Lovell Lake
Watershed Survey Report

2022

Acton Wakefield Watersheds Alliance

Lovell Lake Association

Acknowledgments

The following people and organizations were instrumental in the Lovell Lake Watershed Survey Project and deserve special recognition for their efforts:

Watershed Survey Volunteers

Peter Lewis	Dick DesRoches	Stanley Flint
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David Pawlowski	Sam Sherrill	Jillian Darling
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Supporting Organizations

Acton Wakefield Watersheds Alliance (AWWA)

Lovell Lake Association (LLA)

New Hampshire Department of Environmental Services (NHDES)

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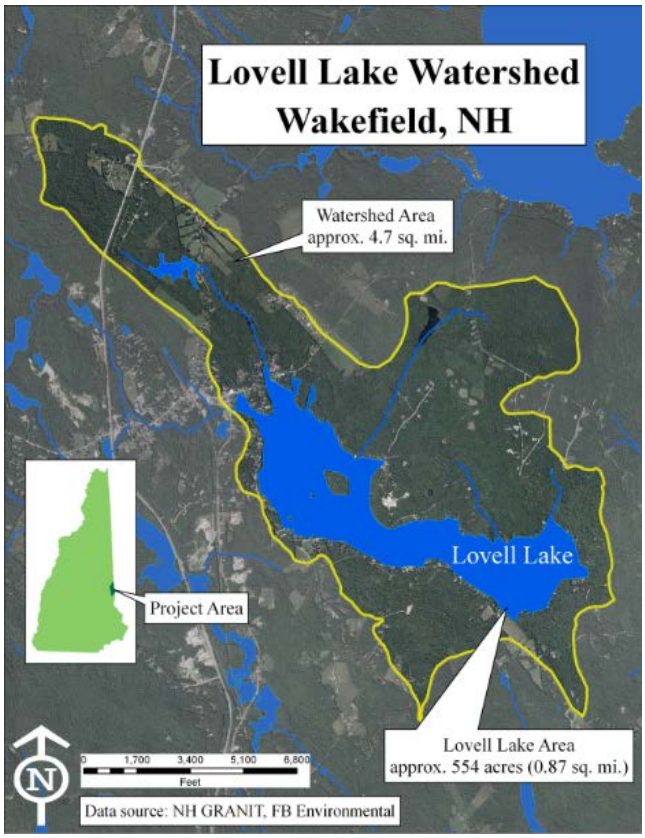
Introduction

This report serves to compile, summarize, and analyze the data collected during the Lovell Lake watershed survey conducted in the spring of 2022 and is intended for residents, landowners, and town officials within the Lovell Lake watershed.

Watershed surveys provide a snapshot of the condition of the watershed at the time the survey is conducted and document all evidence of sediment erosion. The information gathered during the Lovell Lake survey will be used by the Lovell Lake Association (LLA), the Acton Wakefield Watersheds Alliance (AWWA), and the Town of Wakefield to guide future efforts to preserve the lake's water quality for future generations to enjoy.

Lovell Lake Watershed

The area of Lovell Lake is 552 acres (0.86 square miles) while the area of the entire watershed is approximately 3,008 acres (4.7 square miles). The maximum water depth is 38 feet, with an average depth of 19 feet. The lake is located in the town of Wakefield, NH, and is a headwater lake for the Salmon Falls River. The shoreline of Lovell Lake is highly developed; all precipitation that falls in the watershed drains into the lake through a network of streams, ditches, and overland flow.



The outlet is at the Northwestern end of the lake. This outlet is dam controlled and becomes the Branch River which flows south to Union Meadows and eventually connects with the Salmon Falls River at Northeast Pond in Milton, NH. Lovell Lake is part of the Salmon Falls Headwater Lakes Watershed that includes Lake Ivanhoe, Great East Lake, Wilson Lake, and Horn Pond. Salmon Falls flows through New Hampshire and Maine, acting as the state border, and ultimately drains into the Atlantic Ocean at 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 Lovell 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 Lovell Lake must be addressed on a watershed level rather than simply focusing on shoreline activity.

Water Quality

Volunteers have been testing the water quality of Lovell Lake since 1989. The UNH Lay Lakes Monitoring Program (LLMP), and NHDES have collaborated with LLA in order to evaluate water quality, track algae blooms, and determine water quality trends. This includes 33 years of Secchi disk transparencies, total phosphorus (TP) data, chlorophyll-a, (Chl-a) data, and 11 years of dissolved oxygen (DO) profiles.

Lovell Lake ranks highly for most water quality metrics but is considered impaired for DO. By New Hampshire standards, "outstanding water resources" exhibit average Secchi disk transparency (SDT) greater than 9.1 meters (30 feet), Chl-a levels of <2 ppb, and TP concentrations of 2 to 5 ppb. Lovell Lake has an average SDT of 7.0 meters, average TP of 7.1 ppb, and average Chl-a of 2.9 ppb. Analysis shows that TP has remained at a consistent level over 33 years, slightly increasing over time.

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, this allows algae and bacteria populations to expand.

Lovell Lake is classified as an Oligotrophic lake. Oligotrophic lakes are nutrient-poor. They tend to have rocky substrates and shorelines, deeper water, limited algae and aquatic plant growth, and an abundance of dissolved oxygen. Eutrophic lakes are nutrient-rich, which allows for abundant plant growth and tends to lead to lower DO levels over time. Mesotrophic lakes are in between these two trophic levels. Lovell Lake has historically exhibited dissolved oxygen depletion in the deepest parts of the lake, which makes it more difficult for cold-water fish and other aquatic fauna to thrive.

Despite a steady increase in TP levels, Lovell Lake has not begun experiencing widespread cyanobacteria blooms. One species of cyanobacteria, Gloeotrichia, can be quite abundant in the water column during the hottest part of the summer, but there is always some presence of cyanobacteria in the water and this alone does not constitute a bloom. This increased presence, however, combined with steadily increasing TP levels may indicate that Lovell Lake is slowly approaching the point where a full bloom could occur. This scenario gives Lovell the opportunity to reverse the trend of TP before it reaches levels that would support cyanobacteria blooms. Warmer temperatures combined with localized sources of stormwater runoff contributing to excess nutrients play a large role in bloom development and are not always reflected by the average TP levels of the lake.

LLA has been effective in recruiting volunteers to monitor the health and vitality of the lake. A dedicated water quality monitoring group has participated with the UNH Lakes Lay Monitoring program and Lake Stewards of Maine since 1987. 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.

LLA and the Town and Wakefield have also supported the efforts of AWWA and its Youth Conservation Corps (YCC). AWWA provides technical assistance to landowners with erosion issues and advises the use of best management practices (BMPs) to address stormwater runoff.

Threats to Lovell Lake

The largest threat to lakes in New England, including Lovell 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 flushes into the lake.

In an undeveloped, forested watershed, stormwater runoff moves more slowly due to uneven terrain, tree and shrub roots, ground cover plants, leaves, and other natural debris on the forest floor. These features give runoff time to infiltrate into the ground, soaking into the uneven forest floor and filtering through the soil. The soil and mineral substrate below ground is the most effective form of filtration for stormwater runoff.

In a developed watershed, stormwater does not have the opportunity to infiltrate and does not receive the filtration provided by the forest floor. Rainwater picks up speed as it flows across impervious surfaces like rooftops, compacted soil, gravel camp roads, and pavement, and becomes a formidable, erosive force.

Although much of Lovell 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 roads convey most of the runoff to the lake, public access points such as beaches and boat launches were found to contribute as well. 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?

Though stormwater by itself can cause environmental issues when it gets into the lake, the primary issue with stormwater is the pollutants that it picks up and carries with it. The sediment and nutrients in the runoff can be bad news for freshwater lakes.

The nutrient known as phosphorus is food for algae and other plants and is found in soil, 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/Sediment 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" Lovell Lake with the soil that erodes from our driveways, roads, ditches, pathways, and beaches.

Reasons to Reduce Runoff

Lovell Lake's current water quality conditions make it a valuable asset to the community for multiple reasons; economic, recreational, ecological, and cultural.

- Once a lake has declined, it is difficult or impossible to restore. Prevention is the key.

- Economic studies show that declines in water quality are directly correlated with waterfront property value. 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.

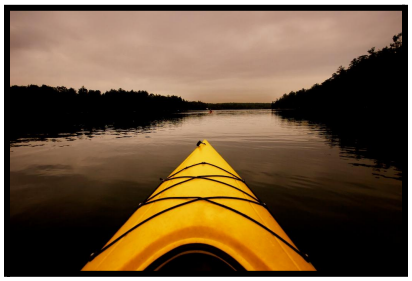
- The lake attracts anglers and boaters from across the region. The convenient location draws weekend visitors who flock to the area to pursue leisurely activities. The size and length of the lake make it a popular site for powerboat activities such as water skiing, wakeboarding, and tubing. Likewise, 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, largemouth bass, Chain Pickerel, Brown Bullhead, White Perch, Walleye, and Burbot/Cusk. Lovell Lake also has a population of invasive Koi Fish.

- 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 sight and have become a symbol of the region. Declining water quality could force these majestic birds to find healthier waterbodies 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, algae, and cyanobacteria to thrive.


Purpose of the Lovell Lake Watershed Survey

The purpose of this survey was to gain an in-depth understanding of the current conditions of the watershed in terms of surface sediment erosion through 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.

- To 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 a basis to obtain grant funding to assist in remediation of identified erosion sites.

- Make general recommendations to landowners to remediate erosion problems on their properties.

- Identify sites for future Youth Conservation Corps/grant projects

- To update the Salmon Falls Watershed-Based Management Plan, which covers Lovell Lake, and use the information gathered as one component of a long-term lake protection strategy. All sediment erosion along the shoreline that reaches the lake was documented, thus the resulting watershed based plan has a real-world perspective with hard data collected from first-hand observations.

- *Lovell Lake can use this survey to develop its own unique Watershed Management Plan.*

Note: The purpose of the survey is *NOT* to blame landowners for erosion or seek enforcement action against landowners not in compliance with ordinances. This is an education, outreach, and science-based tool intended to help the Lovell Lake community work together with landowners and community partners to solve erosion problems on their property through technical assistance, Youth Conservation Corp projects, and grants.

Local citizen participation was essential in completing the watershed survey and will be even more important in years to come. With the leadership of LLA and AWWA and others concerned with lake water quality, the opportunities for stewardship are limitless.

Survey Method

The survey was conducted by LLA volunteers with the help of trained technical staff from, NHDES, NH LAKES, and AWWA. 28 volunteers were trained in survey techniques during a two-hour virtual training session on May 18th, 2022. On Friday, May 20th, the volunteers met in the parking lot of the Poor People's Pub, organized into eight groups, and spent the day documenting erosion on the roads, properties, driveways, and shorelines in their assigned sectors using a tailored digital data collection app called Survey123. The volunteers completed the survey in a single day. Surveys are almost always conducted in the spring because this is when stormwater erosion is most apparent. Each survey group had one technical leader, a group leader who lived in that sector, and 2-3 additional volunteers. The Technical Leader was responsible for entering data into the app and providing quality control for each entry. Team leaders and volunteers were responsible for efficiently navigating their sector, numbering site photos, and engaging with homeowners. The entire group was responsible for seeking and identifying erosion sources.

When erosion was identified on a site, it was categorized in several ways:

- Degree of impact on lake water quality
- Estimated remediation cost
- Technical level required to remediate the erosion issue

Impact on Lake Water Quality: Each site was rated for its potential impact on lake water quality. The impact was based on slope, amount of soil loss, proximity to water, and the presence and size of a vegetated buffer.

- "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 remediating erosion at each site and the associated cost of labor and materials was estimated for the homeowner.

- "Low" cost sites were estimated to cost less than $1,000

- "Medium" cost sites were estimated to cost between $1,000 and $3,000

- "High" cost sites were estimated to cost in excess of $3,000

Technical Requirements: In addition to cost, surveyors also determined what level of technical expertise would be required in order to correct an erosion issue. This often correlates with cost, but not always.

- "Low" tech recommendations can easily be installed by homeowners using hand tools and do not require landscape design knowledge or engineering.

- "Medium" tech recommendations require a site-specific landscape design using specific stormwater best management practices and could be completed by a landscape design company or by AWWA's Youth Conservation Corps Program.

- "High" tech recommendations will require large, complex installations and will likely require an engineered design.

Photos and additional site information were gathered for each site to get a full picture of the erosion. All site information was then submitted through the Survey123 App and downloaded into an excel spreadsheet for analysis. Estimates of soil loss to the lake and the associated phosphorus loading estimates were made using the EPA Region 5 Model. This model is the standard used by most organizations to estimate soil loss, including Maine DEP, NHDES, and the US EPA.

All information collected during the initial survey and subsequent soil loss estimations were entered into an excel database managed by AWWA. This data was standardized, validated, and organized to allow relationships and rankings to be determined. The sites that were identified by volunteers were prioritized for remediation based on rankings of their impact on the lake, required technical expertise, and estimated cost of remediation. The documented erosion sites were then marked on the Lovell Lake watershed map.

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 or to find out if a site number corresponds with your property (contact info found on page 29).***

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Note: This Survey was conducted using the Maine DEP Lake Watershed Survey Protocol. View at: https://www.maine.gov/dep/land/watershed/materials/lakewsurveyguide.pdf

Summary of Watershed Survey Findings

Volunteers identified 136 erosion sites that were directly impacting Lovell Lake. Of these, 11 were low impact to the lake, 88 were medium impact, and 37 were deemed high impact, see figure 1. All three of these categories had a range of costs and technical complexity associated with remediating erosion. In addition to being categorized by water quality impact, erosion sites were also identified by land use type. The majority of erosion sites were identified on residential properties, followed by driveways and roads, both public and private. Figure 2 depicts the types of land use and their water quality impact on the lake. This is also outlined in Table 1.

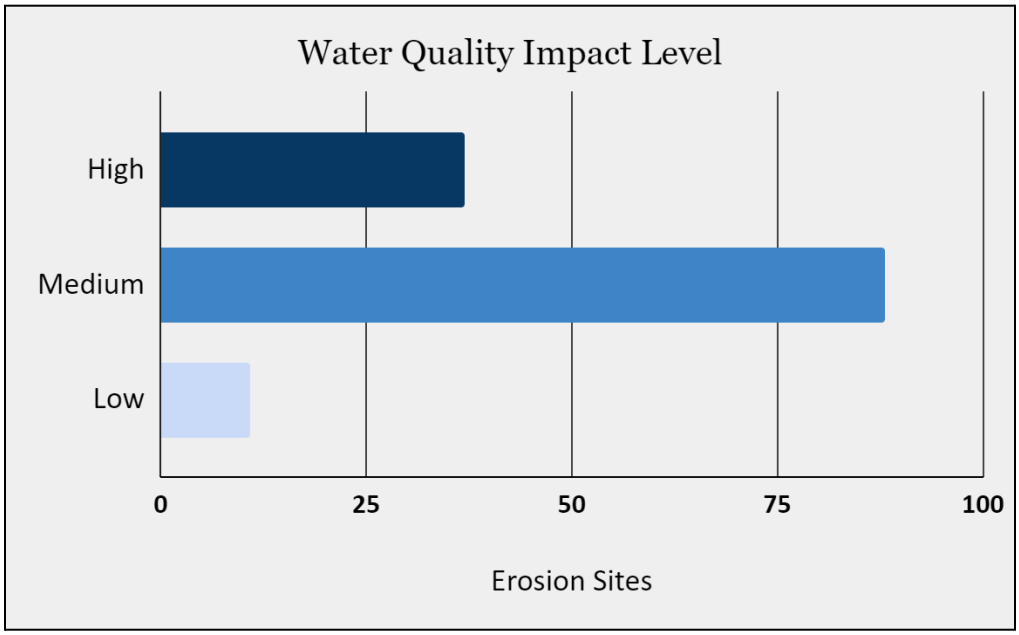


Figure 1. Identified Erosion sites based on estimated water quality impact.

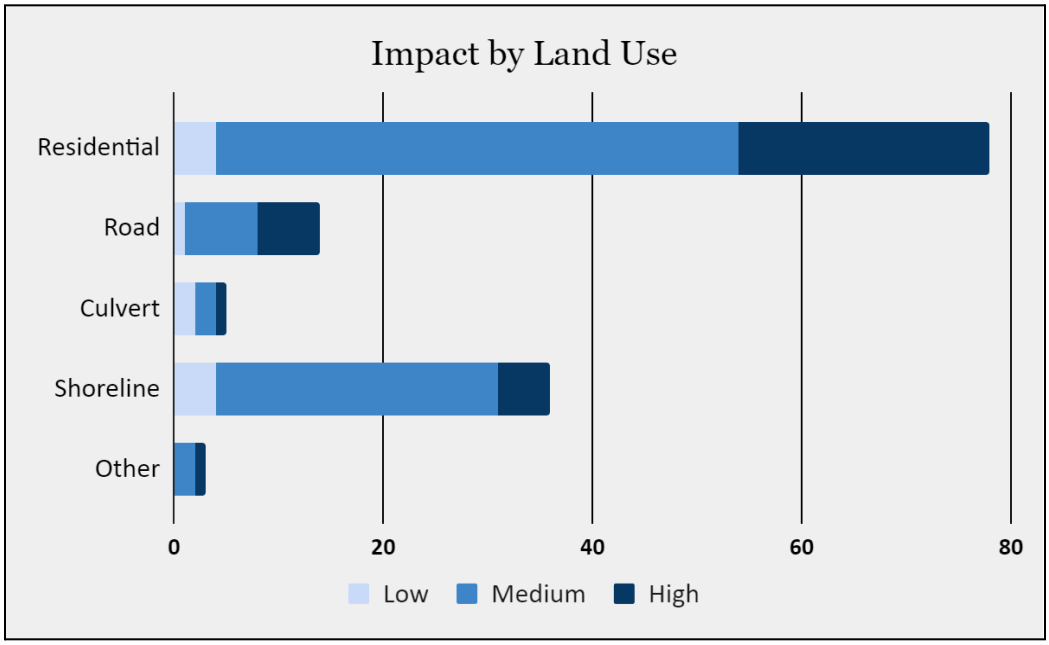


Figure 2. Impact to water quality separated by land-use type.

After assessing water quality impact, volunteers also estimated the cost and any technical requirements to remediate each erosion site. These are important considerations when prioritizing erosion control efforts given that inexpensive, simple projects can be completed in greater abundance and in less time thus maximizing the benefit to water quality. Figures 3 and 4 compare the water quality impact of a site to both cost and technical requirements. *Notice that the graphs are nearly identical.* There were only a handful of sites where cost estimates and technical level to repair differed.

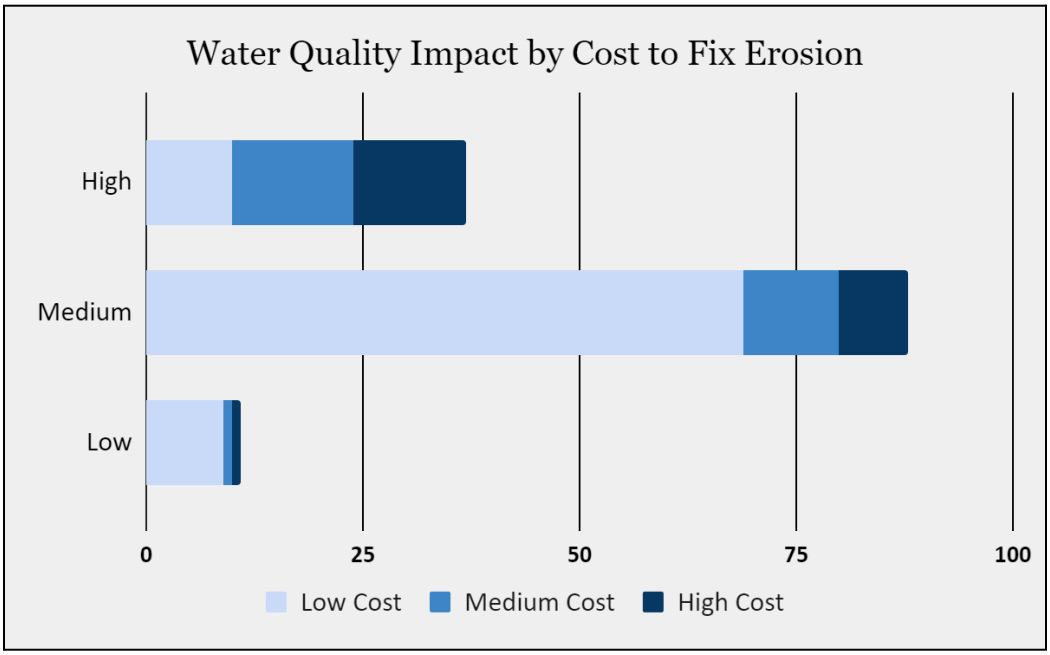


Figure 3. Water quality impact of erosion is separated by repair cost.

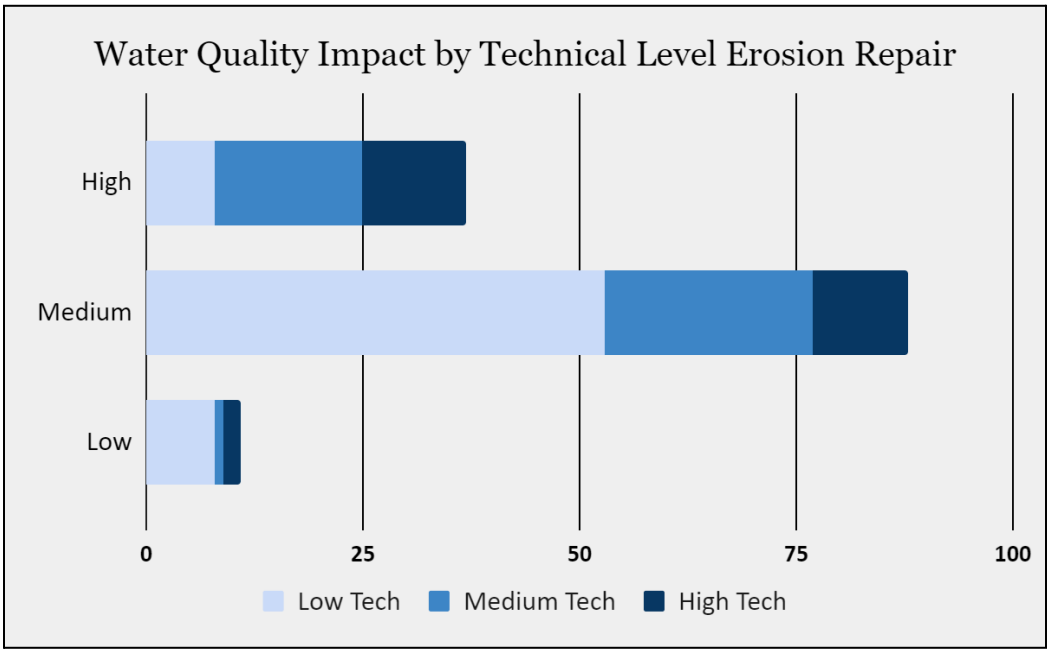


Figure 4. Water quality impact of erosion separated by complexity of repair.

Discussion

While discussing the impacts of the survey's findings it is important to remember that polluted runoff is a nonpoint source pollution problem, meaning that *no single source has a major impact on water quality*. When added up, however, these small impacts have a significant accumulative effect on water quality. As seen in the figures above, the majority of erosion sites identified by volunteers do not have a high impact on water quality. These ratings (high, medium, and low), are relative and are primarily used as a way to prioritize which sites should be addressed by the community, but any erosion that can be addressed should be. For example, one high-impact site may represent 5% of the overall erosion in the lake and should be addressed right away. A site that represents only 1% of the lake's erosion is a lower priority to repair, however, if 10 of these low-priority sites are repaired, the effect will be 10% of erosion eliminated, twice as much as repairing the previously mentioned high-priority site. **Every erosion source that we eliminate contributes to an overall reduction of pollution getting into the lake.**

By prioritizing sites by impact, cost, and technical level, we can focus our efforts on high-priority, complex sites, while encouraging homeowners to address the much larger category of inexpensive, low-impact sites. In Appendix B, the list of erosion sites is broken down by priority. The highest priority sites are those that have a high impact on the lake but are inexpensive and easy to remediate. The lowest priority is low-impact sites which would be expensive and complicated. This prioritization ensures that we spend our limited financial resources efficiently while having the greatest impact on the lake. *If your own property is ranked higher on the priority list, this does not mean you have more responsibility to protect water quality than others*. Everyone is responsible for doing whatever they can to minimize their effect on water quality. This data will be a resource to the Lovell Lake community for accomplishing that goal.

Tables

Land Use	Low	Medium	High	Total
Residential	4	50	24	78
Road	1	7	6	14
Culvert	2	2	1	5
Shoreline	4	27	5	36
Other	0	2	1	3

Table 1. Water quality impact level separated by land use

Impact	Low Cost	Medium Cost	High Cost
High	10	14	13
Medium	69	11	8
Low	9	1	1

Table 2. Water Quality impact separated by cost to address erosion.

Impact	Low Tech	Medium Tech	High Tech
High	8	17	12
Medium	53	24	11
Low	8	1	2

Table 3. Water quality impact separated by technical level needed to address erosion.

Next Steps

Remediating the erosion issues identified in this survey will require efforts by LLA, AWWA, community members, road associations, and municipal officials.

LLA & AWWA

- Contact property owners, road associations, and town officials with identified erosion to offer technical assistance. Encourage them to make improvements and provide the resources to do so.
- Make this report available to all residents of the Lovell Lake Watershed.
- Partner with NHDES and towns to seek grant funding, such as CWA Section 319 grants, and implement grant-funded projects to protect lake water quality.
- Continue to promote the Lake Host, Weed Watch, and water quality monitoring programs and encourage lake stewardship.
- Increase awareness; provide educational materials and guidance to members of the Lovell Lake watershed community.
- Organize workshops and volunteers to start remediating identified erosion problems and teach citizens how to repair similar problems on their own properties.
- Educate municipal officials about lake issues and work cooperatively to find solutions.

Individual Landowners

- Repair areas of your property where erosion is occurring if possible. Contact LLA via email at watershedsurvey@lovelllakenh.org or AWWA at info@awwatersheds.org for technical assistance and educational materials about erosion best management practices.
- Contact LLA to get involved with current water quality programs and efforts.
- Encourage the growth of native vegetation on your property; stop mowing and raking where possible and avoid exposing bare soil. Seed and mulch bare soil areas.
- Call your local Code Enforcement Officer (CEO) before doing any tree cutting or soil disturbance projects. (see contact info on Page 29)
- Maintain septic systems properly. Pump your tank every 1 to 3 years.

Municipal Officials

- Enforce shoreland zoning and other ordinances to ensure the protection of Lovell Lake.
- Conduct regular maintenance on town roads in the watershed, and address town road issues identified in this survey where feasible.

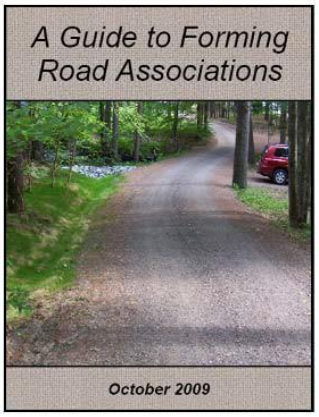
Forming a Road Association

- Proper maintenance of camp roads is crucial to the long-term health of Lovell Lake.
- 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.
- While small roads can make do with informal associations, it is becoming more common to establish road associations as 501(c)3 non-profit organizations. These associations are run through a straightforward, democratic process and have the ability to collect dues, receive legal protections, and may qualify for grant funding to remediate erosion issues.

Why form a road association on Lovell Lake?

- 14 impact sites identified during the watershed survey are on private roads. Maintaining these roads helps protect Lovell Lake from the impacts of soil erosion.
- A road association provides an avenue for private camp road users to formally manage roads in a fair, organized, and cost-effective manner.
- Regular maintenance can reduce road expenses over time. The Maine Camp Road Maintenance Manual estimates that $1 spent on routine maintenance saves $15 in repairs.

For information on forming road associations:



- New Hampshire Road Association Laws - RSA 231:81-A
- NH Private Road Tax Payers Alliance - nhpvrta.com
- How to form a Non-Profit: learning.candid.org/resources/knowledge-base/starting-a-nonprofit
    - NH Charitable Trusts Unit - doj.nh.gov/charitable-trusts

Other useful resources:

Maine DEP's 'Guide to Forming a Road Association - www.maine.gov/dep/land/watershed/roadassociation.html.

Common Erosion Issues and Best Management Practices for Homeowners

Below are common examples of erosion and the Best Management Practices (BMPs) that are recommended to prevent it. Erosion takes many forms and can occur naturally, but in all cases, the end result is that running water (stormwater runoff) picks up soil and transports it into the lake. These practices are designed to trap stormwater and allow it to infiltrate into the ground before it reaches the lake, while also operating as functional and aesthetic landscaping features on a property. Some BMPs are useful for residential properties and some are specifically for use on private and town-owned roads. Residential BMPs are relatively simple to install and can be done by homeowners and landscapers. Road BMPs often require heavy machinery and in some cases require engineering (i.e. culvert installation).

For additional information on Stormwater Runoff and Erosion BMPs, please use the following resources:

- BMP Manuals (Maine DEP) - https://www.maine.gov/dep/land/watershed/materials.html
- Gravel Road Manual: www.maine.gov/dep/land/watershed/camp/road/gravel_road_manual.pdf
- NH Homeowner's Guide to Stormwater Management: https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/homeowner-guide-stormwater.pdf
- Conservation Practices for Homeowners - awwatersheds.org/conservation-practices-for-homeowners

Common Erosion Issues

Gully Erosion - forms when fast moving water forms a channel on bare soil and begins to pick up and transport sediment downhill to the lake. Most visually obvious form of erosion. Smaller gullies are referred to as rills.

Shoreline Erosion - Shoreline can erode both from stormwater runoff and intense wind and wave action. The root systems of plants on the shoreline work to stabilize soil on the slope and protect it from eroding. In the absence of permanent, woody vegetation, the bank soils have no structure and can easily erode into the lake.

Sheet Erosion - Less apparent than a gully. Occurs when soil erodes in equal amounts across the landscape and the soil level lowers. Exposed roots are evidence of this. Roots naturally grow underground, so the amount of soil loss equals at least the height of the exposed roots. Sheet erosion often goes unnoticed and can lead to significant soil loss.

Best Management Practices: *Infiltration*

Infiltration Path - a trench filled with crushed stone that traps stormwater. Can replace dirt paths susceptible to runoff.

Dripline Trench - Traps roof runoff and directs it into the ground. An alternative to gutters.

Infiltration Steps - Crushed stone steps that trap stormwater instead of allowing it to flow downhill.

Best Management Practices: *Diversion*

Rubber Razor - strips of hard rubber are partially buried in the driveway, placed on an angle to divert stormwater into an adjacent trench or natural area.

Water Bars - 6"x 6" lumber is installed on a slope with crushed stone on the uphill side to trap and divert stormwater. Water bars are left slightly raised to slow water down an can be used as seen above, or placed in a pathway in shorter lengths to function as steps.

Firehose Diverter - In paved driveways, burying rubber and wood are not an option. Old firehose, or other durable material, can be filled with sand or stone and placed on an angle to divert stormwater. These have the added benefit of being movable.

Best Management Practices - *Retention*

Rain Garden - pervious detention basin designed to store stormwater during a rain event and allow it to infiltrate. Typically a trench directs water into the rain garden. Water tolerant plants are put in to uptake additional water and absorb excess nutrients.

Vegetated Buffer - The shoreline is the last line of defense from stormwater. Dense, woody vegetation slows down stormwater and the root system binds sediment together and keeps it from eroding.

Erosion Control Mulch - This chunky mulch is made of tree and stump grindings of various sizes, this allows it to bind together and trap stormwater without washing away. This is the simplest way to protect bare soil and will last for many years before breaking down.

Best Management Practices - *Roads*

Hard Pack - This is an aggregate stone material that does not wash away as easily as sand and gravel. The lack of fine materials means less sediment erosion.

Crowning - A dirt road must be slightly pitched so water will run off of it instead of forming potholes and gullies. The high point can be in the middle to direct water in both directions, or on a far side to direct all water in one direction.

Ditching - Once water is directed off the road, it should flow into a pervious ditch to allow it to infiltrate. There are various methods such as vegetation and check dams which can be used to slow stormwater down in a ditch.

Permitting and Regulations - New Hampshire

The Shoreland Water Quality Protection Act (SWQPA) establishes buffers known as "protected shoreland", located along public waters. Certain homeowner activities are regulated within the protected shoreland, which includes all lands within 250' of pubic waters:

- Lakes & ponds greater than 10 acres;
- Year-round flowing waters (streams and rivers) of fourth-order or higher;
- Coastal waters.

Waterfront Buffer Requirements

Within 50' of the reference line, ground cover and shrubs may not be removed and replaced with landscaping or lawn. They may only be removed to provide a 6' wide footpath to the water or to structures in the waterfront buffer (a shoreland permit may be required). Ground cover and shrubs may only be trimmed to a height of no less than 3'. Trees may also be pruned as long as the health of the tree is not endangered. Pruning only the bottom 1/3 of a tree is recommended to maintain property aesthetics and tree health. Pruning trees increases views while providing wildlife habitat, privacy, and retaining shade. No pesticides can be applied within 25' of the reference line, and no chemicals of any kind can be applied within 50' other than by an NH licensed professional.

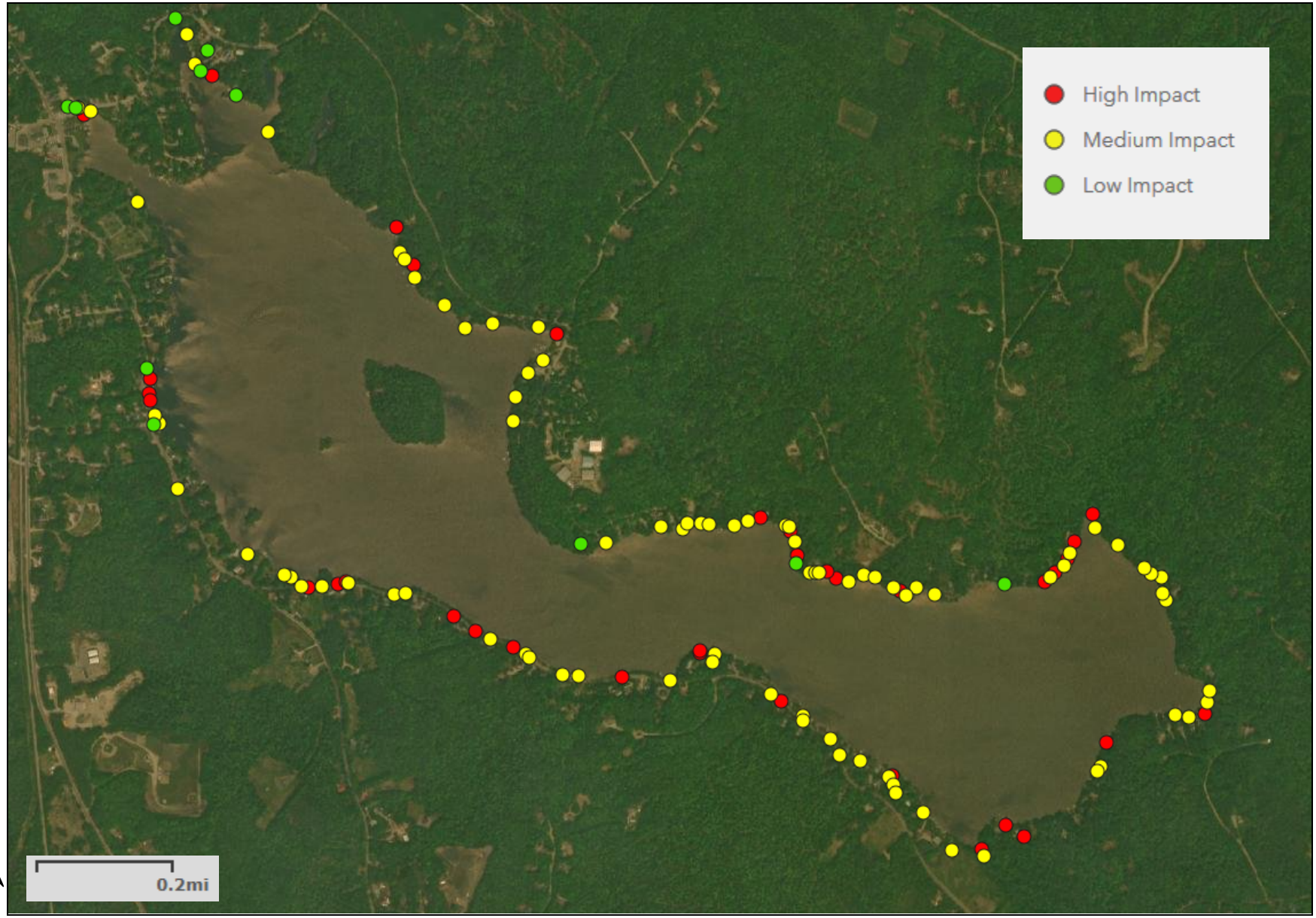
Permitting Requirements

- A shoreland permit is not required for vegetation management provided it occurs in accordance with the SWQPA.
- Any dead, diseased or hazardous tree may be cut to ground level at any time.
- An NHDES shoreland permit is required for excavation, fill, or construction within 250' of the reference line. Examples include, but are not limited to removing stumps, constructing most walkways, patios, other structures, or grading. Any earthwork or construction on the bank, in the water, or on the bed of a waterbody is regulated by the NHDES Wetlands Bureau and is subject to the NHDES Wetlands Permitting Process.
- Areas cleared of ground cover, shrubs, or trees prior to July 1, 2008 may be maintained but not enlarged.
- Before removing trees, always check local ordinances as well. Many municipalities have standards that are stricter than the NH Shoreland Water Quality Protection Act.
- Low-impact activities that propose no greater than 1,500 SQFT of impact may qualify for a shoreland permit by notification, which is a simplified permit with a faster turnaround.

To apply for a Shoreland Permit, visit the NHDES Shoreland webpage at this link: https://www.des.nh.gov/land/waterfront-development/protected-shoreland.

The Town of Wakefield also requires a Town issued shoreland permit. Contact the Town of Wakefield Land Use Office for more information.

Appendix A: Watershed Survey Map - Water Quality Impact Rating



Appendix A: Watershed Survey Map - Land Use Type of Each Erosion Site

Appendix B: Site Descriptions

Site	Impact	Cost	Technical Level	Land Use	Erosion Type	Recommendations
3-31	High	Low	Low	Road	Sheet	Vegetate Shoulder, ECM and waterbar along road
3-24	High	Low	Low	Residential	Rill	Erosion Control Mulch
3-28	High	Low	Low	Residential	Sheet	Erosion Control Mulch, Water Bars
3-30	High	Low	Low	Residential	Sheet	Erosion Control Mulch, Water Bars
1-05	High	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Erosion Control Mulch, native vegetation, crushed stone, address source in driveway
6-02	High	Low	Medium	Road	Gully	Restabilize infiltration steps; Steps refreshed and vegetation to stabilize road shoulder
5-08	High	Low	Medium	Residential	Sheet, Rill, Bare Soil	Erosion Control Mulch, Water Bars, Rubber Razors, infiltration steps
1-01	High	Low	Medium	Residential	Dripline	Native Vegetation
3-26	High	Low	Medium	Residential	Sheet	Erosion Control Mulch, Water Bars
5-02	High	Low	Medium	Residential	Rill, Dripline	Water Bars, Dripline Trench
2-01	High	Medium	Low	Residential	Sheet, Bare Soil	Erosion Control Mulch, Infiltration Path, Native Vegetation, Water Bars, Eliminate Raking leaf blowing, Reseed bare soil
6-16	High	Medium	Low	Residential	Bare Soil	Erosion Control Mulch, Native Vegetation, Infiltration Path, Reseed bare soil
6-08	High	Medium	Low	Residential	Sheet	Native Vegetation, Dry Well, Reseed bare soil
3-08	High	Medium	Medium	Shoreline	Erosion, Inadequate Shoreline Vegetation	Establish Vegetated Buffer
3-14	High	Medium	Medium	Shoreline	Erosion, Excessive Clearing	Establish Vegetated Buffer
5-06	High	Medium	Medium	Residential	Sheet, Gully, Bare Soil	Erosion Control Mulch, Infiltration Path, Native Vegetation, Water Bars, Reseed bare soil, Capture driveway runoff with trench
7-03	High	Medium	Medium	Residential	Sheet	Erosion Control Mulch, Rubber Razors, Dry Well, Native Vegetation
7-11	High	Medium	Medium	Residential	Sheet	Erosion Control Mulch, Native Vegetation, Water Bars
6-25	High	Medium	Medium	Road	Gully, Sheet	Vegetate Shoulder
3-13	High	Medium	Medium	Residential	Sheet	Erosion Control Mulch, Rubber Razors
7-04	High	Medium	Medium	Residential	Sheet	Erosion Control Mulch, Infiltration Path, Native Vegetation
7-19	High	Medium	Medium	Residential	Sheet	Erosion Control Mulch, Native Vegetation, Water Bars

Site	Impact	Cost	Technical Level	Land Use	Erosion Type	Recommendations
4-03	High	Medium	Medium	Residential	Rill, Sheet, Bare Soil	Erosion Control Mulch, Native Vegetation, Water Bars, Reseed bare soil
7-20	High	Medium	High	Residential	Gully	Erosion Control Mulch, Native Vegetation, Water Bars
6-17	High	High	Medium	Shoreline	Undercutting, Erosion	Establish Vegetated Buffer, Shoreline Stabilization
2-04	High	High	Medium	Residential	Gully, Bare Soil	Erosion Control Mulch, Infiltration Path, Native Vegetation, Water Bars, Rubber Razors, Reseed bare soil, Reveg shoreline
3-20	High	High	High	Road	Maintain existing BMPs	Install Catch Basin, Ditch & Check Dams
1-01	High	High	High	Other		
2-10	High	High	High	Residential	sheet	Erosion Control Mulch, Infiltration Path, Native Vegetation.
8-03	High	High	High	Road	Sheet , Rill	Pave Boat Launch
6-19	High	High	High	Road	Gully, Sheet	Vegetate Shoulder
5-07	High	High	High	Residential	Sheet	Driveway trench both sides
7-02	High	High	High	Residential	Sheet	Erosion Control Mulch, Native Vegetation, Repair retaining wall
7-14	High	High	High	Residential	Gully	Erosion Control Mulch, Native Vegetation, Water Bars
3-06	High	High	High	Culvert		other
1-03	High	High	High	Shoreline	Undercutting, Inadequate Shoreline Vegetation	Establish Vegetated Buffer, Shoreline Stabilization
7-15	High	High	High	Residential	Gully	Erosion Control Mulch, Native Vegetation, Engineering needed
1-02	Medium	Low	Low	Shoreline	Erosion, Excessive Clearing	Establish Vegetated Buffer
4-08	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
3-32	Medium	Low	Low	Road	Sheet	Vegetate Shoulder
1-04	Medium	Low	Low	Residential	Gully, Dripline	Erosion Control Mulch, Dripline Trench
3-25	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch
5-01	Medium	Low	Low	Residential	Bare Soil, Sheet	Reseed bare soil, Erosion Control Mulch
2-02	Medium	Low	Low	Residential	Sheet, Dripline, Bare Soil	Erosion Control Mulch, Native Vegetation, Dripline Trench, Eliminate Raking leaf blowing, Reseed bare soil
7-10	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch

Site	Impact	Cost	Technical Level	Land Use	Erosion Type	Recommendations
6-21	Medium	Low	Low	Residential	Bare Soil	Reseed bare soil, Rubber Razors, Native Vegetation, Erosion Control Mulch
1-01	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation, Erosion	Establish Vegetated Buffer
1-04	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
1-08	Medium	Low	Low	Shoreline	Unstable Access	Shoreline Stabilization, 4x4 post on top of timber to hold back sand
3-21	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
2-06	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
2-16	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
2-17	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
2-18	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
2-19	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
4-06	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
4-07	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
4-09	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
4-11	Medium	Low	Low	Shoreline	Erosion, Undercutting	Shoreline Stabilization, Establish Vegetated Buffer
6-01	Medium	Low	Low	Road	Gully	Vegetate Shoulder
3-18	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch
3-27	Medium	Low	Low	Residential	Dripline	Dripline Trench
3-29	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch
2-09	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch, Native Vegetation, Gutters to drywell
7-09	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch, Dripline Trench, Reseed bare soil
7-11	Medium	Low	Low	Residential	Rill	Erosion Control Mulch, Water Bars, Dripline Trench
4-01	Medium	Low	Low	Residential	Sheet, Rill	Erosion Control Mulch, Infiltration Path, Reseed bare soil, Water Bars, Rubber Razors, other

Site	Impact	Cost	Technical Level	Land Use	Erosion Type	Recommendations
6-03	Medium	Low	Low	Residential	Gully, Bare Soil	Reseed bare soil, Recover drive with secure road based aggregate
6-07	Medium	Low	Low	Residential	Sheet	Rubber Razors
6-24	Medium	Low	Low	Residential	Bare Soil	Infiltration Path, Native Vegetation
6-06	Medium	Low	Low	Culvert		Install Plunge Pool
2-08	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
2-11	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer
2-20	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	
2-21	Medium	Low	Low	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer, Mulch
4-04	Medium	Low	Low	Shoreline	Erosion, Inadequate Shoreline Vegetation	Establish Vegetated Buffer, Shoreline Stabilization
1-02	Medium	Low	Low	Residential	Gully, Bare Soil	Erosion Control Mulch, Native Vegetation, Water Bars
3-19	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch
3-22	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch
5-04	Medium	Low	Low	Residential	Sheet	Erosion Control Mulch, Native Vegetation
7-13	Medium	Low	Low	Residential	Rill	Erosion Control Mulch, Native Vegetation, Dripline Trench, Rain Garden
7-17	Medium	Low	Low	Residential	Rill	Erosion Control Mulch, Native Vegetation, Water Bars
4-02	Medium	Low	Low	Residential	Bare Soil	Erosion Control Mulch, Native Vegetation, Reseed bare soil
4-10	Medium	Low	Low	Residential	Sheet, Bare Soil	Erosion Control Mulch, Native Vegetation, Eliminate Raking leaf blowing, Reseed bare soil
6-09	Medium	Low	Low	Residential	Dripline	Dripline Trench
6-14	Medium	Low	Low	Residential	Dripline	Dripline Trench
6-15	Medium	Low	Low	Residential	Gully	Rubber Razors
6-20	Medium	Low	Low	Residential	Bare Soil	Erosion Control Mulch, Native Vegetation, Reseed bare soil
8-01	Medium	Low	Medium	Residential	Gully, Bare Soil	Erosion Control Mulch, Water Bars
3-07	Medium	Low	Medium	Residential	Sheet	Erosion Control Mulch, Native Vegetation
3-10	Medium	Low	Medium	Residential	Sheet	Erosion Control Mulch, Infiltration Path
1-11	Medium	Low	Medium	Residential	Sheet	Erosion Control Mulch
3-12	Medium	Low	Medium	Residential	Sheet	Erosion Control Mulch

Site	Impact	Cost	Technical Level	Land Use	Erosion Type	Recommendations
5-05	Medium	Low	Medium	Residential	Sheet, Bare Soil	Erosion Control Mulch, Native Vegetation, Reseed bare soil, Infiltration Path
5-09	Medium	Low	Medium	Residential	Sheet, Rill	Erosion Control Mulch, Infiltration Path
7-08	Medium	Low	Medium	Residential	Sheet	Erosion Control Mulch, Native Vegetation, Rain Garden
6-23	Medium	Low	Medium	Road	Gully	Vegetate Shoulder
3-04	Medium	Low	Medium	Residential	Dripline	Dripline Trench
8-02	Medium	Low	Medium	Residential	Gully	Erosion Control Mulch, Water Bars, Rubber Razors
3-15	Medium	Low	Medium	Residential	Dripline	Erosion Control Mulch, Dripline Trench
3-17	Medium	Low	Medium	Residential	Sheet	Erosion Control Mulch
8-04	Medium	Low	Medium	Road	Gully	Erosion Control Mulch, Rip Rap
2-13	Medium	Low	Medium	Residential	Rill	Erosion Control Mulch, Infiltration Path, Water Bars, Reseed bare soil
2-14	Medium	Low	Medium	Residential	Gully, Dripline, Bare Soil	Dry Well, Water Bars, Riprap
6-12	Medium	Low	High	Shoreline	Erosion, Undercutting, Inadequate Shoreline Vegetation	Establish Vegetated Buffer, Shoreline Stabilization
1-01	Medium	Low	High	Other		
2-05	Medium	Medium	Low	Shoreline	Undercutting	Establish Vegetated Buffer, Shoreline Stabilization
7-16	Medium	Medium	Low	Residential	Rill	Erosion Control Mulch, Native Vegetation
4-05	Medium	Medium	Medium	Road	Gully	Erosion Control Mulch, water bar at top of hill.
7-06	Medium	Medium	Medium	Residential	Sheet, Bare Soil	Erosion Control Mulch, Native Vegetation
6-13	Medium	Medium	Medium	Other		Culvert flowed directly to lake under porch and walk way
2-12	Medium	Medium	Medium	Culvert	Clogged	Remove Clog, Enlarge, Install Plunge Pool
7-18	Medium	Medium	Medium	Residential	Sheet	Erosion Control Mulch, Infiltration Path, Native Vegetation
6-04	Medium	Medium	Medium	Residential	Sheet	Rubber Razors
6-05	Medium	Medium	Medium	Residential	Bare Soil	Erosion Control Mulch, Dry Well, Rain Garden, Reseed bare soil, Or create safe parking area
6-10	Medium	Medium	Medium	Residential	Sheet	Restabilize driving surface, Rubber Razors
6-22	Medium	Medium	High	Road	Gully	Add road base material, Vegetate Shoulder, Crown, Turn outs
2-03	Medium	High	High	Shoreline	Erosion	Establish Vegetated Buffer, Beach erosion
2-07	Medium	High	High	Shoreline	Inadequate Shoreline Vegetation	Establish Vegetated Buffer, Perch beach

Site	Impact	Cost	Technical Level	Land Use	Erosion Type	Recommendations
6-11	Medium	High	High	Shoreline	Inadequate Shoreline Vegetation	Perched beach
7-08	Medium	High	High	Road	Gully	Install Detention Basin, Ditch & Check Dams
6-18	Medium	High	High	Residential	Sheet, Gully	Stabilized driving material for access, Rubber Razors
3-05	Medium	High	High	Shoreline	Undercutting	Shoreline Stabilization
3-16	Medium	High	High	Shoreline	Erosion, Undercutting	Establish Vegetated Buffer, Shoreline Stabilization
7-05	Medium	High	High	Residential	Sheet	Erosion Control Mulch, repair retaining wall.
1-03	Low	Low	Low	Shoreline	Unstable Access, Inadequate Shoreline Vegetation	Establish Vegetated Buffer
1-04	Low	Low	Low	Shoreline	Inadequate Shoreline Vegetation, Erosion	Establish Vegetated Buffer, Shoreline Stabilization
3-09	Low	Low	Low	Shoreline	Erosion	ECM and native vegetation
1-07	Low	Low	Low	Shoreline	Unstable Access	Shoreline Stabilization
1-01	Low	Low	Low	Residential	Sheet	Erosion Control Mulch
3-23	Low	Low	Low	Residential	Sheet	Native Vegetation
2-15	Low	Low	Low	Residential	Sheet	Erosion Control Mulch, Infiltration Path, Native Vegetation
1-01	Low	Low	Low	Residential		
1-01	Low	Low	High	Culvert		Sediment reduction
7-07	Low	Medium	Medium	Road	Gully	Turn outs
7-01	Low	High	High	Culvert	Clogged, Crushed, Undersized	Remove Clog

Contacts

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New Hampshire Department of Environmental Services (NHDES)

Watershed Assistance Section - Grants, outreach, water quality
Sally Soule Sally.Soule@des.nh.gov (603) 559-0032

Wetlands and Shoreland Protection - Permitting, enforcement, regulations
Wetlands Bureau (603) 271-2147

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