Taking GREEN infrastructure mainstream

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British Columbian cities are on the cusp of taking green infrastructure (GI) mainstream. Watershed research over the past 30 years has made a solid case for GI, Low Impact Development (LID) and source controls as the best available tools for preserving and restoring the water quality and hydrology of urban watersheds. As highlighted at the 2016 International LID Conference, "Mainstreaming Green Infrastructure," most municipalities now have GI pilot programs, but the time has come to make GI a standard practice, with the ultimate goal of all urban stormwater runoff being managed sustainably.

Many of BC's urban and suburban areas have developed integrated stormwater management plans that recommend source controls for minimizing stream erosion, maintaining stream water quality and base flows and protecting aquatic life. These planning studies have encouraged new actions and approaches to stormwater management. With many planning studies complete, we now look to implementation.

Municipalities in BC and elsewhere, are in the midst of an evolution in thinking about the role of green infrastructure both in stormwater management and in how we plan and build our communities.

BC municipalities are GI demonstration leaders in projects that are recognized around the world; from the absorbent country lanes in Vancouver, to permeable parking lots in Burnaby, roadside bioretention swales in Maple Ridge and the use of infiltration bulges in the City of North Vancouver. The City of Vancouver is now taking GI mainstreaming another step forward with its ambitious *Green Infrastructure Strategy* adopted in April 2016. Vancouver is pursuing a long-term target of capturing, infiltrating and cleaning 90% of the rainwater that falls on both private and public lands in Vancouver.

CITIES TRANSFORMING IDEAS INTO ACTIONS

For many municipalities, GI approaches to stormwater management are in the early stages of development. A recent survey conducted by the City of Vancouver on 35 North American municipalities showed American municipalities generally have more advanced GI programs than Canadian municipalities. This may be a result of more stringent regulatory requirements around water quality that have precipitated action and exploration of alternatives to conventional infrastructure.

A number of the cities surveyed indicated they have been implementing GI on a pilot basis, without integrating policies, bylaws, and other agreements. According to survey respondents, the most prevalent GI tools used by municipalities are rain gardens and infiltration bulges, pervious paving, and infiltration trenches. While different tools may be deployed by different municipalities, a commonality between jurisdictions is the challenge of making GI a standard everyday practice.

INTEGRATING GI SYSTEMICALLY AND ACROSS MUNICIPAL DEPARTMENTS

Stormwater management and GI should be just as relevant to utility and water resource departments as it is to departments responsible for sustainability, land use planning, transportation, and park planning. While some planners and designers may be hesitant to reallocate resources, including land, capital and operating funds to stormwater management, there are many opportunities for co-benefits and more resource-efficient community building from thinking across traditional departmental responsibilities.

The New York City Department of Environmental Protection (NYCDEP), required to reduce combined sewer overflows, is implementing GI aggressively on all land use fronts. In a notable cooperation effort, NYCDEP developed green infrastructure standards and details in an iterative review process with City Transportation and Parks Departments. Designers in those departments can pull GI standards off the shelf for use in their projects. The city's departments have developed an accountable process to share resources and coordinate, and recognize they are implementing GI solutions that benefit each other's missions.

NYCDEP is able to use their dedicated stormwater funds to pay for the design and construction of the GI components of projects within City Transportation and Parks Departments. These departments can then leverage the GI funds to complete more and better projects. For example, the Department of Transportation is incorporating bioretention planters into curb bump outs and pedestrian refuges that help the department with its goal of increasing pedestrian safety and right-of-way green space. Through targeted GI retrofits, the Parks Department

This New York City bioswale, which might be known as a bioretention planter or enhanced tree pit in other jurisdictions, is one of over a thousand bioswales installed in New York City's right-of-ways. The city plans to have 5,000 installed by 2020. (Source: NYC Dept. of Parks and Recreation)

CREATING NEW PARTNERSHIPS AND PROCUREMENT MODELS

Prince George's County in Maryland pioneered the use of LID in the 1990s, and now they are continuing to innovate with a first of its kind stormwater public-private partnership, called the Clean Water Partnership (CWP). The CWP addresses many implementation challenges at once for the county through a 30-year agreement between the county and Corvias Solutions.

The CWP aims to implement GI practices, using a streamlined process, to capture runoff from 2,000 acres of existing impervious area by 2017. If targets are met, then the partnership agreement would take on another 2,000 acres. In addition, Corvias Solutions will be responsible for operating, inspecting, and maintaining the GI practices for the remainder of the 30-year agreement. Corvias Solutions will be paid a base fee of five percent plus incentive fees for achieving budget, schedule, and local business hiring goals.

Already, 54% of the work has been performed by local, small and minority-owned business. Meanwhile Prince George's County will also be implementing GI practices through their traditional procurement process. The county's success in implementation can then be used as a benchmark for gauging the CWP's ability to reduce costs and increase project delivery speed. With an emphasis on growing local business, creating jobs, and bringing GI to disadvantaged areas, the County Director of Environmental Protection, Adam Ortiz, considers the CWP "less a regulatory program and more of a community development program."

Stormwater runoff from the MEC store in North Vancouver is treated and infiltrated through a combination of rain gardens, a gravel infiltration gallery, permeable pavers, and underground storage chambers. (Source: Kerr Wood Leidal Associates Ltd.)

NEXT STEPS

The municipalities that make the most progress in implementing green infrastructure are those with council and executive leadership that make it a priority. Sustainability goals laid out in planning documents can be easily ignored or postponed if the leadership is not championing them. The leadership's budgeting power for green infrastructure is important, but just as important is the power to change the business-as-usual mind set and get city departments to collaborate.

We now know how the basic suite of GI practices and design principles work. As we enter the mainstreaming GI phase, we must now pilot strategies for wider implementation of GI. These strategies will include funding mechanisms, development regulations, outreach and incentive programs, innovations in maintenance and operation, and collaborations between city departments and professional disciplines. These strategies are not one-size-fits-all, but there are many lessons that can be learned from each other's efforts.

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benefits from new paving when subsurface stormwater storage gets placed under basketball courts or when degraded landscape areas get upgraded with bioretention landscapes, without sacrificing recreational park space.

Beyond New York, other cities are also grappling with how to be holistic in the planning and implementation of GI. The City of Portland, after a successful green street pilot program, took green streets mainstream in 2007 through the adoption of a policy requiring onsite stormwater management for all right-of-way projects and the establishment of a funding mechanism for GI practices. As of 2015, The City of Portland had 1,783 green street facilities.

ENGAGING THE PUBLIC IN GI

Perhaps the most well-known GI project in North America is the wildly successful Seattle Street Edge Alternative (SEA Streets). This residential street design alternative uses bioretention swales instead of traditional curb and gutter, to filter and retain road and lot runoff. The SEA Streets have become popular neighborhood destinations for residents to walk. As a result, many residents have nominated their own streets for the treatment, giving city planners the opportunity to be selective with future projects and work only with streets that have full buy-in from residents. The success of these projects can be attributed to a thorough community outreach process and Seattle's stormwater experts taking an active role in the design, plan review, and construction monitoring.

In contrast, in 2010 Seattle rushed the design and community outreach for a group of bioretention retrofits in the Ballard neighborhood to take advantage of stimulus funding. The geotechnical work and reviews were inadequate and resulted in long-term ponding in the bioretention curb bump-outs. The community backlash called for the removal of the bioretention. After an investigation, some bioretention was removed while some was corrected with underdrains and modified grades. Seattle has incorporated the lessons from this experience into their current GI program. As part of a wider GI implementation strategy, Seattle is working towards capturing runoff from 10% of all right-of-way impervious areas by 2025.

OPERATION & MAINTENANCE FOR GI IN THE FIELD

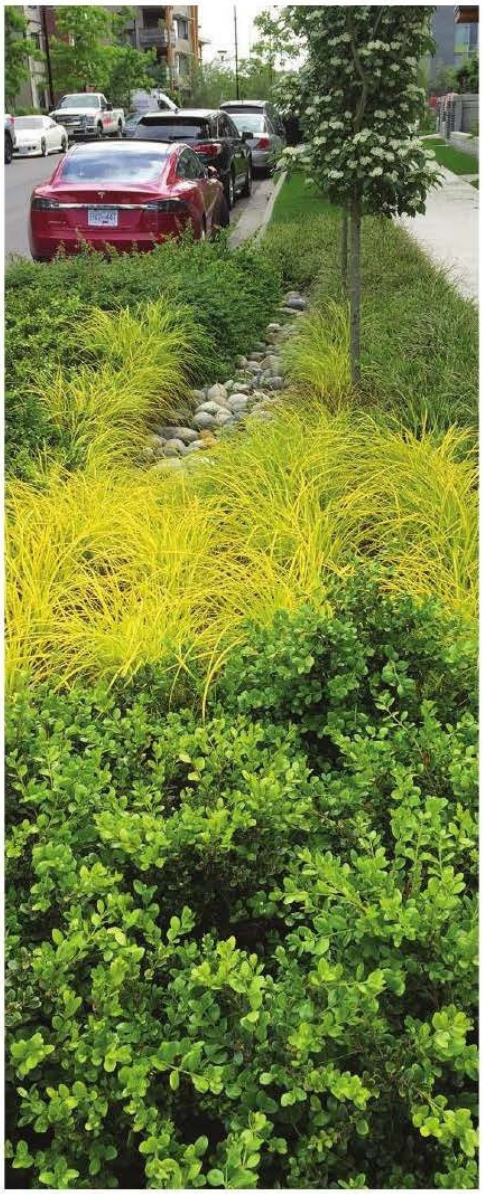
Operations and maintenance departments are chronically stretched thin and may be naturally resistant to taking on the maintenance of more stormwater assets. The prospect that green infrastructure may require new skills and equipment to maintain them is also intimidating.

Many cities are using solutions, like this Rain Guardian inlet near Minneapolis to enhance bioretention function, speed up maintenance, and improve aesthetics. (Source: Rain Guardian)

Better stormwater management to keep streams healthy will never be free of maintenance, but municipalities are developing GI approaches that use resources efficiently and work with existing skill sets and equipment.

Many municipalities have found landscaping approaches that fit with their urban context and existing maintenance resources; they have ruled out complex plantings that are difficult to maintain. The City of Mississauga, Ontario favors a simplified planting plan that uses two or three distinctive plants in a formal design which allows staff without plant expertise to know intuitively what plants belong and what is pulled. In a similar vein, the University of New Hampshire Stormwater Center has found that a mowed turf bioretention provides similar stormwater benefits to a wild naturalized bioretention. Municipalities can choose the stormwater landscape options that work best for them.

Rock-lined forebays, often used for pretreatment at GI inlets, quickly become unsightly with sediment and debris and are difficult to clean out. Many municipalities are favoring catchbasin sumps or inlet structures like the Rain Guardian that both hide sediment and debris and allow it to be removed efficiently with shovels or vacuum trucks.



This rain garden in a curb bump-out in the East Fraser Lands neighborhood of Vancouver is an example of a simple, easily maintained, but attractive bioretention landscape. (Source: City of Vancouver)

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