Brook Creek Erosion Study

Investigation into Erosion within Brook Creek using new Mapping and Modeling Technologies

Brook Creek, GRCA, 2012

Ganaraska CONSERVATION

High Level Results

- Detailed survey information combined with state-of-the-art 3D geospatial modeling was used to conduct a comprehensive erosion control study in a residential creek in the Town of Cobourg.
- The results showed that problematic erosion in the creek occurred when flow exceeded 1.12 m^3/sec and shear stress was greater than 22.16 N/m^2.
- The study's information will allow for effective decision-making necessary for a sustainable community.

"The use of new mapping and remote sensing technology in understanding erosion in stream channels provides an added dimension to a new and evolving area of natural hazard management."

Dr. Jessica Mueller P.Geo.
GIS / Engineering Analyst
Ganaraska Region Conservation Authority

Project Context

Many small communities face flood and erosion management problems. Communities within the County of Northumberland jurisdiction are currently growing and operate on very limited budgets. Significant development has occurred in the Brook Creek watershed and more is planned. As development occurs, significant erosion problems can be created in streams experiencing urban runoff flows.
Historic residential development exists adjacent to the stream and erosion is a major concern for the community living in the lower branch of Brook Creek.

The Ganaraska Region Conservation Authority (GRCA) and the Town of Cobourg are investigating a strategy to reduce erosion in the lower branch of Brook Creek. A main component of the plan is the construction of long term flood control and channel protection facilities. Analysis has been undertaken to help define erosion control targets for the discharge of potential flood control facilities. These targets will be incorporated into hydraulic models as criteria to aid in the design of facilities and the protection of existing residents.

Challenge

By nature, creeks are dynamic and inevitably change shape over time. A thorough understanding of how a creek changes spatially and temporally is of particular importance when the creek runs through an urban center. The traditional solution for addressing erosion in streams is to identify individual sites that are eroding and conduct a site evaluation of the forces needed to create that erosion. Better tools are needed to expand the understanding of the critical flows and shears that create failures of

streams. Recent technological innovations allow for the modeling of creeks which can be used to conduct detailed erosion control studies for entire reaches of a creek system.

Project Goals

The purpose of this project is to provide cost-effective tools that will help to solve expensive flood and erosion management problems that are common in many small communities. The study goal is to utilize innovative mapping technologies to analyze erosion within the section of the main branch of Brook Creek in the Town of Cobourg, from the railroad tracks to Lakeshore Drive. A comparison of these results to traditional geomorphic rapid assessment results will be conducted.

Solution

The traditional site evaluation and analysis was first carried out for the lower branch of Brook Creek. The evaluation included:

- delineation of reaches within the section of Brook Creek targeted area
- synoptic assessment of each study reach
- detailed field survey and data collection of stream cross-sections, gradient, and bed sediment along the most impacted reach
- estimation of erosion threshold values for various hydraulic parameters along the subject reach (e.g. critical velocity, critical shear stress, critical discharge), based on the detailed survey data.

Brook Creek, GRCA, 2010

Under the Ontario Ministry of the Environment's Showcasing Water Innovation program, this study then was expanded to use survey-grade real-time kinematic (RTK) GPS in conjunction with a LIDAR-derived digital elevation model (DEM) to model the entire reach and consider the erosive forces over the entire branch and not just in a single site. These technologies include topographic data that are capable of determining maximum allowable erosion forces with a creek, while also accounting for future build out and potential stream impacts due to climate change. In doing this, new digital elevation information allowed modeling of the creek below full bank capacity. This in turn, provided estimates of shear forces and durations of these forces that are acting to create erosion throughout the creek. This approach further

allowed the evaluation of erosion within the channel under climate change conditions for the period 2040 to 2049.

For further information on the 3D modelling approach, please refer to the technical report and how-to manuals at: http://www.grca.on.ca/downloads/showcasingwaterinnovation/Supporting_Sustainable_Water_Management.pdf

Results

The following critical values were determined to create problematic erosion in the lower branch of Brook Creek:

- Flow in excess of 1.12 m3/sec; and
- Shear stress of greater than 22.16 N/m2.

It was further determined that these critical flows would occur on a frequent basis and it is therefore recommended that it would not be practical to attenuate flows to these levels. Addressing erosion in this stream will require fluvial geomorphic solutions, with some shoreline stabilization for problematic stream reaches.

Brook Creek Erosion, GRCA 2010

Next Steps

The traditional fluvial geomorphic evaluation combined with the modelling approach provides some promise of a better understanding of erosion forces in the Brook Creek. To further develop the understanding of the erosion dynamics, next steps include using more detailed routings to convey flows through the channel, as well as conducting more intensive field surveys to further define the subject reach.

Application for Ontario communities

The project provides cost-effective tools that will help to solve expensive erosion management problems that are common in many smaller communities. Many communities within Ontario are currently growing and often this growth leads to changes in runoff characteristics in adjacent streams. Expanded tools such as those used in this study, are needed to understand the critical flows and sheers that create failures of streams. This will provide communities with better information in their work to protect properties and buildings from stream erosion.

Contact Information

Dr. Jessica Mueller
GIS / Engineering Analyst
Ganaraska Region Conservation Authority
(905) 885-8173
Email: jmueller@grca.on.ca
2216 County Road 28
Port Hope, Ontario
L1A 3W4

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