

# A Guide to Steep Slopes and Highly Erodible Land

Created For Communities in the Newfound Watershed  
by the *Every Acre Counts* project team – April 2011

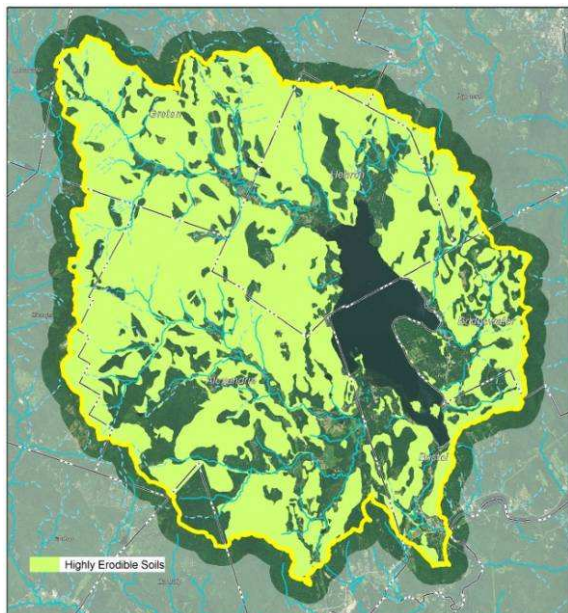
Taken together, the combination of steep slopes and highly erodible land in the Newfound watershed creates a significant threat to water quality and infrastructure if land disturbance is not carefully and pro-actively managed. With nearly 90 miles of perennial streams and rivers; 2,250 acres of wetlands; 8,680 acres of high-quality surface water; and roughly 4,000 acres of aquifer area, soil erosion has a tremendous potential to damage our economy, environment, health and safety far beyond a disturbed area. The purpose of this document is to define steep slopes and Highly Erodible Land, summarize threats from improper land use in these sensitive areas, and provide recommendations and resources to local planners and developers to manage the threats.

## What are Steep Slopes?

Many communities define steep slopes as having grades of 15 % or more, meaning that the elevation increases by 15 feet over a horizontal distance of 100 feet. Some communities also define extremely steep slopes, with grades typically 25% or more. According to mapping by the Society for the Protection of NH Forests in 2010, more than half of the land in the Newfound watershed (32,176 acres) has a slope of 15% or greater. Due to its overall steepness, one inch of rain in the watershed raises the water level in Newfound Lake by roughly ten inches within 24 hours of the rain event.

Steep slope development poses unique health, safety, and environmental challenges. For example, adverse effects on water quality as a result of increased erosion and sedimentation, especially in areas of highly erodible land. In *Every Acre Counts: The Newfound Watershed Master Plan*, protecting hillsides and steep slopes from development was identified as a priority because it helps to preserve high water quality and the environment that supports the local economy.

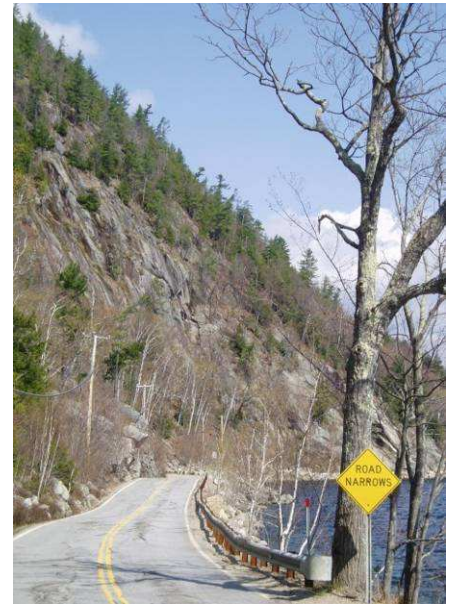
## Highly Erodible Land, Slopes Above 15%



## What is Highly Erodible Land?

Highly Erodible Land (HEL) is an official soil rating of the Natural Resource

Conservation Service (NRCS) aimed primarily at agricultural land management. The HEL rating indicates how susceptible soil is to erosion (high or potentially high). HEL is commonly located on steep to extremely steep slopes and are very susceptible to erosion if disturbed, even in the 3%-8% slope range.



More than 50 percent of the land in the Newfound watershed has a slope of 15 percent or greater.

## **Erosion and sedimentation impacts due to land disturbance:**

- 1. Destabilization of steep slopes.** Removal of trees and other vegetation may lead to erosion.
- 2. Alteration of existing drainage patterns.** May affect abutting properties, public roads, and water quality. Can result in flooding and erosion.
- 3. Stream bank erosion caused by an increase in stormwater runoff.** Erosion harmful to aquatic species and their habitats by increasing sediment loads.
- 4. Reduced potential for groundwater recharge and water supply.** Impervious surfaces prevent rain and melting snow from soaking into the ground.
- 5. Runoff of nutrients into surface waters.** Eroded sediments increase nutrients (nitrogen and phosphorus) in surface water, lowering oxygen levels, stressing native species and encouraging invasive species.

Land development typically involves removal of vegetation, alteration of topography, and covering of previously vegetated surfaces with impervious cover such as roads, driveways, and buildings. Development on steep slopes and HEL presents even more of an issue because removal of vegetative cover and its root system compromises the ability of vegetation to stabilize soil, reduce the velocity of runoff, shield the soil surface from rain, and maintain the soil's ability to absorb water. Thus, removal of vegetation leads to increased soil erosion and sedimentation of water bodies as soil is carried to streams, rivers, wetlands, and lakes.

Constructing access roads and driveways to development on steep slopes can be both technically and economically challenging while raising the cost of ongoing maintenance and risk of catastrophic failure. While the New Hampshire Department of Transportation recommends that commercial driveways not exceed an 8% grade and that residential driveways not exceed a 15% grade, these guidelines are exceeded in parts of all watershed communities. In addition, the amount of cut and fill required to meet grades disturbs an additional two to three times more land than a driveway in a flat area. As such, Towns should carefully consider impacts from access roads on steep slopes before approving a project.

### **Steep Slope Driveway in Newfound Watershed Eroded by Uncontrolled Runoff**





**Stormwater Runoff from Upslope Residential Development**

## **Regulatory Approaches for Managing Steep Slopes and Highly Erodible Land**

Existing state and federal laws protect water quality from various sources of pollution, including sediment. Land disturbance is regulated at the federal and state levels, with federal permits required for disturbances of one (1) acre or more and state permits required for disturbance of 50,000 square feet or more when any portion of the disturbance is within the protected Shoreland; 100,000 square feet or more in upland areas; or in a wetland. In addition, a state permit is required if a project disturbs any area having a 25% or steeper land slope and is within 50 feet of any surface water.

Municipalities may wish to regulate smaller areas of site disturbance because significant environmental damage can occur at levels below the acreage thresholds regulated at federal and state levels. This is especially true in areas of steep slopes and/or HEL. The model steep slope regulation referenced in the “Additional Resources” section below proposes that the regulations apply where a cumulative disturbed area exceeds 20,000 square feet. *Every Acre Counts* recommends using a 10,000 square-foot threshold to reflect the nature of the majority of development activity anticipated in the Newfound watershed.

Regulatory approaches available to local communities include:

- Zoning ordinances that regulate development on steep slopes and HEL,
- Erosion and sediment control regulations,
- A variety of approaches in subdivision and site plan review regulations,
- An administrative process to review applications and inspect development projects,
- Making development permits, plans and approvals readily available for public review (e.g. on Town web site).

As planning, implementation and oversight are most effective at the local level, local authorities are well placed to adopt practical approaches that protect water quality from development impacts. By increasing transparency

and public knowledge of the application, permitting and planning processes, public awareness and support of good building practices will likely grow, resulting in reducing runoff to surface water and protecting its quality.

Some New Hampshire communities have developed both pre- and post-construction erosion and sediment control regulations. The State offers excellent guidance for planning and low-impact development (see Additional Resources at the end of this document). For regulations and guidance to be fully effective, they must address land clearing prior to construction and include requirements for inspection and maintenance. Some towns address this need by requiring the pre-cleared condition to be the basis of stormwater calculations for post-development conditions. Other towns have begun to require construction sequencing and/or development plans that consist of a written agreement between the board and developer that covers pre-construction meetings and inspection, construction meetings, post-storm and post-construction inspections, maintenance schedules, and bonding of erosion and sediment control measures. Note that even the best regulations will only be as effective as their accompanying methods of enforcement.

## **Steep Slopes, Highly Erodible Land and Water Resources**

### **Stormwater Damage to NH Route 123 Alstead, NH**



Much of the land in the Newfound watershed that is currently zoned for development is susceptible to rapid and damaging erosion. As the risk of environmental damage increases (e.g. slopes greater than 8%, presence of HEL, size of the disturbed area, proximity to water resources), so should the level of site planning and use of Best Management Practices (BMPs).

### **How to Protect Steep Slopes and Highly Erodible Lands**

There are many structural (physical) and non-structural (administrative) BMPs that can be used to protect steep slopes by controlling erosion and sedimentation during site development. These

temporary methods address the increased amount of erosion and sedimentation that occurs during construction. Despite their temporary nature, site development BMPs are critical for preventing the erosion and sedimentation that often occur during construction when the land has been freshly disturbed.

Development in the Newfound region is primarily conversion of seasonal structures to full-time use, construction of single-family homes, or construction of small subdivisions. Due to the ready availability of developable land, there is a growing potential for larger subdivisions with multiple house lots and extensive road and drainage infrastructure. As most residential projects fall beneath existing state and federal regulatory thresholds, and the larger projects are subject to a higher level of scrutiny, permitting and professional design, we have suggested some examples of how to address development of smaller lots and single-family homes.

Each of the following examples assumes a moderate-sized home with driveway, on-site septic and drilled water supply well, built on a wooded two-acre lot. This scale of development typically disturbs between 10,000 – 20,000 square feet. Relative impacts and potential BMPs are outlined for each of the three examples.

### Example 1 – Slope < 8%, soil stable, no surface water

- Low potential impact. BMPs include: Site development and land-clearing plan (filed with Town), erosion and sediment control (mulch / seed exposed soil).

### Example 2 – Slope 8-15%, soil moderately erodible, surface water near by

- Moderate potential impact. BMPs include: Site development and land-clearing plan (Planning Board approval required); construction phasing; erosion and sediment control (silt fence, hay bales etc.); drainage control (swales, detention ponds, check dams, infiltration basins); soil stabilization (mulch / seed, jute mats); minimum 50-foot undisturbed buffer around streams, ponds and wetlands.

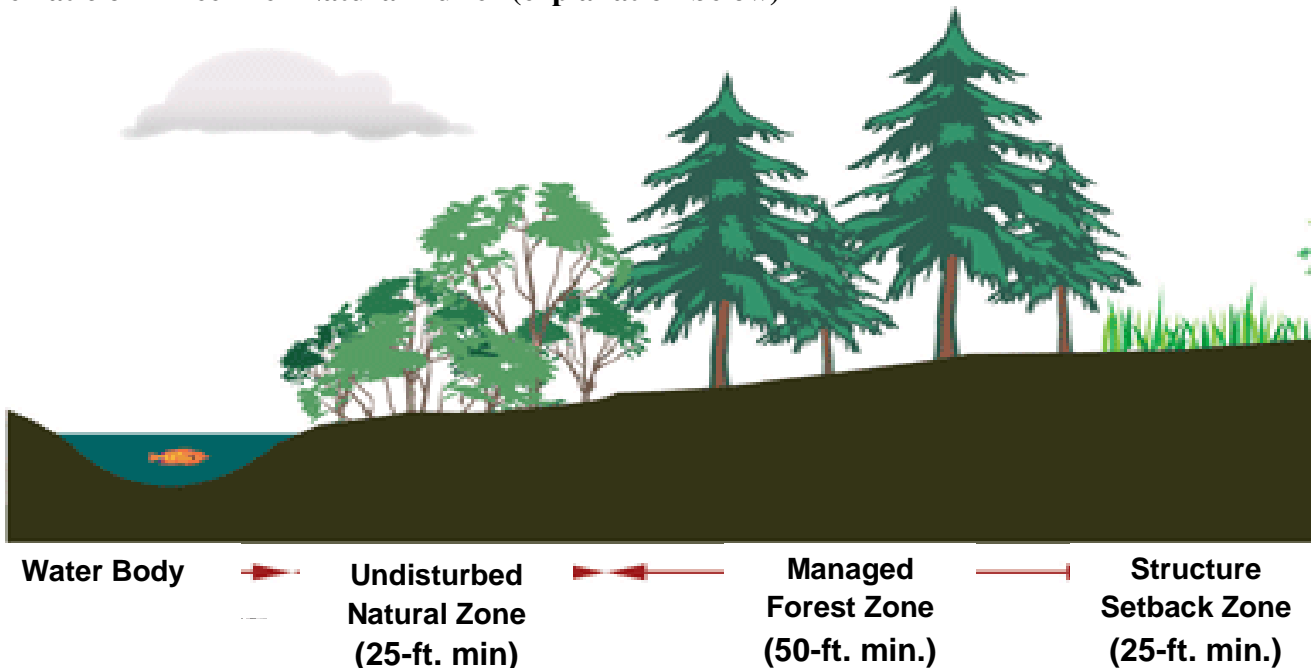
### Example 3 – Slope >15%, soil highly erodible, surface water near by

- Significant potential impact. BMPs include: Site development and land-clearing plan (Planning Board approval required); construction phasing; erosion and sediment control (silt fence, hay bales etc.); drainage control (swales, detention ponds, check dams, infiltration basins); soil stabilization (mulch / seed, jute mats); 100-foot to 300-foot undisturbed buffer around streams, ponds and wetlands.

### Natural Buffers – The Best “Local Control”

A natural buffer is a strip of undisturbed native vegetation between a water resource and nearby development. Natural buffers protect biological, chemical, and physical qualities of surface and ground water. Using natural buffers when disturbing HEL is a practical approach to meeting existing state and federal water quality regulations while providing flexibility to the property owner and local authorities. Note that using a larger natural buffer may reduce the need for more intensive engineered controls, while a smaller buffer may make engineered controls more critical.

### Schematic of Three-Tier Natural Buffer (explanation below)



The above graphic indicates a three-tier natural buffer that provides an effective and efficient means to balance land use restrictions with habitat and infrastructure protections. The total buffer width should be at least 100 feet, and wider where needed to encompass adjacent wetlands, steep slopes or critical habitat areas. Buffers provide many valuable services, including flood protection and erosion control, pollutant removal, wetlands and habitat protection, natural stream channel migration and future greenways (see *Watershed Protection Techniques* under Additional Resources).

The three-tiers of a natural buffer are summarized as follows:

- The Undisturbed Natural Zone – minimum width of 25 feet from each side of stream. Protects physical and ecological integrity. Consists of mature riparian forest. Land use is highly restricted (footpaths and limited road / utility crossings).
- The Managed Forest Zone – minimum width of 50 feet from edge of Undisturbed Natural Zone (may be wider to encompass 100-year floodplain, adjacent wetlands and steep slopes). Protects stream, provides buffer from upland development. Consists of mature forest with limited clearing for stormwater management, access and recreation.
- The Structure Setback Zone – additional 25-foot setback beyond edge of Managed Forest Zone. Protects the buffer, allows typical residential uses (lawn, gardening, compost piles, etc.), however septic systems and new permanent structures not allowed. Consists of lawn, landscaped plantings, or natural meadow and forestland.

Where space allows, natural buffers are the best means to protect water quality. As space for buffers becomes less available, engineered structures may be required to meet water quality and quantity standards. As with all investments, the costs and benefits of various methods that meet local and state performance standards must be carefully assessed before the project is approved to be sure the outcome is favorable for all affected parties.

## **Additional Resources**

Additional resources for construction in sensitive areas include:

NHDES Guide on Steep slopes and Ridgeline Development:

[http://des.nh.gov/organization/divisions/water/wmb/repp/documents/ilupt\\_chpt\\_2.2.pdf](http://des.nh.gov/organization/divisions/water/wmb/repp/documents/ilupt_chpt_2.2.pdf)

NH Stormwater Manual Vol. 3 – Erosion and Sediment Controls During Construction:

<http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20c.pdf>

SSSNNE Order One soils manual:

[www.sssnne.org/nh-vt.pdf](http://www.sssnne.org/nh-vt.pdf)

The Soils Dictionary:

[http://www.nh.nrcs.usda.gov/Soil\\_Data/soil\\_data\\_documents/datadict.pdf](http://www.nh.nrcs.usda.gov/Soil_Data/soil_data_documents/datadict.pdf)

<http://www.nh.nrcs.usda.gov/>

The Web Soil Survey:

<http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>

The Architecture of Urban Stream Buffers

*Watershed Protection Techniques*, 1(4): 155-163

## Acknowledgements

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For more information about *Every Acre Counts* or how you can be involved in protecting the Newfound Lake watershed, please contact:

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***The Newfound Lake Region Association's mission is to protect Newfound Lake and its watershed. The Association - through education, programs and collaboration - promotes conservation and preservation of the region's natural, social and economic resources.***