OCTOBER 2016

SITELINES

Landscape Architecture in British Columbia

GREEN + BLUE INFRASTRUCTURE

Adapt or Retreat: The Future of Richmond | Green+Blue Parallels from Down Under | Inspiring Innovative Urban Water Management | Rainwater Harvesting and Management | Resource or Hazard? Stemflow from Urban Trees | BCWF Wetland Institute 2015 | St. George Rainway | Green Infrastructure and the Art of Persuasion

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450–355 Burrard St. Vancouver, BC V6C 2G8

T 604.682.5610
F 604.681.3394
TF 855.682.5610 *(Canada and US)*
E office@bcsla.org
admin@bcsla.org
W www.bcsla.org
www.sitelines.org

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SITELINES GROUP

GUEST CO-EDITOR	Julie Taylor Schooling, MSCES, MBCSLA
CO-EDITOR	Stephanie Nguyen 604.682.5610
ADVERTISING	Tara Culham 604.682.5610 fax: 604.681.3394
GRAPHIC DESIGN	Addon Creative 604.379.5943
PRINTING	Initial Printing Inc. 604.669.2383

The purpose of Sitelines is to provide an open forum for the exchange of ideas and information pertaining to the profession of landscape architecture. Individual opinions expressed are those of the writers and not necessarily of those of the BCSLA.

Green+Blue Infrastructure:

Global Issues, Local Initiatives (and Some Rebranding!)

Julie Schooling, MScES, MBCSLA

When I started brainstorming about this issue of Sitelines with Ray Visser and Keith Nyhof (thanks to both!), I believed the articles would focus on the technical and environmental aspects of green infrastructure as it relates to water quantity and quality (see sidebar definition). And yet every author has emphasized how intertwined the social and economic dimensions of our "watershed assets" are with their ecological benefits. Kevin Connery leads off with the global-scale challenge of sea-level rise, and imagines solutions in Richmond inspired by case studies in New York and Europe (but how to gain public buy-in to difficult decisions?). Kim Stephens draws parallels between made-in-BC solutions and those "Down Under," noting cultural differences but the common need to adapt. Randy Sharp and Amy Greenwood introduce us to 'Salmon-Safe' certification, and present an inspiring case study of the award-winning Mountain Equipment Co-op Head Office in Vancouver. Ken Nentwig describes rainwater harvesting and management tools and practices along with incentive approaches to motivate adoption of the techniques! I then invite you to "think like a raindrop" as I share highlights of my MScES thesis project on tree characteristics that can influence site hydrology. Christina Walkden outlines her experience at the seven-day Wetland Institute held by the BC Wildlife Federation: she emphasizes that her interactions with other participants, from various disciplines and walks of life, was a highlight in itself! Sarah Primeau uses images to pique our curiosity about the St. George Rainway: a community deeply engaged, and a younger generation motivated to action! Finally, Shasta McCoy issues a challenge to all of us to tackle "watershed illiteracy and suburban aesthetic preferences" by appealing to people's values and emotions – by fundamentally rebranding Green+Blue Infrastructure, one bioswale at a time! SL

> A Blue-Green City aims to recreate a naturally oriented water cycle while contributing to the amenity of the city by bringing water management and green infrastructure together. This is achieved by combining and protecting the hydrological and ecological values of the urban landscape while providing resilient and adaptive measures to deal with flood events. Blue-Green Cities generate a multitude of environmental, ecological, socio-cultural and economic benefits.
>
> BlueGreenCities (http://www.bluegreencities.ac.uk/bluegreencities/index.aspx)

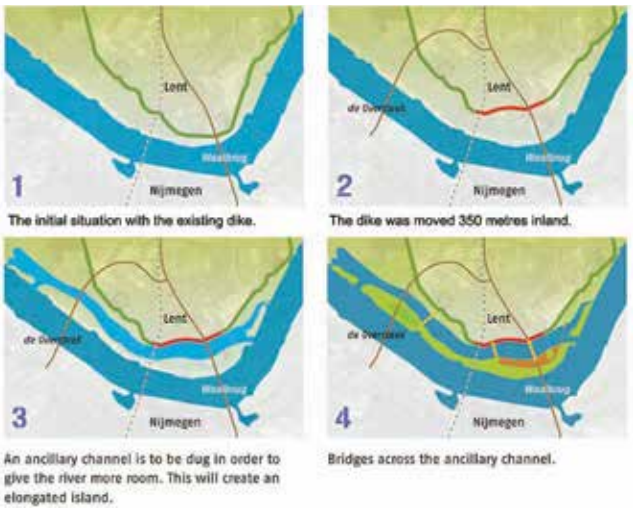
Cover Image: McArthur Island Park, Kamloops, BC.
Photo Credit: City of Kamloops

In this Issue:

Kevin Connery, MBCSLA

Adapt OR Retreat:

The Future of Richmond in the Face of Sea-level Rise



Based on a presentation given at the 2016 BCSLA Annual Conference — *Shifting Currents: Rethinking Our Relationship with Water*

After decades of debate and inaction on climate change, the Paris Agreement of 2015 finally recognized humanity's contribution to a warming planet and rising seas. The City of Richmond welcomed this agreement! At an average of 1m above mean sea level (MSL), the City's deltaic location is highly vulnerable to rising seas. Local high tides range from 1m above MSL during normal tidal cycles to 2m above MSL during 'spring' tides. Without perimeter dikes, parts of the City would regularly flood; during combined high tide and storm-driven wave surges, the whole City could be underwater.

Richmond's very existence depends on an extensive network of dikes, pump stations, pipes, and watercourses which prevent inundation. In 2011, the British Columbia government released its Sea Dike Guidelines as direction for the province's low-lying cities responding to sea-level rise. Factoring in Richmond's ongoing subsidence, the City's target is to raise its dikes by 1.2m by 2100 (reflected in the City's current upgrade program). However, recent climate change research indicates the Province's targets are likely too conservative and that sea-level rise will be closer to 2m by 2100. More troubling is that if the Paris Agreement fails, like Kyoto and Copenhagen before it, sea-level rise by 2100 could be much higher!

Even a 2m sea-level rise scenario presents profound economic and social questions as to how Richmond adapts. Do the dikes get raised 2.2m instead of 1.2m? Is there room to accommodate higher dikes without appropriation of large tracts of private property? What alternative protection strategies could be used? Who would pay for such a multi-billion-dollar exercise? How long will the dikes protect the City given that sea levels are expected to rise more than 2m, post-2100? And when do we contemplate managed retreat?

These questions are not unique to Richmond. Low-lying cities globally wrestle with the conundrum of protecting, accommodating and/or retreating. '***Protection***' makes short-term sense due to the value of existing infrastructure and assets. However, if seas rise as projected, protection becomes prohibitively expensive. '***Accommodation***' is an appealing mid-term proposition to retain development, in-situ, by armoring development to withstand some flooding. '***Managed retreat***' is a long-term scenario, requiring a paradigm shift that (barring catastrophic flooding) is unlikely to garner enough public support. Intriguing examples of each offer some lessons.

On October 29, 2012, Hurricane Sandy ravaged New York City, causing 43 deaths, ►

HIGHLIGHTS

1. Make infrastructure multi-functional! Flood protection, recreation, ecological enhancement...

2. Work together and learn from others! All levels of government, private landowners, non-governmental organizations...

3. Adapt and accommodate! Past strategies are futile against projected change...

Above Left: Terraced Dike Face: Middle Arm Fraser River, Richmond, BC. Photo credit: City of Richmond. **Above Right:** Relocated Dikes, Room For The River Program: Nijmegem, Netherlands. Photo credit: www.ruimtevoorderivier.nl.

flooding 17% of the City, leaving almost 2 million people without power, and doing $19 billion in damage. Post-Sandy, a design competition explored solutions to protect NYC from future hurricanes. One winner, The Dryline, by BIG, proposes a series of terraced berms, sea walls, and flood gates along the East River and Lower Manhattan to protect the City from flooding and storm surges while creating park and recreational spaces.

In Hamburg, Germany, HafenCity, a former inner-city brownfield site undergoing mixed-use redevelopment, is designed to 'accommodate' floodwaters and sea-level rise. Notably, buildings and infrastructure (e.g., roads, bridges, utilities) have been elevated well above MSL while a 15m wide continuous public open space encircles the development at the historic elevation of the quays to maintain river access.

No country has more history battling inundation than the Netherlands where 55% of housing is vulnerable to flooding; however, climate change has convinced them that building higher dikes is not the answer. The country's 'Room for the River' initiative involves 'managed retreat' through relocating dozens of dikes to accommodate rivers. In Nijmegen, a dike is being moved 350m inland, a new channel will absorb floodwaters of the river Waal, and an urban river park in the heart of Nijmegen is being created.

Ultimately, climate change demands that we think more creatively about how we build and operate our cities. Rather than simply building higher dikes or seawalls, we have opportunities to reconfigure cities to respond to rising seas while providing valuable ecological and recreational benefits. SL

Resources:

1. The following website features the design competition that responded to the range of problems left in the wake of Hurricane Sandy and its climate change implications. **http://www.rebuildbydesign.org/**
2. This is an informative climate change web site. **http://climate.nasa.gov/**

Flood Control Plinths: HafenCity, Hamburg, Germany. Photo credit: www.HafenCity.com.

Green+Blue
Parallels from Down Under

Kim A. Stephens, M.Eng., P.Eng.Executive Director,
Partnership for Water Sustainability in BC

In 2001, Kim Stephens was keynote speaker for a conference and training workshop organized by a coalition of local governments in New South Wales, Australia. It was a seminal moment for cross-pollinating Australian and British Columbia (BC) experience, and for relationship-building. At that 2001 event, Kim Stephens remarked on our parallel worlds and how they revolve around a shared vision for Water Balance management.

Fast forward to August 2016. His keynote presentation at Stormwater 2016, a national conference held in Queensland, Australia, provided a platform for reflecting on our parallel journeys during the period 2001 through 2016, and for looking ahead. He explained how BC is responding to a changing climate, and he compared Australia's "top-down" type of governance with BC's "top-down & bottom-up" approach to implementing changes in water and asset management practices.

Towards a Water-Resilient Future

Green+Blue. How well are we doing in BC, really? Time and distance provide perspective. Two keynote presentations in Australia over a 15-year period allowed me to view our BC situation in a comparative context. BC and Australia are on parallel journeys, but our pathways to a **water-resilient future** differ. Still, by sharing and comparing, we can inspire each other. Also, we can learn from each other's experience to avoid going down dead-ends.

In 2001, the challenge on both sides of the Pacific was HOW to overcome fear and doubt. Conventional wisdom at the time questioned whether Green+Blue approaches would work. Trans-Pacific sharing and learning helped to overcome fear and doubt. In 2016, the spotlight is on GETTING IT RIGHT.

Judge progress by the distance travelled, not the distance remaining. Although BC is progressing, communities must continually strive to do better by implementing Green+Blue practices that would achieve a water-resilient future, over time. BC experience over the past 15 years demonstrates that "designing with nature" does make a difference.

To prepare for my 2016 keynote, I interviewed a cross-section of "water thought leaders" from across Australia. These conversations helped me identify over-arching themes that then shaped my storyline and its relevance to an Australian audience. When I reflected on the differences in our approaches, it reinforced my appreciation for the transfor-mational potential of our "top-down & bottom-up" approach.

Bringing about change in practices ultimately depends on alignment between decision-makers in local government and community champions. As BC case study experience shows, such an alignment can be a powerful combination. Once everyone agrees on expectations and how all the players will work together, each community can reach its goals in its own way.

Towards Sustainable Watershed Systems

In my 2016 keynote, I introduced Australians to three "big ideas" that underpin where we are heading in BC, namely: **Primacy of Hydrology, Shifting Baseline Syndrome,** and **Cathedral Thinking.** The three are interconnected. The outcome would be Sustainable Watershed Systems. ►

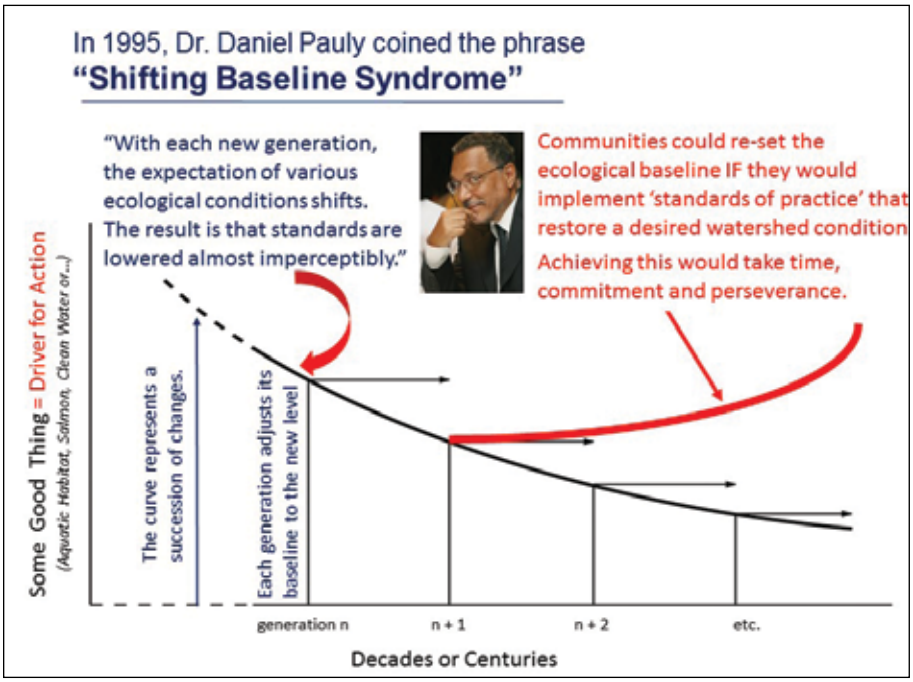


Figure 1: Shifting Baseline Syndrome illustrated. Graphic credit: Kim Stephens

'Convening for Action' experience shows that success will follow when local governments...

- Choose to be enabled
- Establish high expectation
- Embrace a shared vision
- Collaborate as a 'regional team'
- Align and integrate efforts
- Celebrate innovation
- Connect with community advocates
- Develop local government talent
- ***Promote shared responsibility!***
- Change the land ethic for the better

- Changes in hydrology, not water quality, must be the primary focus of Green+Blue practices. If we get the hydrology right, water quality typically takes care of itself, especially in a residential development.
- Coined by University of British Columbia's Dr. Daniel Pauly, the Shifting Baseline Syndrome describes an incremental and imperceptible eroding of expectations and standards that results from each new generation lacking knowledge of the historical condition of the environment (Figure 1).
- The good news is that redevelopment creates an opportunity. If we can get the hydrology right the second time, and restore the water balance, we can then reset the ecological baseline.
- Achieving this outcome would take time, intergenerational commitment, and perseverance. This is the essence of "cathedral thinking" which describes our BC vision for Sustainable Watershed Systems.

In embarking on the journey to a water-resilient future, we can learn from our ancestors. The foundation for cathedral thinking is a far-reaching vision, a well thought-out blueprint, and long-term implementation.

These ideas resonated with the audience in Australia and opened eyes and minds to a different way of thinking.

Rod Wiese, a member of the Stormwater Australia Board provided this perspective in his conference presentation: "It is evident that Australian 'best practise' (which is founded on water quality metrics) falls dramatically short of effective waterway protection. Clearly, we need to manage volume and restore water balance pathways as Kim Stephens explained in his keynote about the **primacy of hydrology**." This seems a promising sign that both experience and inspiration have once again been shared. SL

INSPIRING INNOVATIVE URBAN WATER MANAGEMENT WITH SALMON-SAFE STRATEGIES

Randy Sharp, FCSLA, ASLA, LEED® A.P., G.R.P. and
Amy Greenwood, MSc, Fraser Basin Council

Based on a presentation given at the 2016 BCSLA Annual Conference — *Shifting Currents: Rethinking Our Relationship with Water*

Top: Great Northern Way is subject to flooding during intensive storm events.
Centre: Sedges, rushes, and irises in a series of rain gardens.
Bottom: Accessible green roof and urban agriculture. Photo credits: Randy Sharp.

Vancouver City Council recently approved the Integrated Rainwater Management Plan (IRMP), setting out a general direction and targets for water management and green infrastructure in the City for the next 50 years. The initiative supports the establishment of an interdepartmental task force consisting of Transportation Design, Streets Design, Sewers Engineering and Operations as well as Planning and Park Board staff, to collaborate and to identify specific ways to implement innovative rainwater management strategies. Setting a precedent in green infrastructure for Vancouver, Mountain Equipment Co-op's head office became the first urban site in Canada to achieve 'Salmon-Safe' certification.

Why green infrastructure and why now? Vancouver receives an average annual rainfall of 1,457mm over its 114km² surface area of which about 60% is impermeable. This results in approximately 100 billion L of largely untreated stormwater flowing into the Pacific Ocean each year. City Engineering is part way through a program of separating storm and sanitary sewers to minimize the occurrence of combined sewage overflow (CSO) events; however, it will take another 50 years to install and connect the separated pipes. During major rainfall events, the existing combined sewers exceed capacity, resulting in raw sewage flowing into English Bay, Burrard Inlet, and the Fraser River. As climate change brings more intense and frequent rainfall events, the amount of CSOs is expected to increase.

The City, and many design professionals, have realized that by implementing a range of green infrastructure solutions for urban sites and the public realm, we need not rely solely on under-ground storm sewers to convey rooftop and street runoff. The Fraser Basin Council (FBC) and Pacific Salmon Foundation (PSF) are promoting and incentivizing water management best practices through Salmon-Safe certification. In 2011, FBC and PSF collaborated to "raise the bar" on land and water management practices across a range of urban and agricultural land uses.

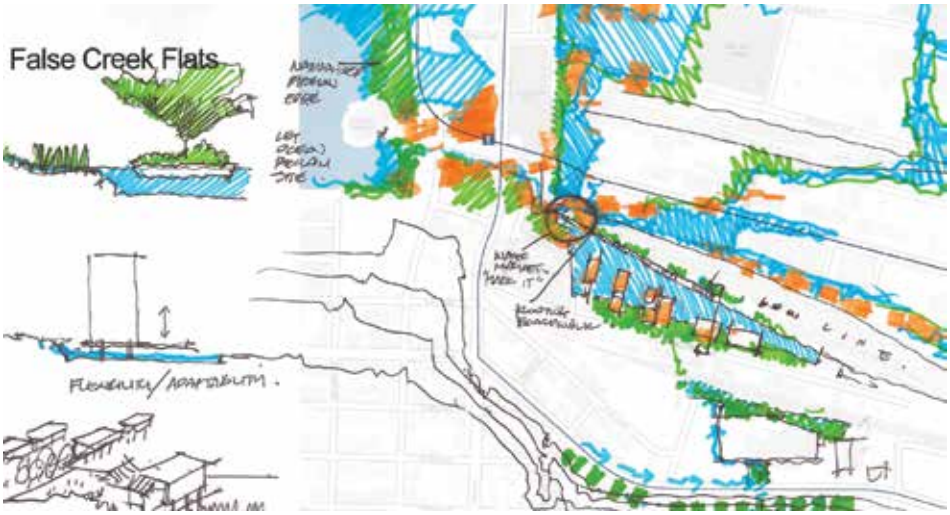
Salmon-Safe site certification involves a detailed review of environmental management policies and practices along with a site inspection and assessment by a team of independent Salmon-Safe experts. Teams use scientific, performance-based criteria to verify compliance with Salmon-Safe land and water management standards. These standards cover a range of categories to protect and enhance water quality:

- stormwater management, including sediment and erosion control;
- chemical containment;
- contribution of the site to overall ecological function; and
- protection or restoration of riparian habitat.

Salmon-Safe is governed by the principle that "everything is interconnected," and recognizes that land management practices upstream of a watercourse can have negative – or positive – impacts on water quality and habitat. As such, a site can be certified even when no watercourse is present.

In 2015, Mountain Equipment Co-op's head office (MEC HO) in Vancouver became the first urban site in Canada to achieve 'Salmon-Safe' certification. During the assessment process, the Salmon-Safe assessment team noted MEC's strong commitment to water sustainability and innovative approaches to environmental best practices both inside and outside the building, such as:

- using rainwater that is harvested, stored, and filtered in a 60,000L cistern, for flushing toilets and irrigating rooftop gardens, effectively reducing non-potable water use by 55%; ►



Overleaf: One of the sketches from a design charrette facilitated by Amy Greenwood and Randy Sharp for the False Creek Flats during the BCSLA Blue Green session. For context, see: http://falsecreekflats.ca/

- capturing stormwater generated from impervious surfaces in the parking lot and biologically treating it in rain gardens;
- using drought-tolerant native plants throughout the landscaping features;
- using no pesticides, herbicides, or chemical fertilizers;
- periodic soil testing and using slow-release organic fertilizers or compost if needed; and
- comprehensive site remediation process to remove historically contaminated soil and cap the remaining soil to ensure no contact/ contamination of water leaving the site.

In addition to energy efficiency and greenhouse gas emissions reduction, water management was a major driver in MEC's design of the building, the mechanical systems, and the site. Clear rainwater is collected on a white thermoplastic polyolefin (TPO) membrane over the fifth floor, then filtered and stored in a cool cistern. Sedges, rushes, and irises biologically consume hydrocarbons, oil, grease, and brake pad metal from vehicles. The green roof provides flowering plants for pollinators and the waterfall, clearly visible at the entrance to the building, is an architectural feature to celebrate rainfall during and after a storm event. The nutrient-rich water cascades down the side of the building, then flows through a series of pools, channels, rills, and rain gardens, easily accessible from adjacent pathways. The playful use of water is very visible and engaging for staff, visitors, and the public passing by the site.

A special feature of this living building is an accessible green roof. When planning the building, through a series of workshops, MEC staff expressed a strong interest in places to go outside to gather, collaborate, and enjoy nature in quiet contemplation. To address this and support the priority MEC places on the health, happiness, and productivity of occupants, the green roof was designed to include raised planters for urban agriculture along with custom benches, picnic tables, and a BBQ area as an informal gathering place to enjoy food harvested from the planters and encourage interaction between MEC staff. The MEC site gives back to both the community and to the environment: fresh air, contact with nature, wildlife habitat, and most importantly, clean water for the salmon and species that live in our coastal waters. In 2015, MEC received an Award of Excellence from the Canada Green Building Council (see Resources below), and is working towards LEED Platinum certification.

The MEC HO is part of the False Creek Flats industrial area, which is undergoing a re-visioning process to create a green-jobs hub and eco-district in the inner part of the city. During the planning process, participants recognized the important ecological past of the Flats. By daylighting historic waterways, implementing continuous green infrastructure, and planting high-canopy trees to 'cool' public places, the Flats will be transformed into an engaging public space while strengthening resilience to climate change. This was a recent topic of conversation at the BCSLA Annual Conference in Vancouver where delegates participated in a mini design charrette to envision how water and biodiversity could be incorporated as central themes in the False Creek Flats visioning and redevelopment process.

In summary, the MEC Head Office is raising the bar for living architecture in the urban realm. It sets a clear precedent for water management while sparking innovation and attracting green enterprise to the False Creek Flats. MEC's approach to collaborative engagement and planning from the outset challenged and inspired the design team and contractors to produce outstanding results. Achieving Salmon-Safe certification for site-wide water management practices clearly demonstrates MEC's position as a sustainability leader. SL

Project Credits:

Owner/Developer: Mountain Equipment Co-op | Architect: Proscenium Architecture and Interiors Inc. | Landscape Architect: Sharp & Diamond Landscape Architecture Inc. | Mechanical and Electrical Engineer: Pageau Morel and Associates | Green Building/Development Manager: Corin Flood | General Contractor: Ventana Construction Corporation | Landscape Contractor: North by Northwest Ventures | Green Roof Materials: Soprema, Eterra and Architek

Resources:

To find out more about Salmon-Safe best practices for water management, visit:
www.salmonsafe.ca and www.fraserbasin.bc.ca/water_salmon-safe.html .

For more on MEC's Salmon-Safe certification and best management practices, visit:
http://www.fraserbasin.bc.ca/_Library/Media/mr-ssbc-mec-certification_Oct_23_2015.pdf

For highlights of MEC HO's Canada Green Building Council Award of Excellence, see:
http://www.sabmagazine.com/uploads/editor/documents/2015%20awards%20material/2015%20winners%20pdfs/MEC%20HEAD%20OFFICE.pdf

Rainwater HARVESTING AND MANAGEMENT

Ken Nentwig, MLA, CLM, CLD, ARCSA AP

Based on a presentation given at the 2016 BCSLA Annual Conference — *Shifting Currents: Rethinking Our Relationship with Water*

Around the world, the existing paradigm of 'water as infinitely available' is rapidly being replaced with 'water as a finite resource'. Current practices of treating excess runoff from the built environment as waste result in depletion of groundwater resources, increased pollution, and habitat modification. On-site management of our precious water resources is imperative and far preferable to translocation of water to distant outfalls.

Decades of constructing impervious cover over the landscape have created deserts under our feet and floods in over-stressed storm drain systems. Climate change is compounding the issue with more intense storms than designed systems can accommodate. Soil moisture, essential for the health of all life below and above ground, is a critical factor that landscape architects can manage. Design for the judicious use of rainwater on-site is becoming more popular, yet objectives are not always well articulated, especially when applying current-paradigm design criteria.

Humans are huge water-wasters: Canada-wide, we average 300L per person per day for domestic use — among the highest in the world. About one-third of treated (potable) water goes to outdoor applications such as irrigation, and one-quarter to flushing. By reducing demand and conserving water, we can reduce these numbers, but other problems remain. Using treated, potable water to meet non-potable demand strains supplies during the summer, and can restrict community development. Meanwhile, a free and untapped resource is quietly diverted out of sight and mind as excess waste to be disposed of.

Drivers of change include awareness and incidents of disaster — both are currently growing. The media is paying attention to major problems with existing infrastructure capacity and is showcasing more responsible plans and practices. Municipalities are seriously addressing capacity issues through stormwater charges in various formats. Responsibility for rainwater management, and the associated price tag, is downloaded to property owners, a tactic that gets an immediate response. Through harvesting and controlling rainwater, stormwater runoff problems can be mitigated or eliminated. Detaining water on-site delays and reduces outflow volumes; retaining water on-site eliminates some or all outflow and increases groundwater reserves.

Incentives for managing rainwater include rebates on rainwater harvesting (RWH) system installation, or credits on stormwater charges, and vary widely among jurisdictions. An increasing amount of research on water management and water quality points to the value of RWH as a management tool for a host of problems. Using calculations based on potential demand for rainwater uses, local climate conditions, and catchment type and area, we can estimate the feasibility of harvesting rainwater.

One estimation process developed in Arizona equates historic climate data, catchment size, and canopy cover of the landscape, resulting in a canopy-to-catchment ratio as a guideline for landscape planning. Adaptation of this method demonstrating agricultural uses for rainwater on Vancouver Island, and determining residential garden sizes across ►

Rainwater Harvesting and Management: Taking Charge with Nature — City of Victoria

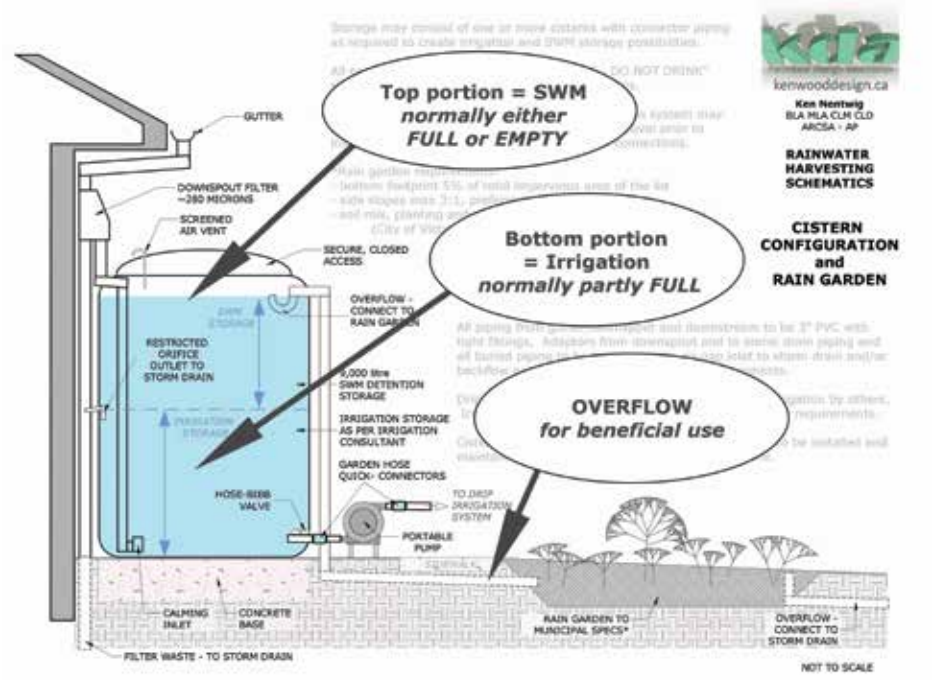
Stormwater Utility* (based on property size and impervious area)	Single Family (1 to 4 Units)			Multi-Family Commercial/Industrial Institutional	
Rainwater Rewards System		REBATE (max)	CREDIT		CREDIT
- Rain barrels	X	$ 100			
- Cisterns (1,200 L)**	X	$ 600	10%	X	10% to 25%
- Rain gardens	X	$ 1,000	10%	X	5% to 40%
- Infiltration Chambers	X	$ 1,000	10%	X	5% to 40%
- Permeable paving	X	$ 750	10%	X	5% to 40%
- Perm. paving w/ infil	X	$ 1,500	10%	X	5% to 40%
- Bioswales	X	$ 1,000	10%	X	5% to 40%
- Green roofs				X	5% to 30%
- Education (Businesses/Institutions)				X	5% to 10%

** = Portion of the costs of stormwater management (SWM) transferred to new utility, the roads portion and street cleaning etc., remain in the general SWM system funding.*

*** = Design Storm: 32 mm in 24 hr, release in 96 hr*

Canada, has been completed by the author. Various online rainwater calculators, along with proprietary versions, provide storage size calculations based on user input. Some are fairly complex, requiring knowledge of soil infiltration, or fixture (e.g., toilet) volume requirements, while others are too rudimentary to be useful. Current efforts to create a standardized calculation process parallel the development of education and training in RWH best practices, accreditation, and certification.

Diverse RWH systems can be formulated to meet irrigation, stormwater, potable, fire suppression, and emergency needs. Commercial and industrial applications can be used for heating, cooling, and process uses. Infiltration components such as rain-gardens, bioswales, and soak pits (of various names and configurations) help to restore groundwater reserves and environmental health in landscapes. Evapotranspiration through healthy green infrastructure can help mitigate heat-island effects, increase air-borne water content, and sustain municipal living assets. Overall, RWH is one means by which the water balance of our watersheds can be re-established, mitigating existing problems and preventing future degradation of our planet. Concentrating on human use alone, and meeting current oversubscribed needs, must be superseded by care for the environment and ecologies at a very local level. Landscape Architects are well-positioned technically and creatively to respond to the challenges and opportunities of rainwater as a resource we must heed the call for every project to incorporate prudent management of rainwater. SL



RESOURCE OR *Hazard?*

STEMFLOW *from* URBAN TREES

Julie Schooling, MScES, MBCSLA

We hear a lot about "green infrastructure" these days, and usually in relation to hydrology. To me, the term "Green+Blue" infrastructure emphasizes the intricate relationship between vegetation and the hydrological cycle, particularly in highly engineered cityscapes.

How can landscape architects use trees to promote healthy hydrology on urban sites? Let's start by defining some terms (Figure 1). Of the total rain that falls on a tree canopy:

- Stemflow is funneled to the base of the trunk
- Throughfall reaches the ground through gaps in the canopy or by dripping from it
- Interception loss is rain stored in and evaporated from the canopy
- Evapotranspiration is the sum of evaporation plus transpiration

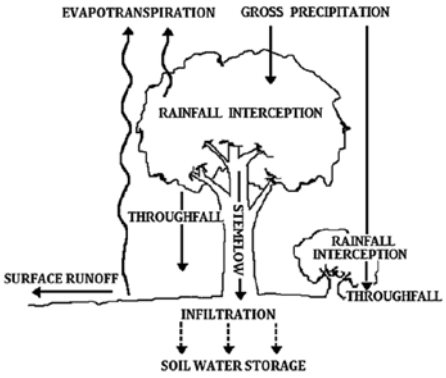


Figure 1 above. Partitioning of rainfall. Graphic credit: Inkiläinen et al., 2013 adapted from Levia and Frost 2006

To reduce flooding caused by stormwater, urban foresters, landscape architects, and stormwater engineers typically aim to maximize interception loss, but haven't focused on throughfall or stemflow. Could designs for stemflow infiltration (and tree self-irrigation) also accommodate integrated stormwater management practices?

Few studies in urban environments have looked at isolated deciduous trees, such as those in urban parks, streets, or parking lots. Growing investment in green infrastructure has intensified the need for studies specific to urban trees. My MScES thesis project with Dr. Darryl Carlyle-Moses at Thompson Rivers University tested the assumption that forest trees and urban trees perform similarly for stemflow in a manicured urban park.

Study Highlights

Our study site was an intensively managed urban park in semi-arid Kamloops, BC (Figure 2). Stemflow and weather data were collected over 17 months using methods described in my thesis (see Figure 3 and Resources). Stemflow in our 37 isolated deciduous trees was associated with the following traits, though it was also affected by storm meteorology:

- High branch angles
- Smooth bark
- Linearly furrowed bark
- Multiple leaders (major branches converging at the trunk)
- High wood cover percent (density)

Picture a European beech in its prime: this represents a highly efficient stemflow producer. In contrast, characteristics like horizontal or gnarly branches, rough bark, discontinuous or diamond-shaped bark patterns, single leaders, and sparse wood cover were associated with less stemflow – in this case, picture an older Honeylocust or Black Locust.

What are the Implications of our Results?

Most importantly, we showed that stemflow is not necessarily negligible, as had previously been assumed, particularly for certain tree species, forms, and sizes.

Existing Streetscapes: If soils are compacted and/or paving dominates the site, neither stemflow nor stormwater are infiltrating at the tree's base. The risk of concentrated stemflow contributing to runoff quantity and quality issues depends on the rainfall regime, airborne pollutant conditions, size and traits of existing trees, and consequences of mismanagement (e.g., sensitive ecosystems). Runoff may be diverted to various best management practices (e.g., rain gardens or rock pits/trenches). ►

Figure 2 bottom left. McArthur Island Park, Kamloops, BC. Photo credit: City of Kamloops

Figure 3 below. Stemflow collection system. Photo credit: Julie Schooling

Proposed Streetscapes: Ensure infiltration capacity by specifying appropriate soils and generous soil volumes. If stemflow can infiltrate into either grass or permeable soil at the base of the tree (such as into a suspended pavement system, open planter, or rain garden) for most anticipated storm events, choose species that promote stemflow. Benefits include:

1. water quantity and quality management;
2. self-irrigation;
3. self-nourishment with nutrient-rich stemflow;
4. biofiltration of pollutants washed from the canopy; and
5. groundwater recharge.

If infiltration into surrounding soil is limited or undesirable (e.g., soil instability), select trees for non-conducive traits. However, characteristics that reduce stemflow may increase dispersed throughfall, which is more difficult to manage than concentrated stemflow.

Conclusions

1) Recognize urban trees as part of the hydrological cycle. Stemflow can be a valuable input (or problematic in excess), so tree selection, siting, and planting design should reflect a tree's anticipated contribution to site hydrology over its lifespan.
2) Provide sufficient quality and quantity of soils to absorb and biofilter stemflow (as well as throughfall and runoff) and support growth of trees to maturity.
3) Integrate trees with broader "Green+Blue infrastructure" in a system designed to manage rainwater at the source. **SL**

Resources:
www.kamloops.ca/stormwatertrees (for MScES Thesis and derivative peer-reviewed and popular literature articles)

Sponsors: Kamloops Naturalist Club • Golder Associates • NSERC • Thompson Rivers University • Urban Systems Ltd. • City of Kamloops • Real Estate Foundation of British Columbia • University of Victoria • Kamloops Foundation • TD FEF • Partnership for Water Sustainability in BC

BCWF Wetland Institute 2015: DIVERSE DISCIPLINES, INTEGRATED SOLUTIONS

Christina Walkden, MLA, BCSLA Intern

Since 1998, the BC Wildlife Federation (BCWF) has hosted intensive seven-day workshops led by wetland experts. Each workshop provides hands-on training for participants interested in constructing, restoring and protecting wetlands in their communities. Participants come to the Wetland Institute with a project they wish to implement and a focus on restoration, protection, enhancement, or education. Workshops are held in different regions of BC each year. In 2015, the BCWF's 13th Wetland Institute was held in the central Okanagan, with over 25 participants and 14 instructors sharing their knowledge and interest in wetland restoration and protection. Participants included biologists, landscape technologists, environmental planners, educators, consultants, teachers, engineers, and landscape architects.

Bird banding in the field.

At the Institute, each participant made a short presentation on who they are, their interest in wetlands, and a summary of the project they wish to implement in their own community. The presentations created a collaborative environment where indi-vidual knowledge and expertise could be shared among group members.

After these introductions, participants were immersed in the intensive seven-day course, learning about restoration, construction techniques, habitats, and wetland ecology. Courses were taught both in the field and classroom, providing many opportunities to share expertise from various fields. Late on day one, the participants headed to Curly Frog Farm in Kelowna to begin on-site planning for a new wetland. The group surveyed the site then flagged and marked the future wetland areas. The Curly Frog Farm concept combined wetland restoration and permaculture farming practices in the form of "chinampas," essentially farmed berms surrounded by water. ►

In total, the group helped build and restore two wetlands, commencing with site analysis and ending the course by planting native sedges, grasses, rushes, and shrubs on the final day. All participants receive a certificate from the Institute after completing the course.

The Value of the Wetland Institute

The mix of participants representing various disciplines is one of the greatest strengths of the Institute. The conversations between participants during evening dinners, or car rides to a site, were as educational as the course itself. While all the participants in attendance shared an appreciation and value for wetland construction, restoration, and protection, they came from very different backgrounds such as permaculture, logging, aboriginal affairs, and ecology. These diverse backgrounds and experiences provided very different perspectives on the priorities for wetland restoration and construction.

In terms of landscape architecture, where landscapes are primarily constructed to fulfill human needs, wetland protection, restoration, or construction are often closely tied to human use. As a result, landscape architects seldom work with untouched, natural landscapes, but are typically asked to mimic natural processes through design and construction of detention ponds, swales, or rain gardens — all of which can be considered wetlands within the urban fabric. The Wetland Institute provides valuable insight into functional considerations, construction techniques, habitat creation, local ecology, permits, and grants — knowledge that can easily be adapted to various landscape wetland projects within any community.

Unlike many conferences and workshops where applicants simply register and pay their fees, the Wetland Institute is free, sponsored by the BC Wildlife Federation. A limited number of participants are chosen based on the merits of their applications, their proposed project interests, and the impact of their projects on their local communities. For further information, to apply for an upcoming Institute, to learn about past projects, or to find out if your next wetland project qualifies to be constructed as part of an upcoming course, visit the BCWF Wetlands Institute website at **http://www.bcwf.net/index.php/wetland-sub-2** SL

Below: Clay liner wetland construction, Vernon, BC. **Right:** Dip netting for insects, Kelowna, BC. All photos by Christina Walkden

St. George Rainway:

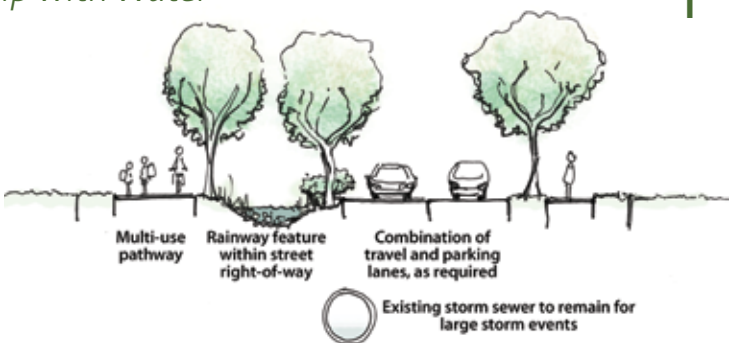
ENVISIONING BLUE INFRASTRUCTURE

Sarah Primeau, MSc, MLA, MBCSLA

Based on a presentation given at the 2016 BCSLA Annual Conference —*Shifting Currents: Rethinking Our Relationship with Water*

The St. George Rainway is a community-led initiative aiming to recreate the historic creek that used to flow along the path of St. George Street in Vancouver. Here we tell aspects of the project's story in images. For more information and images, see www.rainway.ca SL

1



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6

1. St. George Street currently has two driving lanes and two parking lanes. Different blocks can have different combinations of vehicle circulation and parking lanes depending on local needs. This section shows two of the street's existing lanes converted to the rainway feature with remaining lanes used for traffic and/or parking. Photo credit: Sarah Primeau

2. The design of the rainway mural was developed- and painted by neighbourhood residents and students from Mount Pleasant Elementary school. The students also participated in a "Creek Stewards" program at the school, whereby they learned about Vancouver's urban watersheds and opportunities for managing rainwater in the city. Photo credit: Max Adrien

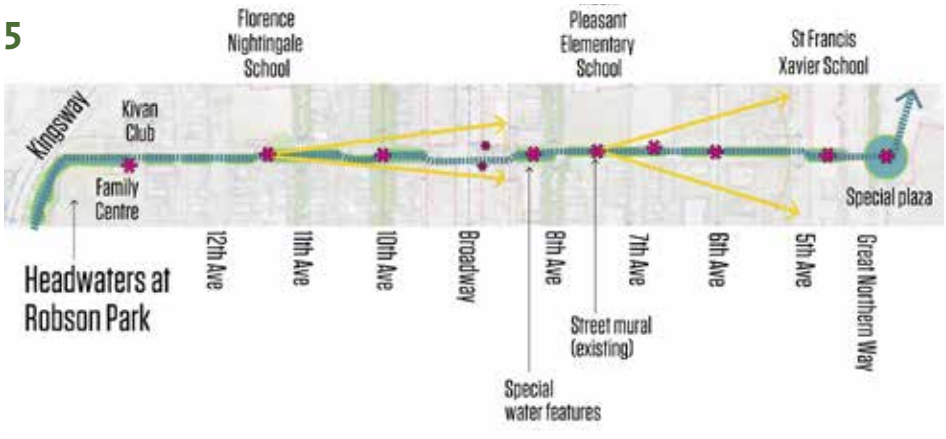
3. The rainway mural was first painted in 2012 with the support of the City of Vancouver, Mount Pleasant Elementary School, and dozens of local residents and students who helped with painting Photo credit: St. George Rainway group

4. The rainway mural showcases the lifecycle of salmon, and celebrates water in many of the languages spoken in the neighbourhood. Artist Melanie Schambach synthesized concepts and images for the mural from community gatherings. Photo credit: St. George Rainway group

5. Creekway Park, near Vancouver's Hastings Park, is a great local example of a constructed waterway, similar to what is envisioned for the St. George Rainway. Creekway Park filters stormwater from the surrounding area and provides the starting point for a new ecological corridor that will eventually connect to the Burrard Inlet. Image credit: Sarah Primeau

6. The vision for the rainway consists of a continuous, seasonal water feature that extends from Kingsway in the south, to Great Northern Way in the north, linking the many community amenities and elementary schools along the way with a safe and attractive multi-use pathway. At key points along the route there would be opportunities for public art, community gathering places, outdoor classrooms, and pocket parks. Photo credit: Sarah Primeau

5



GREEN INFRASTRUCTURE and the *Art of Persuasion*

Shasta McCoy, MLA, MBCSLA

The bioswale – my favourite tool for disconnecting pavement from catch basins, for integrating habitat into the urban fabric, for separating motorized travel from non-motorized modes – is a solution that is almost always met with suspicion and misconceptions. It illustrates perfectly and painfully how watershed illiteracy and suburban aesthetic preferences can derail green infrastructure practitioners' best-laid plans. So, I ask, are we using the right tools to guide the fickle current of public opinion?

Figure 1. One of our "naturalized" bioswales working hard and waiting to be loved. Photo credit: Shasta McCoy

Is a bioswale landscaping? It certainly seems like landscaping. There is soil, mulch, and plants, but is it really landscaping? The answer is, "yes but no but yes but no," because if we frame green infrastructure as "landscaping," we will undoubtedly run up against the dominant cultural aesthetic of curb appeal and ornamental horticulture. In some cases, particularly at the small scale, this presents no real issue, since a bioswale can be planted like any other shrub or perennial border conforming to societal expectations, thus presenting no real challenge to our dominant paradigm.

It is when we jump to the neighbourhood or corridor scale that creating and maintaining a manicured "garden" becomes unrealistic for clients' maintenance resources, not to mention capital budgets. Thus, we seek solutions that can be implemented for a lower cost over larger scales, exhibit a diminishing maintenance regime, and are not overly offensive to the dominant landscape aesthetic. Enter "naturalized" planting – the planting that loves to be hated. The naturalized planting conundrum: drought-tolerant and low-maintenance when established, rugged, native, and diverse – but, unfortunately, only appreciated by those who are aware that they once wore cultural blinders, and have chosen to remove them.

The "wasted" space? A functional bioswale in a road corridor can claim some prime real estate – this is particularly offensive to some, regardless of their opinion of the associated aesthetics. In this scenario, I'm usually competing with automobiles for space in one way or another – how many times have you encountered the opinion that there can be no possible good reason for taking away space for cars in favour of plants? These cultural goggles are even harder to dislodge. Deep sigh.

These challenges to creating green cities are real, understandable, and even amusing at times, but where is the path forward? I found myself giving a lecture a few years ago to students from an environmental program who were helping to plant some bioswales for the City of Nelson's new skate park. I led them through what I call the "watershed litany" in a nutshell. You all know the story – precipitation, interception, infiltration, interflow, sustained base flows = healthy watersheds, people, and economies. In contrast, impervious surfaces, pipes, spiking hydrographs, reduced concentration times, erosion, high water temperatures, turbidity, hydrocarbons = degraded watersheds, leading to ecological, health, and economic impacts. Although these students were keen to be environmental warriors, they were not aware of the link between urban runoff and watershed health. If these granola-eating, tree-hugging hippies from Nelson didn't know, this story must not be getting out there!

How can we expect support for green infrastructure, with its rugged looks and car-displacing reputation, if its underlying purpose is a mystery to the masses? We can't. Are there too few informational brochures? No. Have we failed to sign a celebrity spokesperson? Well, yes. Are there tools we have yet to leverage to make this green infra-structure movement a success?

Definitely, yes! Connecting with people beyond the rational–informative level will empower them to seek out and support green infrastructure initiatives to satisfy not only their physical needs, but their emotional needs as well. Let's give folks a reason to brag about bioswales. I contend that our work is not done until green infrastructure is not only widely understood for its purpose and practicality, but also branded as fashionable, sexy, beautiful, and integral to a healthy lifestyle…like Lululemon for your street!

Resources

Etmanski, A. 2015. Impact: Six Patterns to Spread your Social Innovation. Orwell Cove. Print.

Kylander, N. and C. Stone, 2012. The Role of Brand in the Nonprofit Sector. http://ssir.org/articles/entry/the_role_of_brand_in_the_nonprofit_sector

Tsai, E. 2009. The 12 Principles of Brand Strategy. www.designdamage.com/the-12-principles-of-brand-strategy/#axzz4J1TdNPez

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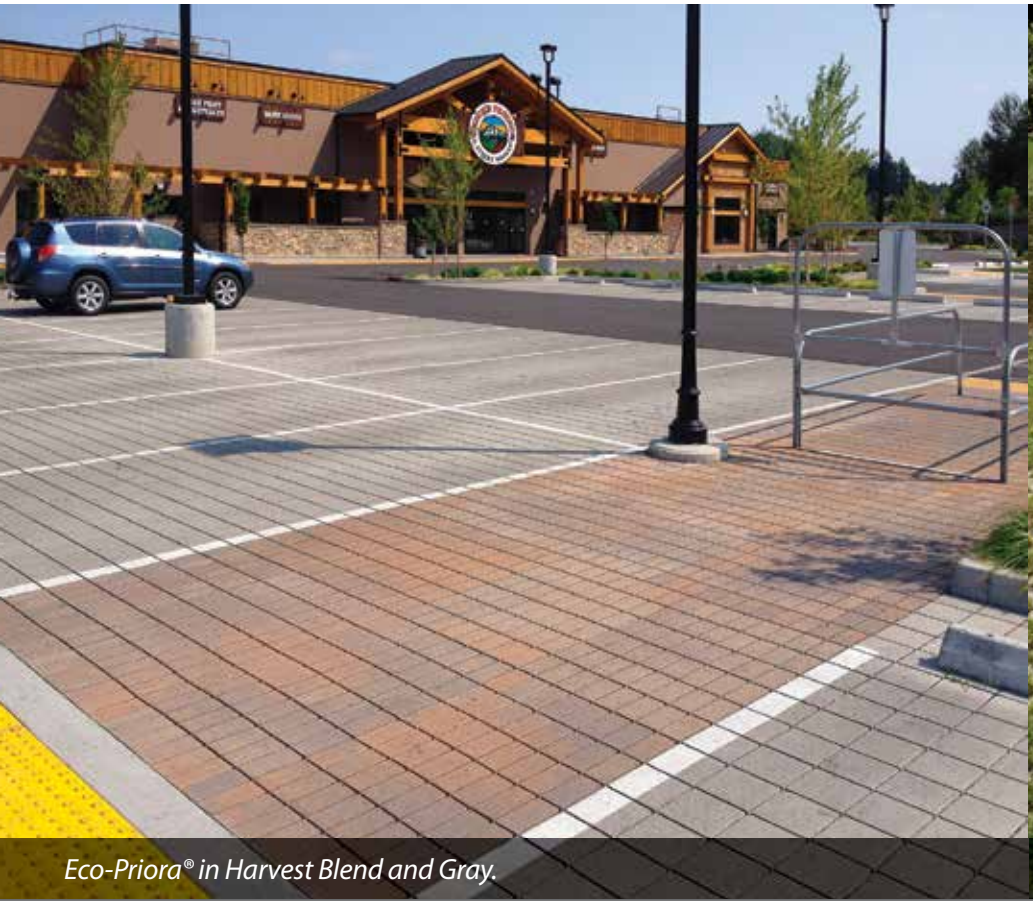

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