistance designs pledge to implement at least one BMP within one year of the landowner's receipt of the information.

2008 BMP Projects

The crew completed 16 projects over the course of the seven week season. There was a wide diversity to the scope, size, and design of the projects that reflected the sophistication, maturity, and abilities that the YCC has developed over the three years that we have operated. Each project host received a packet prior to the YCC's arrival outlining the nature of their project, their responsibilities, what the YCC would provide, a letter of agreement signed by both the land owner and the technical director, and fact sheets defining maintenance procedures for each BMP to keep their project functioning properly.

A follow-up procedure was adopted this year to formally inspect and subsequently ensure the viability of the BMP project sites. The policy exists as follows:

- Follow-up visit and photo documentation by Technical Director (TD) will occur at least once within 12 months of project completion.
- TD will inspect site and BMPs for functionality, looking for reemergence of gullies or other indicators of erosion.
- If BMPs are functioning properly, TD will review maintenance procedures with Project Host (PH) and TD will not return unless contacted by PH for further evaluation, as described below.

- If erosion continues to occur, TD will evaluate whether it is the result of improper design, BMP failure, lack of maintenance, or caused by a larger issue.
 - o If cause of erosion is result of lack of maintenance, TD will review maintenance procedures with PH and revisit within 12 months to reevaluate. Referrals for maintenance companies will be made available upon request of the landowner.
 - o If cause of erosion is improper design or BMP failure, TD will redesign project for PH and discuss implementation options, either YCC or self-install.
 - o If cause of erosion is due to a larger issue outside of the scope of our capabilities, TD will formally address the issue with the responsible party.
- TD will visit redesigned site within 12 months of new implementation and reevaluate BMP performance.
- PH is encouraged to contact TD to request assistance with any erosion problems.

YCC Project Hosts by Waterbody

Great East Lake

1. Public Launch	North Shore Drive	East Wakefield, NH
2. Community Property (upper)	Leisure Lane	Sanbornville, NH
3. Community Property (lower)	Leisure Lane	Sanbornville, NH
4. Dee Kasprzak	74 Chipmunk Run	Acton, ME
5. Sue Cain	370 Mann Road	Acton, ME

Lovell Lake

6. Alan Heacock	298 Brackett Road	Sanbornville, NH
7. Public Launch	Wichtrot Road	Sanbornville, NH

Belleau Lake

8. Will Collier	214 Fisher Road	East Wakefield, NH
9. Bob Grant (upper)	182 Fisher Road	East Wakefield, NH
10. Bob Grant (lower)	182 Fisher Road	East Wakefield, NH

Province Lake

11. Municipal Property	Bonnyman Road	East Wakefield, NH
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Great East Lake Canal

12. Municipal Property	Robinson Road	Acton, ME
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Branch River

13. St. Anthony's Church	251 Meadow Street	Sanbornville, NH
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Horn Pond

14. Barbara Wing (driveway)	11 Mountain View Drive	Acton, ME
15. Barbara Wing (lower)	11 Mountain View Drive	Acton, ME

Wilson Lake

16. Celia Thibodeau

Peacock Road

Acton, ME

Descriptions of YCC Projects

1. Alan Heacock

Lovell Lake

Sanbornville, NH

Alan served as a project host at the end of the 2007 season. Large ruts were cut into the driveway due to the high velocity of the runoff. Four rubber razors had been installed to divert the runoff coming from the paved road above the driveway. The rubber razors slowed and diverted the runoff into nearby vegetation. However, over the course of the fall, winter, and spring, ruts had reappeared and it became obvious that the rubber razors we had installed were not operating correctly due to some improper installations. It was the responsibility of the YCC to return to the site, amend the previously installed BMPs, and install an additional rubber razor to fully remediate the site. The crew re-sank the two rubber razors at the top of the driveway to place them flush with the driveway surface so that runoff would be diverted by the rubber and not the lumber anchor. The two rubber razors at the bottom of the driveway had their angles reversed so that they diverted water to the opposite side of the driveway where the runoff could be more effectively controlled by the receiving vegetation. A fifth rubber razor was installed in the middle of the driveway above the parking area to divert any remaining runoff into nearby vegetation. This project was important in demonstrating the YCC's commitment to the quality of our work and the desire to provide a quality service focused on sustainability and effectiveness.



Alan Heacock Before



Alan Heacock After



Alan Heacock New Rubber Razor

BMPs installed:	Rubber Razors		
Total Number of BMPs:	1		
Ton of Sediment Prevented:	1.3		
Pounds of Phosphorus Prevented:	1.1		
Cost to Landowner:	\$0.00 (landowner already owned materials)		
Crew Man Hours:	28.5 hours	1 day	(3 crew + crew leader)

2. Will Collier

Belleau Lake

East Wakefield, NH

This property was relatively flat, but received a large amount of runoff from the roof, which was concentrated by gutters and downspouts. The downspouts led to bare soil at the front of the house that was easily eroded to the back of the house and down a final steep slope to the lake. The runoff from the gutters at the back of the house concentrated flow onto a beach leaving large gullies where the sand had been eroded into the lake. Rain barrels were originally recommended to be placed at the downspouts to collect the runoff, but they were difficult to find and expensive to purchase. Additionally, the rain barrels would not be able to contain the entire amount of runoff from the roof during even minor precipitation events. It was then recommended that a rain garden be installed on one side of the house to collect the roof runoff from the downspouts on that side. Also, the rain garden would help to stabilize the ground surface, protecting it from any other surface runoff. Both downspouts led to the large rain garden, sized to contain large quantities of water and infiltrate it into the ground and feed the native vegetation planted inside. A buffer strip was added as a last line of defense between the property and the final steep slope leading to the lake. This buffer would capture any runoff that was not contained by the rain garden and infiltrate it into the ground as well. The downspouts on the other side of the house were redirected to vegetated areas with high absorption capacities where the soil had not been compacted by vehicle or foot traffic.



Will Collier Before



Will Collier After

BMPs installed: Rain Garden
Buffer Strip

Total Number of BMPs: 2

Ton of Sediment Prevented: 0.1

Pounds of Phosphorus Prevented: 0.1

Cost to Landowner: \$550.00

Crew Man Hours: 25 hours 1 day (2 crew + crew leader)

3. Public Launch

Great East Lake

East Wakefield, NH

This property is used as a boat launch for the local residents. There is a relatively long and flat right-of-way dirt access to the lake leading to a steep drop down to the water. The adjacent properties are elevated above the right-of-way, causing water flowing down the road to enter the boat launch, erode the ramp surface, and carry sediment into the lake. The steep portion of the ramp is paved with asphalt before turning back to dirt at the waterline. The eroded access surface is punctuated with tree roots and large rocks, making the installation of diverters nearly impossible. Additionally, there is no place to divert the runoff to as the access is the lowest property in the area. It was decided that the most severely eroded part of the property, the slope adjacent to the paved section, should be stabilized in order to curb any further erosion, and absorb and infiltrate any runoff entering it. The severity of the slope demanded a solution that would hold on to the surface and not easily erode away, even with frequent inundations. Erosion control mix was utilized for these exact reasons. It will adhere to very steep slopes, it will not float or wash away easily, and it will absorb runoff and control it while it infiltrates into the ground. The erosion control mix also improved the overall aesthetics of the property by filling and stabilizing the bare landscape with a uniform covering.



Public Launch Before



Public Launch After



Public Launch Before



Public Launch After

BMPs installed: Erosion Control Mix

Total Number of BMPs: 1

Ton of Sediment Prevented: 3.2

Pounds of Phosphorus Prevented: 3.2

Cost to Landowner: \$539.09 (with projects #4 and #5 below)

Crew Man Hours: 22 hours 1 day (2 crew + crew leader)

4. Public Launch

Lovell Lake

Sanbornville, NH

This property was a YCC project site from the 2007 YCC season that runs along the lower portion of a heavily used road by the center of town. It required some maintenance to keep it working effectively and looking manicured and professional. This site receives a lot of use by the public and also is our most visible project site. It has been the policy of the YCC to maintain

these municipal project sites by providing the necessary labor combined with the financial support of the towns for required materials. Stormwater runs down the paved road and initially enters the project site where it is diverted by a waterbar into a rain garden. The rain garden infiltrates the water into the ground at the lake's edge, rather than allowing the runoff to enter the lake directly. Further down the site, runoff entering the property is controlled by a strip of erosion control mix. This erosion control mix not only absorbs and controls the road runoff, but also provides a stable temporary parking area for vehicles utilizing the boat launch. The erosion control mix is bordered by a line of timber waterbars, preventing the migration of sediment and runoff into the grassy portion of the property adjacent to the lake. However, over the past year, the vehicular traffic and large amount of precipitation have taken a high toll on the efficiency of the BMPs. The maintenance of the site involved spreading another layer of erosion control mix to the strip adjacent to the road, installing and fastening another row of timber waterbars, and removing the accumulated sediment from the rain garden. The erosion control mix and rain garden can again adequately absorb the road runoff, and the new waterbars can better contain the erosion control mix, divert runoff into the rain garden, and reestablish the visually attractive sharp contrast between the erosion control mix and grass areas.



Public Launch Before



Public Launch After

BMPs installed: Erosion Control Mix
Waterbar

Total Number of BMPs: 2

Ton of Sediment Prevented: 0.4

Pounds of Phosphorus Prevented: 0.4

Cost to Landowner: \$539.09 (with projects #3 and #5)

Crew Man Hours: 28 hours 1 day (2 crew + crew leader)
18.5 hours ½ day (3 crew + crew leader)

Total: 46.5 hours 1 ½ days

5. Municipal Property

Province Lake

East Wakefield, NH

This is a community lot providing lake access for many of the backlot residents in the area. A considerable amount of runoff comes from the surrounding landscape and adjacent paved road washing into the top portion of the property. This inflow eventually weaves its way over the property and finally down a slope into the lake. During the 2007 YCC season, the crew installed many BMPs to successfully control the runoff at the top part of the property where the runoff first enters the site. The BMPs include waterbars and drywells that we cleaned out and revitalized this season to ensure proper working order. On the lower portion of the site, adjacent to the lake, the crew had previously installed simple timber steps to provide access to the lake. However, we learned over the past year, that local residents wanted more sure-footed access. We also knew that we were capable of constructing a better solution to the erosion problems occurring on the slope. This was the first test of the crew's abilities to install a more technically advanced BMP. We removed the old steps and constructed a large staircase of infiltration steps that were capable of collecting as much runoff as the site could provide. These steps also created a wide, deep, stable platform for easy access to the lakefront. The staircase tied in with stabilizing riprap the crew previously installed to make a complete barrier for runoff interception. Above the stairs, the crew better defined the walkway leading through the property to dissuade residents from trespassing onto adjacent properties. Along this path, timber waterbar steps were installed to divert water off the trail into vegetation and provide better traction along the steeper portions. The new BMPs proved to be a dramatic improvement over the previous design, and boosted the crew's confidence in their construction abilities.



Municipal Property Before



Municipal Property After

BMPs installed:

Infiltration Steps
Paths & Walkways
Waterbars
Riprap

Total Number of BMPs:

4

Ton of Sediment Prevented:

3.4

Pounds of Phosphorus Prevented: 2.9

Cost to Landowner:	\$539.09 (with projects #3 and #4 above)
Crew Man Hours:	142.5 hours 4 ¼ days (3 crew + crew leader)
	15 hours 1 day (2 crew)
Total:	157.5 hours 5 ¼ days

6. St. Anthony's Church

Branch River

Sanbornville, NH

The YCC installed two rain gardens and an infiltration trench to this site in 2007 in order to collect and control the massive amounts of runoff created by the large paved driveway surrounding the church. Further compounding the challenge was the asphalt berm bordering the driveway, concentrating the runoff to inconvenient areas, and the small portion of workable land between the berm breaks and the Branch River. Also, winter sand was used liberally on the site and never cleaned up. The two rain gardens and infiltration trench that were installed worked very efficiently. However, a year's worth of sediment had accumulated in them and the site needed maintenance that the priest was not able to perform. The YCC returned this season to clean the sediment out of the infiltration trench and the rain gardens, returning them to their original functioning condition. Next year, a volunteer crew from the congregation will be trained and utilized to perform these maintenance procedures. Additionally, it has been recommended that the winter sand be removed from the site in the spring to minimize the impact on the BMPs.



St. Anthony's After



St. Anthony's After

BMPs installed:	Infiltration Trench (maintenance) Rain Garden (maintenance)
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Total Number of BMPs:	2
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Ton of Sediment Prevented:	sheet erosion, could not measure
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Pounds of Phosphorus Prevented: could not calculate

Cost to Landowner: \$0.00 (no materials involved)

Crew Man Hours: 24 hours $\frac{3}{4}$ days (3 crew + crew leader)

7. Municipal Property

Great East Lake Canal

Acton, ME

Water coming down Robinson Road is shed off the road surface and runs along the side of the road as it opens to a turnaround area. Ordinarily, water would flow across this flat, gravel open area, pick up sediment, cross paved Canal Road and subsequently flow into the Great East Lake/Horn Pond canal. An infiltration trench already existed on this site to intercept the runoff as it initially flowed off of Robinson Road, but it was not functioning properly. It had filled with sediment and could no longer collect road runoff and transport it. A new infiltration trench was installed by the YCC. The trench was deeper and wider and led to a new part of the property that could adequately control the runoff. At the terminus of the trench, we installed a drywell to collect and infiltrate the water before it could enter the canal. The trench provides a complete barrier to the flat area at the corner of Robinson and Canal Road where stormwater would ordinarily collect sediment and gain velocity before crossing Canal Road and flowing into the canal. The drywell now properly allows for complete infiltration of the runoff into the ground. The system has proven to be a very effective stormwater control measure. This project was an example of the true benefit of the YCC to the community. With no out-of-pocket expenses and the use of only on-site materials, a dramatic alteration of the site was accomplished and a highly effective system of BMPs was installed to properly control stormwater.



Municipal Property Before



Municipal Property After

BMPs installed: Infiltration Trench
Drywell

Total Number of BMPs: 2

Ton of Sediment Prevented: 0.6

Pounds of Phosphorus Prevented: 0.5

Cost to Landowner:	\$0.00 (no materials involved)		
Crew Man Hours:	25 hours	1 day	(2 crew + crew leader)
	18.5 hours	½ day	(3 crew + crew leader)
Total:	43.5 hours	1 ½ days	

8. Community Property (upper) Great East Lake Sanbornville, NH

The size and scope of this property and the time invested by the crew dictated that this site be split into two separate projects, each with its own set of issues and solutions. This season we tried to tackle large projects that amended entire landscapes for a complete solution to a property's erosion problem. Because of the variety of BMPs employed, these large projects were treated as two distinct projects with obvious isolated approaches to each section's solution.

This property is utilized by nine backlot properties that do not have waterfront. It is used for water access by these landowners and thus sees a lot of foot traffic. There is a parking area above a long slope leading down to a relatively flat sitting area before the property dips down sharply to the lake. Runoff from the parking area concentrates on the trail leading to the water and gains velocity as it travels. As the trail is the only non-vegetated area on the slope below the parking lot and is also the lowest point on the lakeside of the parking lot, runoff naturally flows down this narrow path. A steep slope, lack of vegetation, no duff layer, and compacted and rocky soil combine to create a serious erosion problem as well as difficulties accessing the lake. The solution for the upper part of this property was to install timber waterbars periodically along the sloped trail to regularly break up water flow to reduce velocity and divert the water off of the path into adjacent vegetation. The waterbars also serve as steps for added traction while walking on the trail. The trail surface was then covered with a layer of erosion control mix to absorb and further slow runoff from the parking lot. The erosion control mix, combined with the waterbars, has helped to stabilize this pathway and improve lake access.



Community Property Before



Community Property After

BMPs installed: Waterbars
Erosion Control Mix
Paths & Walkways

Total Number of BMPs: 3

Ton of Sediment Prevented: sheet erosion, could not measure

Pounds of Phosphorus Prevented: could not calculate

Cost to Landowner: \$1,038.33 (with project #9 below)

Crew Man Hours: 148.5 hours 4 ½ days (3 crew + crew leader)
40 hours 1 day (4 crew + crew leader)

Total: 188.5 hours 5 ½ days

9. Community Property (lower) Great East Lake Sanbornville, NH

The bottom area of the community property opens to a flat area perched above the lake to the left of the bottom of the trail. This flat area leads to a dock. To the right of the bottom of the trail, the property dips down to a small flat area just above the level of the lake. The small slope is used to access the lake for swimming, while the perched flat area is used for sitting and dock access. To provide better access to the lower area with direct access to the lake, a series of infiltration steps were installed for better traction on the slope. The infiltration steps also collect any residual runoff from the upper property. Erosion control mix was continued from the upper portion of the site and spread over the perched flat area, on the slope around the infiltration steps, and on the lower flat area close to the lake. The erosion control mix has stabilized the entire area and the infiltration steps now provide sure access to the lake.



Community Property Before



Community Property After

BMPs installed: Erosion Control Mix
Infiltration Steps

Total Number of BMPs: 2

Ton of Sediment Prevented: sheet erosion, could not measure

Pounds of Phosphorus Prevented: could not calculate

Cost to Landowner: \$1,038.33 (with project #8 above)

Crew Man Hours: see Project #8

10. Barbara Wing (driveway) Horn Pond Acton, ME

This site was another large project that required a lot of the crew's time and expertise. The property is situated at the beginning of a gravel camp road just off of a paved road and adjacent landscape sloping towards it. Runoff comes down the paved road, turns into the camp road, and escapes down the driveway of the Wings' property. Addressing this driveway portion of the property was the first project on the site. The runoff needed to be diverted off of the driveway and into the abundant vegetation. This would prevent it from forming gullies in the driveway, gaining velocity, and transporting sediment downhill into the lake. Two rubber razors were installed across the driveway, one close to the top and another above the parking area. These razors effectively divert water off of the driveway surface and the adjacent vegetation adequately infiltrates the runoff.



Barbara Wing Before



Barbara Wing After

BMPs installed: Rubber Razors

Total Number of BMPs: 1

Ton of Sediment Prevented: sheet erosion, could not measure

Pounds of Phosphorus Prevented: could not calculate

Cost to Landowner:	\$1,134.00 (with project #11 below)		
Crew Man Hours:	80 hours	2 days	(4 crew + crew leader)
	22.5 hours	1 day	(3 crew)
	32.5 hours	1 day	(3 crew + crew leader)
Total:	135 hours	4 days	

11. Barbara Wing (lower)

Horn Pond

Acton, ME

This portion of the property was much more involved than the driveway aspect and utilized many more BMPs. The property beside the house slopes dramatically and was torn up during a diseased tree removal operation. The exposed sediment on the slope has been eroded by driveway runoff. Furthermore, roof runoff falls onto a portion of the slope and exacerbates the erosion problem. Walking access over the slope was required, and part of the slope needed to be open to vehicular travel at the request of the landowner. In addition to that, the entire slope needed to be stabilized and the project had to effectively address the roof runoff and slope erosion together. A large oak tree growing on the property served as a nice break between the foot traffic and vehicular access areas. On the house side of the tree, a set of infiltration steps was constructed adjacent to a dripline trench. The steps allow for much easier access to the lake from the front of the house as well as slowing down and allowing for the absorption of moving water. On the other side of the tree, a rubber razor was installed above the slope to divert driveway runoff into vegetation. Below the razor, erosion control mix was utilized to stabilize the slope surface. The rubber razor and erosion control mix allow for a vehicle to access the back yard but still divert and control runoff.



Barbara Wing Before



Barbara Wing After

BMPs installed:	Rubber Razor
	Erosion Control Mix
	Infiltration Steps
	Dripline Trench

Total Number of BMPs:	4
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Ton of Sediment Prevented: 2.7

Pounds of Phosphorus Prevented: 2.3

Cost to Landowner: \$1,134.00 (with project #10 above)

Crew Man Hours: see project #10

12. Bob Grant (upper)

Belleau Lake

East Wakefield, NH

Recent renovations left this property as a blank slate for our operations. This part of the town is very sandy and erosion has had a very serious impact on the water quality of the lake. Due to the pitch of the roof, there were two distinct problems occurring at this site. Roof runoff from the front of the house was combining with road and driveway runoff to erode sediment along the side of the house as it flowed toward the lake. Better access to the back of the house was required, and there was a door on the side of the house that was used as the primary entrance. Therefore, whatever BMP we utilized would need to work in conjunction with this doorway. The YCC installed a dripline trench at the front of the house. This dripline trench led to a staircase of wide infiltration steps. The steps were aligned with the doorway so that the middle step was centered at the entrance to provide a firm platform at this area. The rest of the slope was left as it was for the landowner to install further BMPs as a means to engage the landowner as an active stakeholder in the projects. The dripline trench and infiltration steps control the majority of the erosion, and the landowner is responsible for adding native vegetation and erosion control mix to complete the project.



Bob Grant Before



Bob Grant After

BMPs installed: Infiltration Steps
Dripline Trench

Total Number of BMPs: 2

Ton of Sediment Prevented: 0.6

Pounds of Phosphorus Prevented: 0.5

Cost to Landowner: NA

Crew Man Hours:	32.5 hours	1 day	(3 crew + crew leader)
	25 hours	1 day	(2 crew + crew leader)
	40 hours	1 day	(4 crew + crew leader)
Total:	97.5 hours	3 days	

13. Bob Grant (lower)

Belleau Lake

East Wakefield, NH

The second of the Grant projects involved the confluence of two roofs at an ell, concentrating the runoff into a torrent at the back of the house. This roof runoff had washed a significant amount of sediment from the back of the house into the lake. Water from the roof had to be collected and controlled before it could flow down the back slope into the lake. A large drywell was installed at the corner of the building where the heaviest precipitation occurred. This drywell connected to a dripline trench to collect the remainder of the runoff. A special situation existed at the back of the house because of the location of the back door. This door provided access to the lake from the house but was located over two feet off of grade. Therefore, in order to allow use of the door without compromising the infiltrating capabilities of the project, we built up a set of infiltration steps to the height of the doorway. This was a technique we had never used before but proved to be quite successful. The underlying dripline trench still functioned effectively and did not compromise the stability of the stairs. Finally, on the path leading to the dock, there was a series of three steps that were retrofitted into infiltration steps. The backfilled soil of the steps had become so compacted that it had become an impervious surface. The soil was removed and replaced with crushed stone to create a porous walking surface where runoff could still be collected. This project concluded with the landowner again pledging to plant native vegetation and spread erosion control mix on the bare soil. Follow up of the landowner's installation will be conducted as outlined under task 6 below.



Bob Grant Before



Bob Grant After

BMPs installed: Dripline Trench
Drywell
Infiltration Steps
Retrofit Infiltration Steps

Total Number of BMPs: 4

Ton of Sediment Prevented: 0.4

Pounds of Phosphorus Prevented: 0.3

Cost to Landowner: NA
Crew Man Hours: see project #12

14. Dee Kasprzak

Great East Lake

Acton, ME

Dee's house is set up atop a steep slope that leads directly down to the lake. Some retaining walls, terracing, and native vegetation had already been established on the slope, but it was inadequate given the amount of erosion the property experiences. At the bottom of the slope, the property flattens slightly for a stretch before eventually reaching the water. Basic cinder block stairs descend the hill to provide access to the lake. At the bottom of the steps, a path has been used to walk along the bottom of the hill to reach the dock. This pathway slopes toward the lake, consists of bare soil, and does not provide adequate traction for foot travel. This project required the implementation of numerous BMPs in order to properly alleviate the erosion problems. The stairs' back-filling had become compacted and was replaced with crushed stone to retrofit them into infiltration steps. Much of the runoff ran down these stairs and gained enough velocity to erode a considerable portion of the beach. The infiltration steps will collect this runoff and provide better access to the lake. The pathway between the bottom of the stairs and the dock was stabilized with a long infiltration step, leading to two smaller infiltration steps to reach the level of the dock. The long step runs along the bottom of the steep hill and collects any runoff before it can enter the lake. It also provides a flat, level, sturdy walking platform. Buffer vegetation was planted between the infiltration step and the lake to further stabilize the soil and absorb water and nutrients, as well as enhance the waterfront aesthetics of the site. Native vegetation was planted and erosion control mix was spread all over the slope above the infiltration step. This will absorb a lot of the runoff coming from the lot above and significantly reduce the amount of runoff reaching the BMPs at the bottom of the slope. Finally, timber waterbars were installed on the slope adjacent to the retrofit infiltration steps. The waterbars will divert the runoff flowing beside the steps into the local native vegetation and keep the water away from the beach area. This project stabilized a very precarious slope.



Dee Kasprzak Before



Dee Kasprzak After



Dee Kasprzak Before



Dee Kasprzak After

BMPs installed:

Waterbars
Retrofit Infiltration Steps
Erosion Control Mix
Infiltration Steps
Buffer Strip
Native Vegetation

Total Number of BMPs:

6

Ton of Sediment Prevented:

0.2

Pounds of Phosphorus Prevented:

0.2

Cost to Landowner:

\$840.00

Crew Man Hours:

57 hours

1 ½ day

(4 crew + crew leader)

11 hours

½ day

(2 crew + crew leader)

32.5 hours

1 day

(3 crew + crew leader)

Total: 100.5 hours

3 days

15. Sue Cain**Great East Lake****Acton, ME**

This property has a long, narrow access road through a heavily wooded area to reach the house directly on the lake. Thanks to the heavy wooded vegetation, the only real source of erosion is runoff from the gravel road and driveway. Runoff was carrying sediment from the road surface and depositing it into the lake. The solution to this erosion problem was rather simple: utilize rubber razors to divert runoff away from the road surface and into the abundant native vegetation where it can be controlled and absorbed. The installation was quick, straight-forward, and highly effective.



Sue Cain Before



Sue Cain After

BMPs installed: Rubber Razors

Total Number of BMPs: 3

Ton of Sediment Prevented: sheet erosion, could not measure

Pounds of Phosphorus Prevented: could not calculate

Cost to Landowner: \$560.29

Crew Man Hours: 38.5 hours 1 ½ day (2 crew + crew leader)
6 hours ½ day (2 crew)

Total: 44.5 hours 2 days

16. Celia Thibodeau**Wilson Lake****Acton, ME**

This property serves as a right-of-way for several other backlot residents on the road. Water would travel down the paved road and either run off the shoulder and enter the site from the roadside culvert or flow directly from the road down the driveway access. The driveway is long

and sloping towards the lake. Complicating the project are the berms on either side of the driveway, severely limiting the ability to shed water away from the driveway surface. It was determined that the runoff needed to be diverted from the right-of-way as early as possible to prevent the runoff from gaining velocity and further eroding the surface material. Two open-top culverts were constructed and installed in areas where water immediately entered the site so that the water would be instantly captured and diverted. At the terminus of each open-top culvert, a turnout was dug through the berm in order to facilitate the movement of water from the site and into the adjacent vegetation. Diverting the runoff so high on the site eliminated the need for further BMP installations closer to the lake, preserving the aesthetics of the property.



Celia Thibodeau Before



Celia Thibodeau After

BMPs installed:	Open-Top Culverts Turnouts		
Total Number of BMPs:	2		
Ton of Sediment Prevented:	0.5		
Pounds of Phosphorus Prevented:	0.4		
Cost to Landowner:	\$80.00		
Crew Man Hours:	10 hours	1 day	(Technical Director)

Map of Distribution of 2008 AWWA BMP Project Sites:



2008 Technical Assistance Designs

Requests for technical assistance were received from residents on all of the lakes in the region. These requests were the result of recruitment efforts by AWWA at community events, press articles, and presentations at lake association meetings. Also, requests were received thanks to the recommendations of previous YCC hosts and Technical Assistance clients.

A total of 39 technical Assistance Design packets were developed and delivered to landowners for them to implement their own erosion prevention measures. Some of these clients expressed interest in being considered as project hosts for the 2009 YCC season. Others preferred to do the work themselves. Technical Assistance Design clients were asked to sign a pledge sheet indicating that they would implement at least one of the BMPs outlined in the design within 12 months. This will be verified with site visits in 2009. The design packets included an introductory letter, an outline of the recommended BMPs with clear descriptions and instructions, the pledge sheet, and fact sheets for each BMP outlining specifically how to install and maintain each BMP. Additionally, a diagram of the site or altered photos of the property displayed exactly where each BMP should be installed [Appendix 7].

The following is a list of Technical Assistance clients by lake:

Great East Lake

1. Bob Berlan	365 Langley Shores Drive	Acton, ME
2. Lisa & Rich Brown	791 Canal Road	Sanbornville, NH
3. Sheila Ross	222 Kiltie Drive	Acton, ME
4. Ailene Reyenger	148 Grand View Road	Acton, ME
5. Ron & Kathy McKay	535 Wansor Road	East Wakefield, NH
6. Dave Barr	107 Leisure Lane	Sanbornville, NH

Lovell Lake

7. Ernie Dery	754 Brackett Road	Sanbornville, NH
8. Glenn Rowley	758 Brackett Road	Sanbornville, NH
9. Anusia Hirsch	698 Brackett Road	Sanbornville, NH
10. David Tinkham	740 Brackett Road	Sanbornville, NH
11. Bob Eldredge	1041 Lovell Lake Road	Sanbornville, NH
12. Debra Fortier	441 Lovell Lake Road	Sanbornville, NH
13. Charles McDonald	125 Witchtrot Road	Sanbornville, NH
14. John Hooper	654 Brackett Road	Sanbornville, NH
15. Jack Reynolds	131 Lovell Lake Road	Sanbornville, NH

Belleau Lake

16. Janet Consolmagno	91 Vange Way	East Wakefield, NH
17. Rosline Landers	15 Desmond Drive	East Wakefield, NH
18. Bob Grant	182 Fisher Road	East Wakefield, NH

Balch Pond

19. Elaine Hall	15 Green Bay Road	West Newfield, ME
20. Bill Sheehan	98 Kennetts Point Road	West Newfield, ME
21. Bill Goodwin	478 Raccoon Road	Acton, ME

Pine River Pond

22. Howie & Pam Knight	139 Chandler Lane	East Wakefield, NH
23. Mary Richards	87 Olde Pine Road	East Wakefield, NH
24. Jack Lemery	26 Crew Road North	East Wakefield, NH
25. Bobbi Darnell	278 Camp Road	Sanbornville, NH
26. Donna Dodge	806 Lord Road	Sanbornville, NH
27. Adin Wolfgram	418 Sparhawk Terrace	East Wakefield, NH
28. Mark McRobbie	488 Pinewood Shores Road	East Wakefield, NH
29. Mike Addesa	962 Lord Road	Sanbornville, NH
30. Norman Clapp	22 Blue Wave Lane	Sanbornville, NH

Wilson Lake

31. Jeff Brown	346 Peacock Road	Acton, ME
32. John Nadeau	252 Hawk Road	Acton, ME

Horn Pond

33. Barbara Wing	11 Mountain View Drive	Acton, ME
34. Elaine & David Shippee	220 Donahue Road	Sanbornville, NH
35. Mary James	143 Martha Horn Road	Acton, ME

Province Lake

36. Grace Barter	219 Bailey Road	Effingham, NH
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Lake Ivanhoe

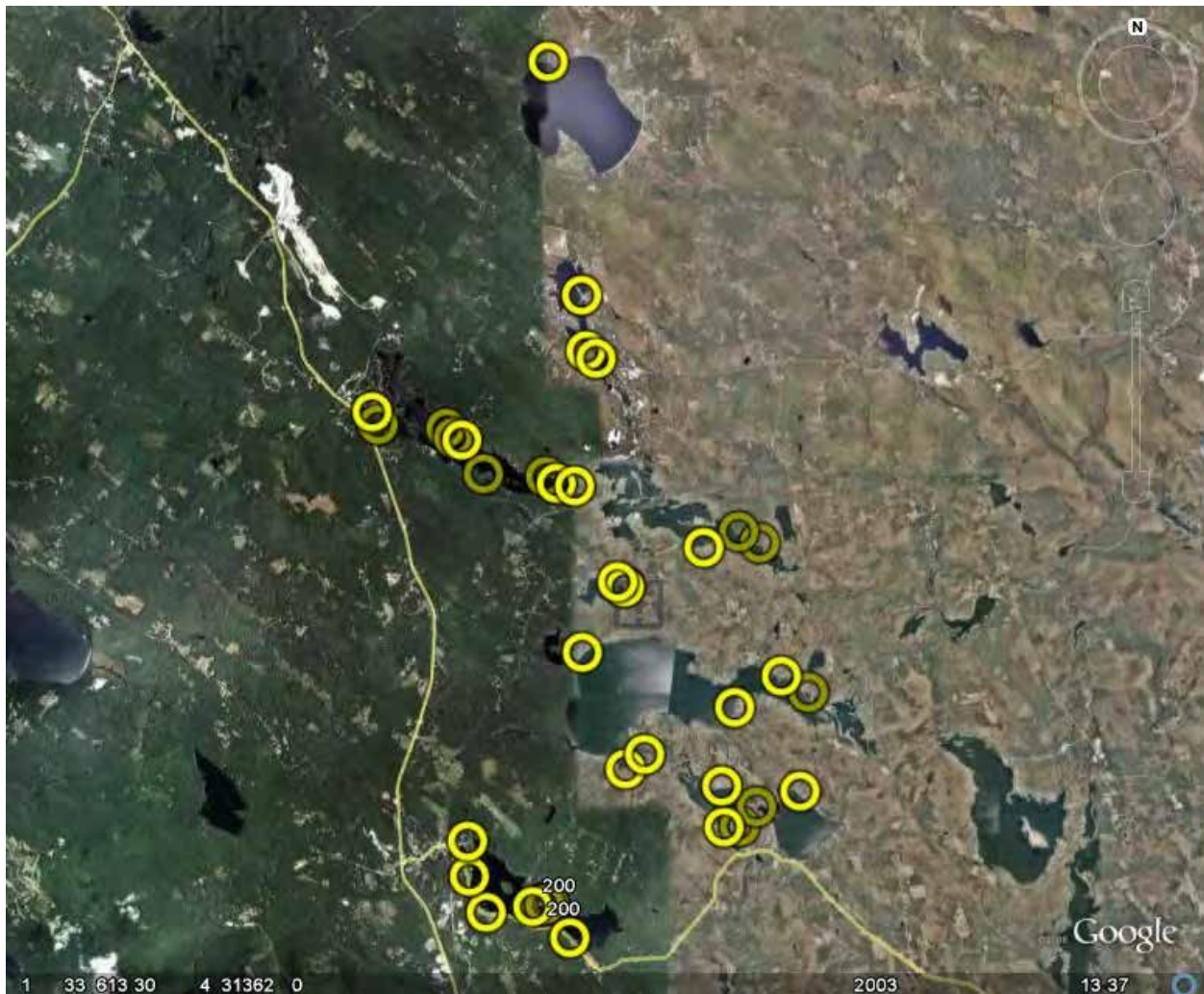
37. Nancy Takis-Conway	766 Acton Ridge Road	East Wakefield, NH
38. Richard Hoage	32 Dearborn Road	East Wakefield, NH
39. Larry & Norma Gray	40 Dearborn Road	East Wakefield, NH

The following follow-up procedure was developed and adopted this season for the inspection of TA client BMP installations:

- Follow-up visit and photo documentation by Technical Director (TD) will occur within 12 months of Technical Assistance (TA) design mailing, but not before adequate time for implementation.
- If no BMPs from the design have been implemented, TD will discuss the design with TA client to encourage implementation and redesign TA if necessary.
- If at least one BMP has been implemented, TD will evaluate functionality of the BMPs and encourage implementation of additional BMPs.
- If implemented BMP is functioning properly, TD will review maintenance procedures with TA client and not revisit site unless contacted by TA client.
- If BMP has failed, TD will determine reason for failure:
 - o If failure is due to design flaw, TD will redesign TA for TA client to implement.
 - o If failure is due to improper installation, TD will demonstrate and/or explain proper installation to TA client, and TD will reevaluate site within 12 months.
 - o If failure is due to lack of maintenance, maintenance procedures will be discussed with TA client and site reevaluated within 12 months. A list of local maintenance companies will be made available upon request of the landowner.

- Upon successful implementation of TA design and subsequent positive inspection by TD, TA client will be awarded AWWA yard sign indicating active involvement in erosion control and water protection efforts.
- TA client is encouraged to contact TD for assistance with any erosion problem.

Map of Distribution of 2008 AWWA Technical Assistance Sites:



Appendix 1**NPS Projects - Pollutants Controlled Report**

New Hampshire Department of Environmental Services, Watershed Assistance Section

DES Project Number: B-08-C-02 Annual Report for the year: 2008Project Title: Youth Conservation CorpsGrantee: Acton Wakefield Watersheds Alliance**Table 1. Pollutant Load Reduction Estimates for NPS Sites Treated with BMPs**

Waterbody Name	Sediment tons per year	Phosphorus pounds per year	Nitrogen pounds per year
Lovell Lake	1.7	1.5	N/A
Great East Lake	4.0	3.9	N/A
Belleau Lake	1.1	0.9	N/A
Horn Pond	2.7	2.3	N/A
Province Lake	3.4	2.9	N/A
Wilson Lake	0.5	0.4	N/A
Totals	13.4	11.9	N/A

Table 2. Wetlands, Streambanks, Shoreline Protected / Restored During This Project

Resource	Planned acres	Actual acres	Planned linear feet	Actual linear feet
Wetlands restored			not applicable	not applicable
Wetlands created			not applicable	not applicable
Streambank /shoreline protected	not applicable	not applicable		
Stream channel stabilized	not applicable	not applicable		

The estimations in this report were determined using the appropriate estimation model(s) and applied according to the procedures prescribed for the model. To the best of my knowledge these are reasonable estimates using appropriate methods. Documentation is kept on file by the grantee and is available for review by DES / EPA.

Submitted by (for Grantee): _____ on ____/____/____
Signature Printed Name

Reviewed by (for DES): _____ on ____/____/____
Signature Printed Name

NPS Projects - Pollutants Controlled Report

New Hampshire Department of Environmental Services, Watershed Assistance Section

DES Project Number: B-08-C-02

Annual Report for the year: 2008

Table 3. List of NPS Sites and Methods Used

Site ID (name or # from site list)	Brief Description NPS Site	Estimation Method / Sub- Method Used	Tons of Sediment This Year	Pounds of Phosphorus This Year	Pounds of Nitrogen This Year
Alan Heacock Property (Lovell Lake)	Rubber Razors	Region 5/GEE	1.3	1.1	N/A
Will Collier Property (Belleau Lake)	Rain Garden, Buffer Strip	Region 5/GEE	0.1	0.1	N/A
Public Launch Property (Great East Lake)	Erosion Control Mix	Region 5/GEE	3.2	3.2	N/A
Public Launch Property (Lovell Lake)	Erosion Control Mix, Waterbar	Region 5/GEE	0.4	0.4	N/A
Municipal Property (Province Lake)	Infiltration Steps, Waterbars, Riprap	Region 5/GEE	3.4	2.9	N/A
Municipal Property (Great East Lake canal)	Infiltration Trench, Drywell	Region 5/GEE	0.6	0.5	N/A
Barbara Wing Property (lower) (Horn Pond)	Rubber Razor, Erosion Control Mix, Infiltration Steps, Dripline Trench	Region 5/GEE	2.7	2.3	N/A
Bob Grant Property (upper) (Belleau Lake)	Infiltration Steps, Dripline Trench	Region 5/GEE	0.6	0.5	N/A
Bob Grant Property (lower) (Belleau Lake)	Dripline Trench, Infiltration Steps, Drywell, Retrofit Infiltration Steps	Region 5/GEE	0.4	0.3	N/A
Dee Kasprzak Property (Great East Lake)	Waterbars, Retrofit Infiltration Steps, Erosion Control Mix, Buffer Strip, Infiltration Steps, Native Vegetation	Region 5/GEE	0.2	0.2	N/A
Celia Thibodeau Property (Wilson Lake)	Open-Top Culverts, Turnouts	Region 5/GEE	0.5	0.4	N/A
Totals for the Year:			13.4	11.9	N/A

Pollutant Load Reduction Estimation Methods

1. Region 5 Model Refer to EPA website <http://it.tetrattech-ffx.com/step1/default.htm> Go to the Region 5 Load Estimation Users Manual, “Michigan Method”.

Descriptors to use for Region 5 Model sub-methods:

Region 5 / GEE	Gulley Stabilization - uses Gulley Erosion Equation
Region 5 / CEE	Streambank / Ditchbank and Roadbank Stabilization - uses Channel Erosion Equation
Region 5 / Fields	Agricultural Fields - uses Revised Universal Soil Loss Equation (RUSLE), sediment delivery ratio and contributing drainage area.
Region 5 / Filter	Filter Strips - uses relative gross filter strip effectiveness
Region 5 / Feedlot	Feedlot Pollution Reduction - uses a 12 step method

2. WEPP Model. Refer to USFS website <http://forest.moscowfsl.wsu.edu/fswepp/> Water Erosion Prediction Project (WEPP) computer model.

Appendix E: AWWA in the News



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[Back](#)

Article published Feb 4, 2010

Salmon Falls headwaters plan aims to reduce phosphorus, improve lake water quality

SANBORNVILLE — P is for problem, and in Wakefield lakes the looming problem is phosphorus for which the chemical symbol is P — a neat, circular mnemonic, but not one attached to any neat solution.

On a recent Saturday morning, dozens of warmly-clad people, some of them lake dwellers, others not, attended the rollout of the Salmon Falls Headwater Lakes Watershed Management Plan (WMP) in Wakefield Opera House — a plan than aims to tackle the problem of phosphorus in the headwaters, before it can seriously impair water quality, aquatic life and property values.

The plan, running to around 200 pages, and crammed with facts, figures, maps, analyses and recommendations, was prepared by FB Environmental Associates at the behest of, and with much input from, the Acton Wakefield Watershed Alliance (AWWA) I, thanks to state and federal grants.

The WMP focuses on a 26-square mile area in Acton and Wakefield, and the four lakes — Great East Lake, Ivanhoe Lake, Wilson Lake and Horn Pond, that form the headwaters of the Salmon Falls River. Also contained within this area, and included in the study, is Lovell Lake, which drains into the Branch River, a tributary of the Salmon Falls River.

Environmental scientist Jen Jespersen of FB Associates and AWWA Executive Director Linda Schier, in their introduction of the plan, noted that people in Maine and New Hampshire, in the course of the WMP data collecting, were talking to each other for the first time, being united by a common goal — maintaining high quality water in the lakes and throughout the headwaters watershed Forrest Bell (of FB Associates), in his presentation, noted that the Salmon Falls was list by the Environmental Protection Agency as an impaired Class B river — one with low levels of dissolved oxygen. As the amount of phosphorus in the water increases, so does algae growth, which, along with low flows and impoundments, contributes to oxygen depletion.

He showed slides giving the acreage, depth and flushing rates of the five lakes — with Ivanoe, the shallowest, having the smallest watershed, but, as later slides showed, one of the greatest potentials for future population growth, development and additional phosphorus, which spells concern.

One pound of phosphorous, said Bell, can result in 300 to 500 pounds of algae in a lake.

"It takes 1,000 times less phosphorus to turn a lake green than to keep a lawn healthy," said Bell, showing an alarming slide of a green lake.

Phosphorus causes high growth in ponds, which leads to low light and low oxygen.

"For every three-foot decline in water clarity, the value of shorefront property can decline by as

much as 20 percent," said Bell.

He then showed spreadsheets of the calculated amounts of sediment and phosphorus being washed into each lake on an annual basis — 240 tons of sediment in total and 204 pounds of phosphorus.

In the past two years, AWWA volunteers have pinpointed 491 sites within the watershed that are contributing to this state of affairs, and need to be fixed. These were only specified in general terms, and include run off from residential and commercial sites, miles of roadway within 250 feet of the shoreline, water-crossings, suspect septic systems. The next presenter was Sally Soule of the NH Department of Environmental Services, who talked of the different standards of measuring impaired water bodies in New Hampshire and Maine, the former driven more by measurement and the latter by description. She also talked about the Federal Clean Water Act, and the perils of being 303 (D) listed — a fate that recently befell Lake Champlain in Vermont because of a phosphorus overload. The cry was then taken up by a pressure group, the Conservation Law Foundation, which sued the state. As a result, landowners with over two acres around parts of that lake need storm-water discharge permits, she said.

The five lakes in the Salmon Falls Headwaters plan are all healthily classified as Oligotrophic, meaning they have (or should have) less than 8 parts per billion of phosphorus.

None are impaired, as yet, said Bell, "but Ivanoe and Horn could be on the threshold." Another chapter of the WMP addressed the population growth rates in Acton and Maine, calculated the available acreages of developable land, and predicted the years that both communities would be built out — the year 2041 for Acton and by 2054 in Wakefield. The calculation model being used also spat out a prediction of the additional phosphorus that will wind up in the lakes as a result of this development, if current practices continue, and the plan's recommendations are not enacted.

Among the short term goals, knowing that Ivanoe and Horn are on the cusp, is to try and reduce the phosphorus count in these water bodies by 0.8 parts per billion to 7.2 ppb apiece, and to reach a similar concentration in Lovell Lake by lower the P count there by 0.3 ppb.

An action plan, the meeting was told, should be community driven, with objectives and action items spelled out, along with approximate cost estimates and funding sources.

Recommendations include a watershed or regionwide phosphorus control ordinance for all new development; reducing or removing grandfathering for both subdivision and shoreline zones; encouraging cluster development; and passing ordinances to require low impact development principles with much less run-off and far greater infiltration of storm-water through vegetative plantings porous surfaces.

Increased fines for non-compliance, particularly in the shore land zone, are suggested, along with ban on phosphorus lawn fertilizer (unless soil tests say its needed) and a prohibition on phosphorus-based detergents. Better tracking of failing septic systems is also desirable in the Fight against Phosphorus, along with green roofs, rain gardens and cisterns.

Schier also said that education and outreach were very important, and suggested Lake Association round tables, a survey of seasonal residents, and floating classrooms for both adults and children, all with the goal of persuading people to reduce their phosphorus footprint.

For much more on the Salmon Falls Headwater Lakes Watershed Management Plan, visit
www.awwatersheds.org

CARROLL COUNTY INDEPENDENT

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RICHARD PIATT, Publisher Larissa Mulkern, Editor
Editorials, while unsigned, represent a consensus of the
views of the editorial board of the Granite State News and
Carroll County Independent.

A productive season for water protection

Southern Carroll County is blessed with abundance of natural beauty, forests, mountains and some great views and of course, many lakes. These resources attract thousands and thousands of visitors, seasonal and full-time residents a year. Without the attraction of our clean lakes, Wakefield would be just be a pit stop to the White Mountains.

It's imperative to our local economy and tax base that we keep the lakes safe and protect our shore-front properties from erosion and decay. We should take our hats off in thanks to one group in particular this season – the Acton-Wakefield Watersheds Alliance Youth Conservation Corps. This group of mostly high school students, lead by technical coordinator Adam Shoukimas, completed 19 projects on six water bodies this summer.

The AWWA is a nonprofit organization dedicated to protecting water quality in the region from threats like erosion and pollution. The kids did projects on Lovell Lake, Great East Lake, Balch Pond, Province Lake, Wilson Lake, and Horn Pond.

Keeping water bodies clean is an important way to protect property values, said Shoukimas. If pollution, like lawn fertilizer, gets into the lake it can produce algae blooms, which can turn water into a “disgusting” green soup, said Shoukimas.

Property values can be reduced by 20 percent for every three-feet in water clarity that's lost. And as Shoukimas said this week, it's far easier to keep water clean than it is to fix it after it gets polluted.

Shoukimas is available to give homeowners advice on how to protect their properties from erosion and how to divert stormwater runoff from pouring into the lakes. AWWA pays the YCC workers from grants and public funds; the homeowner only has to pay for materials. But the advice is free. He will even make house calls.

Thanks AWWA and the youth corps team for helping to protect our resources now and into the future.

Busy season for Youth Conservation Corps

BY DAYMOND STEER

Staff Writer

WAKEFIELD — Nineteen projects on six water bodies were completed this summer through the efforts of Acton (Maine) Wakefield Watersheds Alliance's Youth Conservation Corps.

The AWWA is a nonprofit organization dedicated to protecting water quality in the region from threats like erosion and pollution. This season was more productive than most. During an average season, about 15 projects are completed, said AWWA Technical Director Adam Shoukimas.

The YCC worked on the following water bodies this summer: Lovell Lake, Great East Lake, Balch Pond, Province Lake, Wilson Lake, and Horn Pond.

"We really worked hard," said YCC crew leader Anthony Stanton, 19, of Acton, Maine.

Last week, the YCC provided a tour of one of the projects, located in the backyard of at a residence on Lovell Lake. A group of volunteers and some technical leaders from AWWA and other agencies identified the yard as an area that needed work during a watershed survey last year.

The backyard was on a steep decline, which caused storm water to pour down the yard and into the lake. The problem was most pronounced at the bottom of some stairs that lead to a



DAYMOND STEER ▼ STAFF

THE ACTON WAKEFIELD Watersheds Alliance Youth Conservation Core helped protect 19 pieces of property this summer including this yard on Lovell Lake. Front row from left to right: Ryan Fabian, Adam Shoukimas (technical director), Jordan Shepherd; middle row from left to right: Tyler O'Donovan, Burleigh Hastings; back row from left to right: Anthony Stanton (crew leader), Zach Brown, Sam Wilson (crew leader).

deck.

So, the YCC constructed three "infiltration steps" at the bottom of the deck stairs and on another steep area of the backyard. To a layperson, the infiltration steps

would appear decorative. The steps are covered with a layer of gravel surrounded by a wood frame. Underneath the gravel is a layer of filter fabric, said Shoukimas.

The infiltration steps soak water into the ground, preventing it from rushing into the lake. The steps also provide a way to manage foot traffic, said Shoukimas.

The property owner is re-

sponsible for buying the materials and the YCC constructs the project (or most of it) for free, said Shoukimas.

SEE YCC PAGE A12

YCC

FROM PAGE A1

“The landowner is getting a good deal,” said Shoukimas. “They are protecting their property by getting some high quality work done at minimal cost.”

Keeping water bodies clean is an important way to protect property values, said Shoukimas. If pollution, like lawn fertilizer, gets into

the lake it can produce algae blooms, which can turn water into a “disgusting” green soup, said Shoukimas.

Property values can be reduced by 20 percent for every three-feet in water clarity that’s lost, said Shoukimas. And it’s far easier to keep water clean than it is to fix it after it gets polluted, he said.

However, that’s not to say the construction work was

easy. Some YCC members said while digging ditches they would have to hack through big roots or remove stones to get some projects done.

The length of their construction season depends on funding, said Shoukimas. The teens are considered employees and they do get paid an hourly rate.

Shoukimas said he’s

available to give homeowners advice. He will make house visits.

The AWWA funded by the U.S. Environmental Protection Agency through New Hampshire Department of Environmental Services Watershed Assistance grant program, the Towns of Acton, Maine, and Wakefield, the Alden N. Young Trust, the Roy Foundation, the New

Hampshire Charitable Foundation, the Jane B. Cook 1983 Charitable Trust, local lake associations, and individual donations. The Route 16 Superstore in Tamworth donated a 2004 Ford F150.

Donations are welcome. The physical address is PO Box 254 Union NH 03887. Email at info@AWWwatersheds.org. Phone is 473-2500.