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Long-term riverbank soil bioengineering effectiveness monitoring in Calgary, Alberta Canada

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Session 9: Soil Bioengineering and temporal technical construction in riverbank stability

Chair: Rauch HP. Institut für Ingenieurbiologie und Landschaftsbau, BOKU, Austria

**Keynote: Soil Bioengineering and temporal technical construction in riverbank stability.
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Review paper (Rauch HP., Raymond P.), in preparation

Long-term riverbank soil bioengineering effectiveness monitoring in Calgary, Alberta Canada

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Abstract

Healthy riparian areas provide many ecological, social and economic benefits including water quality protection, resilience to floods and drought, ecological corridors/connectivity, biodiversity and recreational opportunities. In recognition of these benefits and the importance of healthy riparian areas, The City of Calgary (The City) developed a Riparian Strategy in 2013, a Riparian Action Program (RAP) in 2016 to implement the strategy, and the Riparian Monitoring Program (RMP) in 2017 to support the goals and objectives of the RAP. The City retained a consultant team consisting of Kerr Wood Leidal Associates Ltd. (KWL) as Prime Consultant with partners Terra Erosion Control Ltd., Alberta Riparian Habitat Management Society, Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture (Irstea), and Longview Ecological to develop and implement the RMP as a 5-year monitoring program (2018-2022).

The RMP is aimed at monitoring riparian health, and the effectiveness of riparian planting and soil bioengineering techniques for riverbank protection in Calgary. Results of the monitoring program will be used to provide recommendations on system improvement including design approaches and maintenance procedures. This paper will focus specifically on the in-progress effectiveness monitoring program for riverbank soil bioengineering projects. This includes monitoring to assess post-construction site conditions and to evaluate changes resulting from the implemented projects.

Technical details for the effectiveness monitoring program for riverbank soil bioengineering projects were developed in 2017-2018 and included the following steps:

- classifying and selecting sites;
- defining the data to collect for physical structures and planted vegetation;
- developing a scoring system for each monitoring site that includes scores for project design, implementation, maintenance, and success, a new indicator specific to the RMP referred to as the Bank and Riparian Quality Index (BRQI), and a calculation for an overall score for each site by combining the individual component scores;
- developing field data forms and field data collection procedures;
- defining data analysis protocols; and,
- developing reporting templates.

Fifty-five riverbank soil bioengineering sites in Calgary were selected to be monitored at least once over the 5-year RMP.

Annual data collection, analysis and reporting began in the summer of 2018, where detailed desktop, structure, and vegetation assessments were completed according to RMP protocols at 19 riverbank soil bioengineering sites in Calgary. Observations and statistical analysis from the 2018 data have led to the following advances in understanding of riverbank soil bioengineering project effectiveness in Calgary:

- six of 19 sites were identified as failures based on vegetation survival rates of less than 25%;
- fencing around live cuttings for protection against rodent and the public appears to result in higher total live cutting survivorship;
- placing soil amendment around live cuttings results in statistically longer average leader growth;
- reusing native topsoil may result in lower invasive species occurrence;
- planting basal ends of live cuttings below the water table can lead to good survival despite harsh conditions;
- live cutting survivorship was low for most of the common species used in Calgary with a total overall average survival of 52.5% for live cuttings assessed one-year and three-years post construction;
- survivorship of rooted plants was 92% and was statistically higher than live cuttings;
- construction timing outside of live cutting dormancy periods – particularly late summer construction – resulted in very low live cutting survival;
- following best practices for live cuttings harvest, storage, handling, installation, and maintenance led to best project outcomes;
- brush layers were used in the highest-ranking sites. However, other techniques such as live staking also resulted in successful sites;
- the arrangement of timber material and the type of matting used for material containment (or absence thereof) were found to be a problem at some vegetated crib wall sites causing fill material to be washed out of the structure;
- Filling riprap voids with river gravel resulted in a wildlife friendly surface and allowed for vegetative cover; and,
- invasive species were found at all monitored sites with the most common being creeping (Canada) thistle (*Cirsium arvense*) found at 93% of sites.

On average, the riverbank soil bioengineering sites that were monitored in 2018 scored 60 / 100. The highest score was 92 / 100 and the lowest score was 8 / 100.

The 2019 data collection for 21 riverbank soil bioengineering projects is complete with results available in early 2020. The next steps of the RMP will give more accurate results on bioengineering and plant material performances and should result in new technical specifications to inform best practices.

Graphical abstract



Figure 1: RMP Site Assessment photos

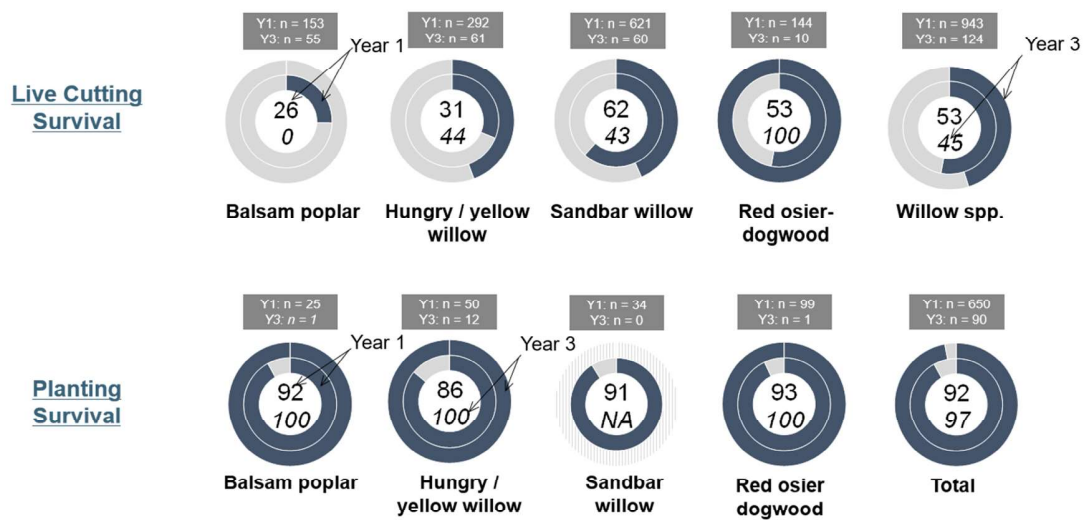


Figure 2: Measured survival (%) of common live cutting versus planting species used in soil bioengineering projects in Calgary, Alberta Canada

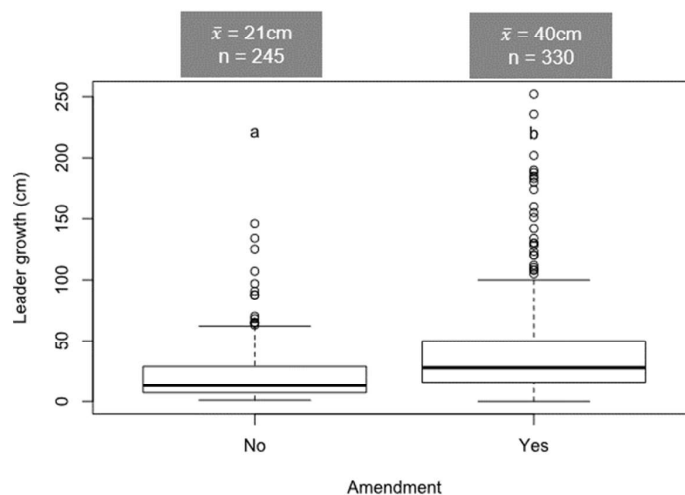


Figure 3: Statistically significant increase in leader growth of using soil amendment on live cuttings