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Case Study

Vancouver, Canada
May 31 – June 3, 2017/ *Mai 31 – Juin 3, 2017*

IMPLEMENTATION OF BIORETENTION AS A LOW IMPACT DEVELOPMENT OPTION FOR STORMWATER MANAGEMENT IN COMMUNITIES: A BARRIER ANALYSIS

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Conventional pipe systems that constitute the bulk of Canada's "stormwater management" have been shown to be unsustainable. The construction of these management systems is costly and their rehabilitation and replacement can be cost-prohibitive. Managing or controlling stormwater pollution at, or in proximity to its source likely enables more efficient and sustainable management. Consequently, many regions have turned to Best Management Practices (BMPs) or Low Impact Development technologies (LIDs), which work with the natural landscape to decentralize source control. LIDs manage urban stormwater runoff in both quantity and quality by targeting pre-developed levels. These technologies can be both environmentally and economically favourable in contrast to conventional stormwater infrastructure. Among a variety of such technologies, bioretention systems, also known as rain gardens, have been demonstrated to counteract the increase in volume and degradation in stormwater runoff quality posed by urbanization. A bioretention system generally consists of a soil bed of mixed sand/soil/organic media, a surface mulch layer below the vegetation layer and occasionally, an underground drainage system. Bioretention functions by temporarily ponding stormwater, allowing it to infiltrate into the sub-soil where it is stored and eventually it is either evapotranspired between storm events or allowed to drain out through a sub-drain to surrounding soil. The storage attenuates the stormwater (both in terms of runoff peak and volume) and the combination of soil media and vegetation promotes pollutant removal by various processes within the system, therefore, making bioretention systems highly beneficial to stormwater quantity and quality management. Numerous research studies conducted over the last two decades confirm the dual benefits of bioretention systems but they have also revealed that this technology is still immature for wide-scale application for a variety of reasons, some of which are technological and some are sociological. There is a lack of attention on how to more efficiently evaluate bioretention performance under different scenarios and how to optimize bioretention design. This is a key barrier hindering municipalities from implement these solutions as close to the stormwater source as possible – a residence.

Bioretention, which was introduced for stormwater management by Prince George's County as early as the 1990's, is a technology that integrates knowledge from multiple disciplines including engineering, hydrology, hydrogeology, ecology, soil science and landscape architecture. While the technology has been around for over two decades, we are still some distance away from implementing this technology in a distributed, pervasive way. To this end, a barrier analysis was conducted recently to further explore how to make bioretention technology a pervasive standard for stormwater infrastructure in our communities. The barrier analysis here refers to the method for determining critical paths to achieving an objective. The process begins with a desired objective, which is phrased into the form of a question: How might we achieve the objective? This question is posed to the invitees who brainstorm to identify the first hurdle or barrier that must be overcome to achieve that objective. Further hurdles are then identified by defining the action/hurdle/barrier to achieving the hurdles previously identified. For example, a group of stakeholders may have the objective of maintaining a healthy watershed and healthy supply of water for their community. The goal is framed as a question: *1. How might we achieve a healthy watershed and healthy supply of water?* The first hurdles that must be overcome right before achieving that objective might be: *1.1 Develop a watershed management plan; 1.2 Protect watershed and its supply;* and *1.3 Achieve political support, compromise and good will.* The questions are then asked as to what are the first steps to achieving each of these three barriers. Thus, the first hurdle to step *1.2* may be identified as, *1.2.1 Identify watershed stakeholders* and so on. The barrier analysis is continued until the session ends and in this way, the bottom of the tree, which may be the last few items identified in the session, is actually *the first steps* that must be taken to achieve the objective that began the session. A session that is only 30 minutes long may produce 50 separate hurdles, but inevitably in such an exercise, many hurdles require the same first steps to be overcome. The facilitator then analyses the hurdles to produce a route map initiated by a group of common first steps that reduces redundancies (effectively trimming the tree).

On September 24, 2015, researchers at the University of Calgary and the University of Victoria together with Source 2 Source Inc. engaged members of the community in a one day workshop to determine the barriers to widespread implementation of bioretention technologies in local communities. Over 20 people from industry, local government, and NGOs attended the workshop ranging in expertise from landscape architecture to ecology to municipal engineering. A barrier analysis was then conducted on the question:

> *1. How might we make bioretention technology a pervasive standard for stormwater infrastructure in our communities?*

This spawned two hurdles:

> *1.1 Make it easier to implement bioretention technology administratively and politically;*
>
> *1.2 Provide regulatory support for stormwater infrastructure with "enabling policy."*

Over an approximately 90 minute period, discussion on *1.1* produced 17 separate barriers and *1.2* produced 21 separate barriers that would have to be conducted prior to achieving *1.1* or *1.2*. Analysis of the hurdles and their relationships led to the following first steps at the bottom of the tree:

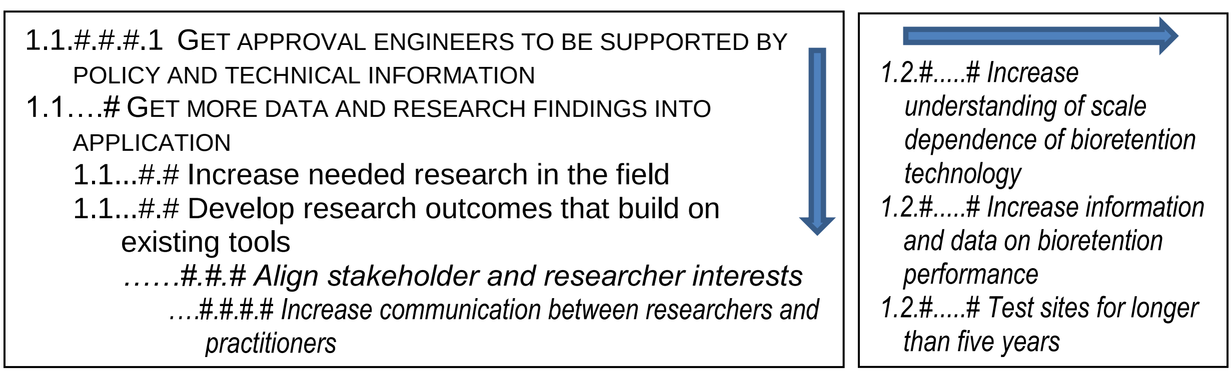

Figure 1: First steps to achieve 1.1 (left) with last step at the bottom to
be achieved firstly and 1.2 (right) where all three steps must be achieved at the same time.

This barrier analysis shows the common first steps often encountered in such analysis related to water resources problems: (a) develop a greater integration and working relationship between researchers progressing the field and practitioners governed by policy; and (b) increase funding directed towards research of critical gaps. Barrier (a) suggests engineers and engineering researchers play a more pivotal role in policy formation. The barriers specific to this analysis not shown in Figure 1 provided good insight into the relationship between the home owner as a user of bioretention technology and local municipalities.

Acknowledgements

The authors would like to thank all the participants in the workshop, which included members from the Town of Okotoks, the City of Calgary, the Bow River Basin Council, Urban Systems Limited, and the Alberta Low Impact Development Group.