Lamoille County
Road Erosion Assessment

A project funded by the Vermont Watershed Grants Program and conducted by the Lamoille County Planning Commission with assistance from Watershed Consulting Associates, LLC.

December 2014

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Introduction

In 2014 the Lamoille County Planning Commission, with assistance from Watershed Consulting Associates, conducted an analysis to map, inventory, prioritize, and prepare repair designs for Class 3 and 4 road erosion sites within the towns of Belvidere, Waterville, Johnson and Eden. The purpose of the project was to 1) better understand the scope of the erosion problems along Class 3 and 4 roads, 2) to provide an inventory of erosion sites, 3) prioritize the erosion sites for impact to water quality by sedimentation, 4) provide a simple site map and erosion treatment techniques for the highest priority erosion sites, and 5) share the results with the towns and discuss the erosion treatment techniques.

The project was funded through a grant provided by the Vermont Department of Fish and Wildlife Watershed Grants Program and an agreement awarded by the Great Lakes Fishery Commission to the New England Interstate Water Pollution Control Commission in partnership with the Lake Champlain Basin Program. NEIWPCC manages LCBP's personnel, contract, grant, and budget tasks and provides input on the program's activities through a partnership with the LCBP Steering Committee. The viewpoints expressed here do not necessarily represent those of NEIWPCC, the LCBP Steering Committee, or GLFC, nor does mention of trade names, commercial products, or causes constitute endorsement or recommendation for use.

Methodology

GIS Analysis

Prior to fieldwork, a geographic constraints analysis of Class 3 and 4 town roads was conducted using ArcGIS 10.2 to identify areas prone to erosion that are likely to have an impact on water quality, to prioritize these areas for field assessment. The presence or absence of five factors – stream/road intersections, proximity of a road to stream (within 50 feet), proximity of a road to wetland (within 50 feet), steep slopes and erodible soils - was evaluated to quantify the potential for erosion likely to impact water quality. The road network within the three towns was divided into 100-foot segments, and for each segment the presence or absence of the five constraints was analyzed. Road segments having 3 or more constraints were prioritized for subsequent field surveys. Then, for each road, the number of constraints was totaled. Highlighting the overall road scores was useful for identifying general road locations where erosion and water quality impact may be present. Identifying specific points was useful for pinpointing the potential trouble spots. Maps displaying the areas prioritized for field surveys are shown in Appendix A. Field crews visited all point locations with 3 and greater constraints and all roads with a total constraints score of 90 and greater. Table 1 below provides a summary of the constraint values considered in the GIS analysis.

Constraint	Criteria	Data Source
Stream Crossings	Road / Stream intersection	Vermont Hydrography Dataset (VHDCARTO, 2010)
Stream Buffer Width	50 feet	Vermont Hydrography Dataset (VHDCARTO, 2010)
Class II Wetland Buffer	50 feet	Vermont Significant Wetlands Inventory (VSWI, 2010)
Slope	rise/run > 15%	Vermont Hydrography Dataset DEM (ElevationDEM_VTHYDRODEM, 2005)
Soil Erodibility	Kw > 0.36	Natural Resource Conservation Service (NRCS) Soil Survey (Geologic_SO, 2011)

Table 1: GIS constraints analysis parameters

Field Priority Indicators

After the completion of the GIS desktop analysis, a series of field priority indicators were developed along with a scoring matrix, which were used by field crews to rank each erosion area impact to water quality during the field mapping effort. These priority indicators included volume of runoff expected through the erosion area, the steepness of the buffer area downstream of the erosion area and upstream of the receiving water, the condition of the ground cover of the buffer area, and the opportunity for sediment deposition in the buffer area. Individual erosion areas were scored in the field as high, medium, and low, for each of these indicators. Following the field data collection, scoring for each of the field indicators was imported into an excel

spreadsheet to calculate total scores for each area. Each high, medium, and low score was assigned a value of 3, 2, or 1, respectively. In the case of the opportunity for deposition indicator, percentages of 30%, 20%, or 10% were assigned to a high medium or low score, given that depositional areas were assumed to have a weighted importance. A summary table of the field priority indicators is provided in Table 2 below. Further explanation and illustration of the indicators is provided in Appendix B. The complete scoring matrix is provided in Appendix C.

Priority Indicators	Score	Description	Note
Volume	Low	Runoff in the headwater of the road watershed	Volume indicator refers to the volume of runoff water going through and to the erosion point
	Medium	Runoff in the middle of the road watershed	
	High	Runoff low in the road watershed, near to receiving natural surface water	
Velocity/Steepness	Low	low slope, <5%	Velocity/Steepness indicator refers to the condition at and downstream of the erosion area
	Medium	moderate slope, >5% and < 15%	
	High	steep slope, > 15%	
Soil Cover	Low	stone	Soil Cover indicator refers to the condition downstream of the erosion area
	Medium	vegetation	
	High	bare	
Deposition	Low	sheet flow over well vegetated terrain/ channel with turnouts to vegetated terrain	Deposition indicator refers to the condition downstream of the erosion area
	Medium	channel flow with defined break in slope with some deposition before stream	
	High	channel flow with no slope breaks, obvious in stream deposition	

Table 2. Priority indicators for water quality scoring.

Data Collection and Reduction

Field crews walked/drove each priority road segment during the 2014 field season. Field crews carried a Trimble GeoXT GPS unit capable of 1-3 meter accuracy and a digital camera. The roadway surface, shoulders, and ditches were scanned for areas of erosion. The geographic location and extent of each erosion area was recorded by the GPS as a discrete point or as a line

along the road. The digital camera was used to take photos of the erosion sites. Field priority indicators were imported into the GPS unit as a data dictionary. This allowed customized drop down menus to be used to log the data, which significantly increased data collection efficiency. In addition to the collection of the priority indicators data, descriptive data for the erosion areas was also recorded. This included the general category of the erosion, where the erosion areas were located relative to the road, and in the case of erosion at culvert locations, specific data about the culvert. Each erosion area was assigned a unique ID that correlated with the road name. The descriptor data is summarized in Table 3, with further explanation and illustration provided in Appendix D.

Descriptors	Type	Notes
General Erosion Category	Rill	small channel that could be graded
	Incision	medium channel that could be graded
	Gully	larger channel that could not be repaired by grading
	Slump	failure of road edge or surface
	Stream/Ditch Scour	Carving of stream bank or ditch side slopes
Erosion Location	Roadway	
	Roadway Shoulder	
	Ditch	
	Ditched Stream	
	Culvert Headwall	
	Culvert Endwall	
Culvert Data (Culvert Sites Only)	Diameter	inches
	Material	metal/plastic/concrete
	Condition	poor/fair/good
	Ownership	Town/Private

Table 3. Erosion area descriptors.

GPS data was exported to ESRI shapefile format. Discrete points of erosion were stored as point features while linear erosion features were stored as line features. The descriptive data collected in the field and scoring of field priority indicators were included in the shapefile's attribute table fields.

Results

A total of 42 erosion sites were mapped in Belvidere. A map of the sites and table with summarized data is provided in Appendix E. Sites having the highest priority scores were organized into a spreadsheet and evaluated. A total of 11 sites were included on this reduced list, shown in Table 4. It was determined that none of the sites would require full engineering design.

From this list 7 sites were selected for a design repair. Design repairs, completed by LCPC and Watershed Consulting Associates, consisted of simple site plans that provide locations of the erosion area and a reference to a corresponding construction detail. The site plans also provide construction material quantity information to allow Town crews to price the specified materials. Site plans for all of the final design sites are provided in Appendix F. Construction details are provided in Appendix G.

Site ID	Road Name	Town	Erosion Type	Erosion Location	Priority
BK05	BACK RD	Belvidere	Incision	Roadway, Ditch	High
BK06	BACK RD	Belvidere	Incision	Roadway, Shoulder	High
BG01	BOG RD	Belvidere	Incision	Ditch	High
BG04	BOG RD	Belvidere	Incision	Ditch	High
BG05	BOG RD	Belvidere	Incision	Ditch	High
BG06	BOG RD	Belvidere	Incision	Culvert	High
LM01	LARAWAY MOUNTAIN RD	Belvidere	Incision	Culvert	High
LM02	LARAWAY MOUNTAIN RD	Belvidere	Incision	Roadway	Medium
LM03	LARAWAY MOUNTAIN RD	Belvidere	Slump	Culvert	High
SH01	SACKETTS HARBOR RD	Belvidere	Slump	Roadway	High
SV09	SMITHVILLE RD	Belvidere	Incision	Culvert	High

Table 4: High priority sites

The site plans, construction details, database and photo log were provided to each Town. The data will serve to help the Towns track erosion area problems, and to repair the final design sites using the Town road crews. For the sites that require full engineering design to repair, the Towns can use this information to help inform future decisions on hiring a design firm to address these areas as funding becomes available. The repair designs can also be used as supplementary documentation for future grant applications.

Conclusion and Recommendations

The Lamoille County Road Erosion Assessment accomplished the following objectives for the participating Towns: 1) an increased understanding of the scope of erosion problems along Class 3 and 4 roads, 2) an inventory of erosion sites, prioritized for impact to water quality by sedimentation, and 3) simple erosion treatment techniques for the highest priority erosion sites.

The identification and prioritization of road erosion sites along with the repair designs will help the Towns budget for and implement the necessary repairs. This will reduce sedimentation to water resources, while also reducing the need for repeated maintenance by road crews.

Local roadways that were not highlighted in the GIS desktop analysis were not evaluated, and therefore it can be expected that additional unmapped erosion areas exist on local roads in the three Towns. The GIS inventory of the erosion sites should be updated periodically to reflect repairs made to the drainage system. Once the initial 7 sites have been addressed, additional mapped sites could be targeted for repair based on the priority scoring. Sites identified for a full engineering design should also be reviewed by the Towns and prioritized for inclusion in Capital Budgets.

It should be noted that the repair designs focused on Class 3 roads, even though there were many sections of Class 4 roads that scored high on the priority indicators and thus were considered to have a detrimental impact on water quality. Because Town budgets are limited and more heavily traveled roads receive higher priority, Class 4 roads have historically received little attention. However, due to growing recognition of their potential water quality impacts, partnerships and funding opportunities to remediate Class 4 road erosion have recently emerged. Because of LCPC's 2-year effort working with communities to inventory and assess road erosion, Vermont Youth Conservation Corps (VYCC) chose Lamoille County as a priority location for implementing Class 4 road repairs leading to water quality improvements. Prior to this remediation work slated for 2015, LCPC will collaborate with the partners – Vermont DEC, VYCC, and involved Towns – to develop suitable repair designs for selected Class 4 roads.

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This project was funded in part by a Vermont Watershed Grant and the Conservation License Plate Program. Additional funding was provided by an agreement awarded by the Great Lakes Fishery Commission to the New England Interstate Water Pollution Control Commission in partnership with the Lake Champlain Basin Program.

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