From Rain to Resource 2010

Managing Stormwater in a Changing Climate

A Report on the Workshop and Trade Show
October 28-29, 2010
Best Western Inn
Kelowna, British Columbia

Co-hosted by:

Okanagan Basin
WATER BOARD

and:

BCWWA
BC WATER & WASTE ASSOCIATION

Message from the Executive Director
of the
Okanagan Basin Water Board

It has always been impossible to predict the weather, but for many years we have relied on long-term weather patterns and storm events to help size pipes, grates and ditches. Now, with climate change, the only certain thing is that we can't use history to plan for the future. In the past decade it has also become clear that problems with water quality, environmental health, and aquifer failure are connected to rainfall and run off management. The situation is even more serious here in the Okanagan, where we depend heavily on clean surface water and healthy aquifers for our communities, agriculture, and the quality of the environment. Looking forward, we need to change the way we view rain and rainstorms—to manage the risks and uncertainty associated with climate change, and to preserve the things we value without going broke on ever-larger engineering solutions.

Throughout North America, progressive planners, designers, engineers and decision makers are changing the way we intercept, collect, and re-direct run off. Rather than moving water off the landscape and into stormdrains or stream courses as fast as possible, they are finding innovative ways to catch and hold the water on the landscape, slowing down overland flows so that they can sink down, recharge the soil layers, and find the water table. Many times, the most cutting-edge and innovative approaches are those that closely mimic natural processes. As Brock Dolman points out, we can use the rain as a resource if we shift our designs from convex to concave, to rain gardens instead of asphalt. This dispersed rainwater capture—in yards, rainbarrels, median strips, wetland parks and permeable pavement—also helps reduce flood risks from major storms, by shaving off the peak flows, tempering their impact. Changing our rain and storm water management will change how we approach development, but we will be living in a healthier environment with lower impact designs.

The Rain to Resource workshop was a great success—bringing these ideas to the Okanagan, and bringing experts together with decision makers and managers looking for new solutions. The recommendations and project summaries collected here capture an emerging new spirit in the fields of urban planning and engineering.

Anna L. Warwick Sears

Anna Warwick Sears
Executive Director

Message from the Chief Executive Officer
of the
B.C. Water and Waste Association

Each day when I leave my home to go to the office, I pass by a community garden on the flat area below my street. Many of the plots have been abandoned because of flooding, and I am reminded of how much more benefit could be derived from the land with effective rainwater management.

While on a recent tour of a wastewater treatment plant, our tour guide spoke of the many complexities involved in wastewater treatment. Many of them are necessary because of the quantity and quality of storm water entering the treatment process—better management of rainwater could result in millions of dollars in savings each year.

We are continuously being warned about the impacts of climate change, the expected extreme weather conditions and the impact this will have on our homes, land, people, food supply, and infrastructure. During the Rain to Resources workshop, I heard presentations on how individual homeowners are harvesting their rainwater to grow plants and vegetables; municipalities are incorporating innovative approaches to managing rainwater in their liquid waste management plans; engineers are developing new approaches to infrastructure design involving multi-disciplinary teams of planners, engineers, policy makers, and others; and tools that are being developed to assist with planning for on-site rainwater management.

While we all recognize the need for more funds and resources to be applied to improving rainwater management, the main thing I learned from this workshop was the need for more education on this topic. Many of the solutions that are currently being implemented, if applied more broadly, could make a huge difference.

The Rain to Resource workshop brought together a wide cross-section of interested and knowledgeable individuals and provided an opportunity for them to share their knowledge and experiences. BCWWA was pleased to partner with the OBWB in this initiative and commends the OBWB for preparing this report and documenting the learnings that took place.

Daisy Foster
Chief Executive Office

Contents

Contents

4.0 Overview cont.

1.0 Introduction

Extreme weather patterns, including higher rainfall intensities and more frequent flooding, are one of the projected outcomes of climate change. Managing stormwater effectively will be a critical climate change adaptation tool.

A key component of managing for storms is redesigning our approach to handling the more frequent, lighter rainfall events. Rainwater management keeps water on-site, improving water quality by reducing runoff pollution, allowing the rain to infiltrate and recharge aquifers, and establishing ways to harvest water for other uses. Rainwater management complements management of larger storm events, and reduces infrastructure requirements overall.

On October 28 and 29, 2010, the Okanagan Basin Water Board and the BC Water and Waste Association co-hosted the workshop "From Rain to Resource: Managing Stormwater in a Changing Climate." The goal of the workshop was to share positive and innovative developments for managing stormwater and rainwater and discuss how barriers to change are being overcome in communities in BC and beyond.

The event was geared to those whose work touches on stormwater management, including planners, engineers, and landscape architects, but also those who develop and adopt stormwater policy, such as senior municipal staff and elected officials.

This report summarizes key recommendations that came out of the workshop and provides an overview of the topics and case studies that were presented.

1.1 Stormwater versus Rainwater Management

Historically, the philosophy of stormwater control has focused on directing water off a site as quickly as possible using infrastructure such as curbs, gutters, trenches, and pipes. The emphasis has been mostly on handling the extreme storms (handling peak flows).

Conventional stormwater management, although useful and necessary under some conditions, contributes to downstream impacts by increasing flow rates and the transport of pollutants; it does not control total volumes and has limited benefit for addressing water quality concerns.

Rainwater management is a more integrated and holistic approach to manage the lighter, more frequent rainfall events in the location where the rain falls. The potential benefits of rainwater management include increased inflow and infiltration, reduced flooding and erosion, reduced need for new pipe infrastructure, and improved water quality.

Rainwater and stormwater management are not mutually exclusive—having good rainwater management systems in place reduces the volume and flow rate of stormwater surges, which can act like high-intensity flash floods.

STORMwater	RAINwater
Traditional	**Integrated**
drainage systems	ecosystems
reactive (solve problems)	proactive (prevent problems)
engineer-driven	interdisciplinary team-driven
protect property	protect property and habitat
pipe and convey	mimic natural processes
limited consultation	extensive consultation
local government ownership	partnership with others
extreme storm focus	rainwater integrates w/ landuse
peak flow thinking	**volume-based thinking**

Key differences between stormwater management and rainwater management.
Adapted from Stormwater Planning - A Guidebook for B.C.

Establishing or restoring wetlands, streamside vegetation buffers and swales—common rainwater management techniques—can have a number of other advantages, including water quality improvement and habitat. In addition, overland flow of stormwater is a valuable resource for recharging aquifers, if it is slowed and allowed to infiltrate.

1.2 Why a "From Rain to Resource" Workshop in the Okanagan?

The Okanagan is particularly vulnerable to the impacts of unmanaged stormwater and rainwater because all surface water flows into the lake system that runs along the bottom of the valley—and that lake is a primary drinking water source.

Over the past decade, the volume of impervious surfaces such as rooftops, roads, sidewalks, parking lots and concrete has increased—replacing soils, grasses, shrubs and trees. Under these conditions, rain and floodwater have less opportunity to soak in, and water flows more rapidly along the ground, eroding ditches and roadsides, picking up sediment and debris. More water enters the stream and storm sewer system, and that water is more polluted. Managing runoff so it doesn't carry its load of sediments, hydrocarbons, chemicals, fertilizers and other toxic compounds directly into the lake, becomes more and more important as those impervious surfaces expand over natural areas of the valley.

Another aspect is that increased runoff reduces groundwater recharge. Many residents living in rural areas, and an increasing number of water utilities, rely on

"We spent the last half a century trying to control runoff with dikes, storm sewers, curbs and gutters. Now, increased development and increased storm intensity from climate change are increasing peak flows and altering the rules of the game. We can't engineer away our problems fast enough, and have to look at other, lower impact solutions."
– Dr. Anna Warwick Sears
Executive Director, OBWB

well water, and are concerned about the sustainability of groundwater supplies. Likewise, hopes for restoring salmon and trout populations depend on maintaining summer stream flows. Stream flows are affected by the movement of surface water to groundwater, which re-emerges to provide base summer flows.

In addition, many of the environmental problems associated with Okanagan rivers and streams relate to the dikes and channels put in place historically to reduce flood risks from storm events. Some of these engineered solutions may be insufficient for handling high intensity storms predicted to occur with greater frequency as a result of climate change, but the water quality problems associated with streams being diked and cut off from wetlands remain.

Many positive and innovative developments in rainwater and stormwater management have not yet been introduced in Okanagan municipalities and rural areas. This workshop was held to highlight the importance of rainwater management to climate change adaptation and to showcase examples from other areas that could be applied to the Okanagan.

2.0 Summary of Workshop Outcomes

The Rain to Resource workshop brought together twenty-two expert speakers and panellists and more than 100 delegates from across British Columbia. Delegates included mayors and councillors, administrative staff, planners, engineers and consultants from around the province attended the workshop.

The workshop provided a unique opportunity for municipal engineers and planners and elected leaders to participate in a shared learning experience. The workshop format and content was designed to facilitate a common understanding between technical and policy people of the issues and solutions around rainwater management.

The speakers provided many practical examples of innovative rainwater and stormwater management techniques that could be implemented in the Okanagan. Integrating the low-impact rainwater management techniques presented at the From Rain to Resource workshop will reduce infrastructure costs and environmental problems in the future.

The presentations covered climate change adaptation, watershed planning, site-level rainwater management and policies and tools for rainwater management. Each presentation included one or more case studies to illustrate the effectiveness of the technique(s), principles, or standards presented.

A set of concrete recommendations for all levels of government were gathered from the workshop and are presented in the next section of this report.

3.0 Key Recommendations for Using Rain as a Resource

The following recommendations are based on presentations, the panel discussion, and audience questions and comments at the From Rain to Resource workshop.

"To achieve watershed benefits, human development designs need to move from drainage to retain-age and run-off to run-on."
**– Brock Dolman,
California WATER Institute**

3.1 Recommendations for Local Government

3.1.1 Use Low Impact Development techniques in your community

Low Impact Development (LID) is an approach that includes ways of designing, engineering, building and landscaping for green management of stormwater—with a focus on retention and infiltration. LID is often cheaper than conventional pipes and concrete and offers additional benefits. It adds urban green space and recreational areas, cleans water and air, and makes the community more attractive.

There are many LID stormwater and rainwater management features available for local governments to use. The table below provides several examples that are appropriate to typical land uses in a community.

	Institutional	Urban	Residential	Park	Mall	Boulevard	Road
Downspout disconnect	✓	✓	✓				
Harvesting/using roof runoff	✓	✓	✓				
Rain gardens	✓	✓	✓	✓	✓	✓	✓
Infiltration basins/tree wells	✓	✓			✓	✓	
Detention ponds	✓	✓		✓		✓	
Pervious pavement	✓	✓	✓	✓	✓	✓	✓
Constructed wetlands	✓	✓		✓	✓	✓	
Floodwater storage areas	✓	✓		✓	✓	✓	
Green roofs	✓	✓	✓		✓		
Wide riparian buffer zones for filtration/flood storage	✓	✓	✓	✓	✓	✓	✓
Maintenance and restoration of natural channels w/ floodplains	✓	✓	✓	✓	✓	✓	✓
Plant and maintain trees	✓	✓	✓	✓	✓	✓	
Prevent soil compaction	✓	✓	✓	✓	✓	✓	
Uncompacted topsoil (+30 cm) for lawns	✓	✓	✓	✓	✓	✓	
Swales instead of curbs and gutters						✓	
Street sweeping							✓
Minimize road width							✓

Low impact development techniques appropriate to six typical land uses.
Adapted from Bowker Creek Blueprint

3.1.2 Assess stormwater risks and watershed vulnerability in your community

"The Public Infrastructure Engineering Vulnerability Committee assessment protocol presents a robust and rigorous methodology to integrate climate change risks into infrastructure planning."
– Don Dobson
Urban Systems

These days, a spotlight rests squarely on the emerging risks to community infrastructure resulting from climate change.

Engineers Canada developed a task force called The Public Infrastructure Engineering Vulnerability Committee (PIEVC) to oversee a national engineering assessment of the vulnerability of Canadian public infrastructure to changing climate conditions. This led to a guiding protocol for vulnerability assessments. The protocol is a procedure to gather and examine available data to understand how climate events will affect infrastructure. It is applicable to all types of public infrastructure. See www.pievc.ca/e/index_.cfm for more information.

To test the protocol prior to widespread use, a series of case studies were selected by the PIEVC, including a project in Castlegar (see Section 4.1.4). The results of the case studies indicate that the PIEVC protocol presents a robust and rigorous methodology to integrate climate change risks with watershed planning. Local governments should consider using the PIEVC protocol to assess risks and watershed vulnerability in their communities.

3.1.3 Incorporate the Water Balance Model into planning

"The Water Balance Model allows users to create watershed objectives and quickly test alternative Low Impact Development techniques prior to implementation."
– Jim Dumont
AECOM

In September 2003, the web-based Water Balance Model (WBM) was launched as an extension of Stormwater Planning: A Guidebook for British Columbia. It allows users to quickly establish the existing, or the predevelopment, base line that will become the standard used to measure the performance of future development scenarios during the planning and design of a project. For more information on the WBM, see Sections 4.4.1 and 4.4.2.

Several communities in the Lower Mainland and Vancouver Island are successfully using the WBM. For example, the District of North Vancouver used the WBM to help develop a watershed restoration vision based on the simple objective of leveraging redevelopment and neighbourhood retrofit into opportunities for landscape based watershed restoration. Other communities using the WBM include Metro Vancouver, Surrey and Courtenay.

Communities in the Okanagan Basin should consider using the WBM for rainwater management planning.

3.1.4 Focus on watershed targets and outcomes

"Communities need to refocus plans on watershed targets and outcomes so that there are clear linkages with the land use planning and development approval process."
– Kim Stephens
Chair, Metro Vancouver LWMP Reference Panel

Integrated Stormwater Management Plans completed to date by many BC communities tend to be engineering-centric and do not integrate land use and drainage planning. These plans are often resulting in unaffordable infrastructure budget items without providing offsetting stream health benefits.

Local governments should develop outcome-oriented Integrated Stormwater Management Plans that emphasize the relationship between controlling the volume of stormwater runoff, and the resulting flow rates in streams. The plans should look at the impacts to a stream; the causes in the urban landscape; and the mitigation methods needed to restore the natural water balance in that stream.

See Section 4.2.4 for more information.

3.1.5 Consider the site

Site planning brings together information collected from the site including vegetation, slope, circulation, sun exposure, water management and wildlife habitat in order to identify buildable and nonbuildable areas. Design options are then developed that respond to site opportunities and constraints. See Section 4.3.1 for more information on site adaptive planning.

Local governments should ensure that their policies and standards do not inhibit developers, engineers, and planners from considering the site when they are determining the most appropriate rainwater and stormwater infrastructure for a development.

3.1.6 Share responsibility and collaborate

Given the range of stakeholders and decision makers involved in the management of urban watersheds, communication that informs and reinforces policy and legal choices is a key factor in the success of any project. Within local government it is important to communicate objectives and establish joint expectations and understanding across all relevant departments. Externally it can be helpful to work with regional governments to develop a regionally coordinated approach. It is also critical to educate and collaborate with consulting, development and building professionals, and to educate the public about outcomes in order to boost compliance through understanding of the rationale for the requirements.

West Coast Environmental Law, in collaboration with the Green Infrastructure Partnership, created a policy and legal tool called the "Shared Responsibility Matrix" (see Section 4.4.3 for more information). Local governments can use this matrix to guide and focus collaboration with the various parties that need to be involved in rainwater management.

3.1.7 Be innovative and learn from the experiences of others

There are many pilot programs, case studies, municipal experiences, and resources available that local governments can learn from and adapt to their own communities.

"With stormwater, there is no "one size fits all" approach. Each site has unique characteristics, and landscape, urban and infrastructure context."
– Paul de Greeff
MDI Inc.

"A key challenge common to green infrastructure projects is that there are many different departments and areas of responsibility engaged around the management of urban watersheds."
– Deborah Law
West Coast Environmental Law

"We have learned through our own experiences and the trials of others that the best way to manage rainwater is not through the application of one size fits all standards but through a combination of innovative techniques and practices."
– Rob Dickinson
City of Vernon

Beyond the Guidebook 2010 tells the stories of rainwater management happening in over 40 local government settings in three regions. These communities are champions in rainwater management and there is much that can be learned from their experiences. See Section 4.2.5 for more information about the guidebook.

Information sharing is critical to improving the management of rainwater and stormwater. The Rain to Resource workshop provided a venue to showcase innovative case studies happening right now throughout British Columbia. The case studies are described in Section 4.

3.2 Recommendations for Provincial Government

3.2.1 Revise grey water re-use regulations

Stormwater harvesting measures that direct rainwater runoff to indoor uses reduces negative downstream impacts.

Current water reuse regulations are quite prohibitive and unclear. It is very difficult to harvest stormwater for indoor water use. Projects that have accomplished this task have spent considerable time and resources to convince regulators that adequate health protection measures have been put in place.

The proposed changes to the B.C. Building Code go a step in the right direction by allowing indoor water use for toilet fixtures providing that the changes are in fact adopted. However, treatment criteria and consistency across other regulations and local bylaws will still cause confusion. More effort is required in this area.

3.2.2 Expand and maintain hydrometric and weather monitoring networks

Accurate, long-term, real-time hydrometric and weather data is essential for climate change assessment, including calibration and verification of climate and hydrology models. Hydrometric data is also critical for regional flood and drought frequency analysis.

The Okanagan network of hydrometric and weather stations has declined significantly since the 1980s and is no longer adequate to support water management planning. 156 Water Survey of Canada (WSC) stations were discontinued in the Okanagan, leaving just 25 active WSC stations in the basin by 2007. A report completed by Dobson Engineering in 2008 suggests that the Okanagan Basin should be supported by a network of 160 stations to meet the long-term requirements for hydrometric data.

Managing the basin water resources in a sustainable manner and properly designing and sizing infrastructure to develop low-impact designs for neighbourhoods will require comprehensive water data. Such data will only be available if the hydrometric network in the basin is improved.

3.2.3 Provide infrastructure funding for rainwater management and LID

Infrastructure renewal and redesign is expensive. While there are significant long-term cost savings, like many green initiatives, the up-front cost of these projects may be prohibitive to most municipalities. While provincial and federal infrastructure funders have made great strides with recognizing the values of new approaches to rain and stormwater management, there is a real need for sustained funding programs to support this work. New construction is, by contrast, easier to build with designed-in solutions. On the other hand, generations of original stormwater infrastructure may take many years to renew.

3.3 Recommendations for Federal Government

3.3.1 Conduct climate impact studies

Regional climate modeling was conducted for Metro Vancouver to predict climate change impacts. The study took the Global Circulation Model results and used relationships based on historical rainfall patterns to build 5 min to 24 hr intensities. From this, a prediction was made on how Intensity-Duration-Frequency curves will be impacted by climate change. Results showed that the observed rainfall trend in Metro Vancouver already exceeds the forecasted climate model trend.

"Regional climate impact studies enable communities to understand the relationship between the current rainfall trend and what is forecasted."
– Chris Johnston
Kerr Wood Leidal

This type of rainfall intensity analysis should be completed by Environment Canada for the Okanagan region. Much of our development is on flood plains and it is crucial that we understand the relationship between the current rainfall trend and what is forecasted for the basin.

3.3.2 Provide infrastructure funding for rainwater management and LID

The recommendation provided in Section 3.2.3 applies equally to the federal government.

3.4 Recommendations for the Okanagan Basin Water Board

3.4.1 Provide infrastructure funding for rainwater management

Since the 1970s, the OBWB has provided sewage facilities grants to Okanagan communities. The result has been dramatic reductions in nutrient loading to lakes and streams. At present, non-point sources, such as stormwater/rainwater runoff are the major inputs of nutrients to waters in the Basin.

The OBWB should investigate the appropriateness of extending the Sewerage Facilities Grants program, which provides infrastructure funding for wastewater treatment, to other infrastructure upgrades, including rainwater and stormwater management systems, to further protect the quality of Okanagan valley lakes. As with the existing grant program, OBWB funds would help leverage senior government infrastructure monies.

3.4.2 Provide small grant funding for pilot rainwater management projects

The OBWB's Water Conservation and Quality Improvement (WCQI) grant program provides funds to local government to support innovative, tangible, on the ground, water quality and conservation improvement initiatives.

The OBWB should encourage local governments to apply for funding under the grant program to support projects in their communities that address rainwater management and can be used as a model for other organizations. These projects could include the installation of rain gardens, absorbents landscaping, green roofs, and rainwater harvesting systems.

3.4.3 Prepare a homeowner's guide to rainwater managements

The publication "Slow it. Spread it. Sink it. A Homeowner's & Landowner's Guide to Beneficial Stormwater Management", compiled and written by the Southern Sonoma County Resource Conservation District and the Resource Conservation District of Santa Cruz County, is an excellent example of what can be done to teach homeowners how to manage stormwater on their properties. The OBWB should contact the conservation districts to request permission to adapt this guide to the Okanagan Basin.

The guide focuses on best management practices that can be done at home. The BMPs are not complicated and are geared toward residential homes or small developments. The underlying concepts follow the mantra: Slow it. Spread it. Sink it.:

- Slow the runoff down,
- Spread it out in planters, gardens, or over other pervious surfaces - do not confine runoff to pipes, and
- Sink it back into the ground.

3.4 Recommendations for the B.C. Water and Waste Association

3.5.1 Develop position statements on stormwater management

In 2009, the BCWWA amended its mission statement to add the words "providing a voice for the water and waste community". One way in which BCWWA will move forward in this new role is by preparing position statements on water and waste related topics that represent the views of their broad membership.

"The BCWWA has embarked on a process to develop position statements on stormwater management that focus on raising awareness of the potential impact of stormwater on receiving waters, risk assessment and mitigation."
– Michael MacLatchy
Chair, BCWWA Watershed Management Committee

The BCWWA is currently developing a draft position statement on stormwater that will focus on water quality issues related to runoff from settlement developed lands (cities and towns). The BCWWA should continue working on this position statement and develop additional position statements covering other aspects of stormwater and rainwater management.

4.0 Overview of workshop topics and case studies

The workshop featured twenty-two high calibre speakers who provided practical examples of innovative rainwater management techniques and tools.

Workshop delegates were treated to an inspirational and informative keynote presentation by Brock Dolman. Brock is the Director of the Occidental Arts and Ecology Center's WATER Institute and Permaculture Program, based in California. He lectures nationally and internationally, has been featured on radio programs and award winning films, and is widely published. Brock's engaging demeanor, uncanny ability to communicate and connect with people, and contagious passion for managing rain as a resource made him an excellent choice for keynote speaker.

This section provides an overview of Brock's keynote presentation and of the other workshop presentations. Digital presentation files and a video of the keynote presentation are available online at www.obwb.ca/rain_to_resource/.

Keynote speaker Brock Dolman addresses a packed house, encouraging particpants to think like a watershed.
Source: OBWB

4.1 Keynote Speaker

4.1.1 - Basins of relations: thinking like a watershed

Presented by: Brock Dolman
Director
California WATER Institute/Permaculture Program

Key Points:

- The water cycle and the life cycle are one and same, and both depend on your ability to maintain them. All creatures, including humans, are largely water.
- Your water supply is your watershed, your water production machine.
- Many people on this continent suffer from "hydrological illiteracy"; they do not know about or understand the water cycle.
- While the volume of water is finite, the potential for renewal is infinite. On a seasonal basis, water cycles through periods of high and low precipitation, alternately filling waterways and then drawing them down.
- The Okanagan Valley is a lifeboat and those in it should leave the city rivalries behind and work together to keep it afloat.
- People and their attitudes are the challenge. We have an historic tendency to try and get rid of water following a storm, instead of looking at rainfall as a resource to be stored and distributed when the weather is dry.
- There is no 'away' when it comes to water. It can only be moved from one place to another, despite the illusion of its disappearance into a storm drain underground and out of sight.
- Groundwater is the oldest water, and the least connected to the annual income allowance of water through precipitation. Yet, in BC, its use isn't regulated.
- We need to think in terms of concave versus convex land systems in order to attract water instead of forcing it to run off the land.
- The best way to handle stormwater is to 'slow it, spread it, and sink it'.
- There are lots of opportunities for harvesting rainwater for dry periods.
- Develop regional plant palettes for rain gardens, where runoff water can be directed to drain back into the ground from asphalt and concrete and rooftops.
- Land use planning is water use planning.

4.2.1 - Using low impact development to mitigate future flooding

Case Study: Bowker Creek Watershed

Presented by: Chris Jensen
M.Sc. Candidate
Dept. of Geography, University of Victoria

Key Points:

- Research questions: Can LID reduce future peak flow rates to current flow rates?
  - Can LID reduce peak flow rates to current flow rates?
  - How much LID is needed?
  - What types of LID are best?
  - How effective is LID under different future climate scenarios?
- Research needed because climate change impacts are expected to increase risk to public safety and infrastructure failure and options are needed to adapt.
- The Bowker Creek watershed is being used as a case study. Flooding risk and peak flow rates in the Bowker Creek watershed are expected to increase with climate change.
- Preliminary results are showing that:
  - LID provides an incremental and flexible approach for climate change adaptation
  - LID has a positive effect on the urban environment in general
  - LID offers a "no regrets" option for flood mitigation
  - In the Bowker Creek watershed, LID can largely mitigate the adverse impacts of climate change

	24 Hour Rainfall (mm)			
Return Period	Existing	Future Median	Future 90th percentile	Potential Increase
25 year	90.6	98.8	120.5	8.2 - 29.9
50 year	101.9	111.1	135.5	9.2 - 33.6
100 year	113.2	123.4	150.1	10.2 - 37.3

Future precipitation scenarios predict increases in the volume of stormwater during flood events. Low impact development could help mitigate the risk and reduce the impact of future flooding
Adapted from Chris Jensen

4.2.2 - Climate Change Adaptation

Case Study: City of Prince George
Presented by: David Dyer
Chief Engineer, Planning and Development
City of Prince George

Key Points:

- The spread of Mountain Pine Beetle, increasing risk of forest fires, ice-related and freshet flooding, increasing freeze-thaw cycles in winter are being attributed to climate change.
- Significant staff and financial resources have gone into dealing with these issues.
- A report by the Pacific Climate Impact Consortium provides temperature, precipitation, degree day, and flow projections for the City to 2050.
- The City and the University of Northern BC used the information provided in the report and conducted surveys, workshops, and presentations in order to develop "Envisioning an Adaptation Strategy for Prince George".
- The strategy outlines recommendations for investigating climate change impacts related to the vulnerabilities listed in the table below.

Priority Level		Impact	Vulnerabilities
TOP	1	Forests	Increased forest fires and insect outbreaks
	2	Flooding	Property damage with more frequent floods
HIGH	3	Transportation/ infrastructure	More potholes with increased freeze/thaw events
	4	Severe weather/ emerg. response	Maintenance of transportation infrastructure during severe weather events
	5	Water supply	Water shortages as a result of drought
MEDIUM	6	Slope stability	Erosion and landslides
	7	Stormwater	Overflowing systems during storm events
	8	Buildings and utilities	Impacts of higher temperatures on building materials and structural stability
OTHER	9	Health	Increased heat waves threatening vulnerable populations
	10	Agriculture	Increased regional agriculture opportunities
	11	New residents and businesses	Population growth as a result of 'climate refugees' migrating north

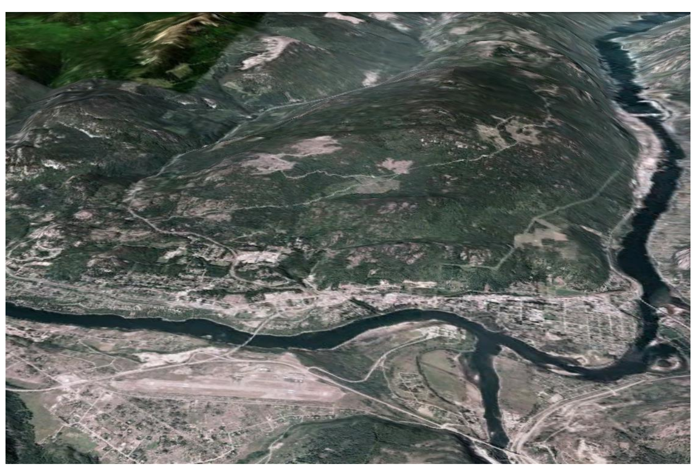
Adapting to the changing climate will provide a number of challenges in the coming years.
Adapted from David Dyer

4.2.3 - Assessing stormwater and watershed vulnerability to climate change

Case Study: City of Castlegar
Presented by: Don Dobson
Senior Water Engineer
Urban Systems

Key Points:

- The City of Castlegar partnered with Engineers Canada and engaged Urban Systems to assess the vulnerability of its stormwater infrastructure from climate change.
- Engineers Canada developed a task force called The Public Infrastructure Engineering Vulnerability Committee (PIEVC) to create an assessment protocol.
- To proof the protocol prior to widespread use, a series of case studies were selected, including the project in Castlegar.
- The vulnerability assessment included:
    - Evaluation of the hydrologic considerations in 7 adjacent watersheds that flow through urban areas en route to the Columbia River
    - Consideration of climate change and analysis of multiple climate scenarios
    - Completion of the PIEVC Protocol which tabulates the probability and severity of failure of engineered or natural drainage systems
    - Developing adaptation strategies
    - Consideration of local creeks and streams, debris flow management, and environmental values
    - Recommendations for preventative works in the watershed
    - Recommendations for increasing the resiliency of local stormwater infrastructure
    - Cost recovery mechanisms which enabled the transition from assessment to implementation
- Conclusion: The City's stormwater systems will be vulnerable to climate change.



Castlegar's proximity to water is one reason for its vulnerability to climate change.
Source: Don Dobson

4.2.4 - Rainwater management as a critical tool for climate change adaptation

Case Study: Metro Vancouver

Presented by: Chris Johnston
Kerr Wood Leidal Associates
Member, BCWWA Climate Change Committee

Key Points:

- Depending on your geographical location, climate change will likely increase rainfall intensities over time.
- As the intensity of rainfall events increases with climate change, designing to slow the movement of runoff and allowing it to be absorbed into the ground becomes more important.
- In the Okanagan, there is concern that the impact of climate change could be even more extreme storms than in areas such as the Lower Mainland.
- By analyzing long term rainfall trends, it may be possible to see if climate change is already happening.
- Regional climate modelling done in Metro Vancouver showed that the observed rainfall trend already exceeds the forecasted climate model trend. This type of modelling can be done for any region.
- We need to build our cities differently. The following can be done to lessen the impact of climate change:
    - Disconnect impervious surfaces
    - Reduce the increases in peak flows due to climate change
    - Capture pollutants from road surfaces and infiltrate, and
    - Re-use rainfall to decrease the erosive impacts on creeks and aquatic habitat.
- The benefits of building differently include:
    - Allows existing drainage infrastructure to accommodate larger storm events due to climate change by removing water from the system and increasing travel times.
    - Improves receiving water quality, fish habitat, and decreases erosive energy.
    - Recharges groundwater aquifers.
    - Reduces risk that these issues will be amplified due to climate change.

This street in Maple Ridge, B.C., mitigates surface runoff using a beautiful rain garden that captures and infiltrates pollutants from the impervious surfaces.
Source: Chris Johnston

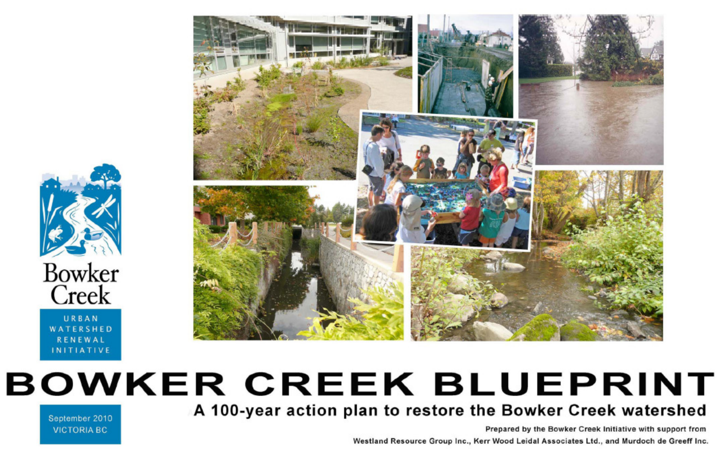
4.3.1 - Urban watershed planning

Case Study: Bowker Creek Watershed

Presented by: Jody Watson
Harbours and Watersheds Corrdinator
Capital Regional District

Key Points:

- The Bowker Creek watershed crosses three municipalities so jurisdiction provides a challenge for water management. In addition, flooding and erosion are common issues in the watershed.
- The Bowker Creek planning committee includes 3 municipalities, a regional district, a university, and 5 community associations. Subcommittees are also involved.
- A blueprint was developed to articulate a 100 year vision for Bowker Creek; recommend watershed management policy, planning and other stewardship actions; recommend site-specific actions for each creek section; and provide support and information to municipalities and other land stewards
- Challenges to the process included:
  - Letting go of the Integrated Stormwater Management Plan (ISMP) template: there was not enough funding to complete the study to ISMP standards and the template was too strategic and engineering centric.
  - Reconnecting with Vision: the group got stuck with the details so hired an external facilitator to help out.
- Success has been attributed to:
  - Hiring a coordinator,
  - Staying on track and keeping focus on the big picture,
  - Successful outreach to and engagement of community and politicians, and
  - Articulating a 100-year time horizon, which made staff more comfortable steering it through councils and easier for councils to endorse.



The Bowker Creek Blueprint outlines a 100 year vision for the watershed.
Source: Bowker Creek Initiative Website

4.3.2 - Re-inventing rainwater management in a region

Case Study: Capital Regional District
Presented by: Calvin Sandborn
Legal Director
UVIC Environmental Law Centre

Key Points:

- University of Victoria Environmental Law Centre (ELC) has proposed a strategy to re-invent rainwater management in the Capital Regional District (CRD).
- Instead of relying on pipes and concrete alone, the recommended new approach relies on soil, trees and open space to naturally absorb, store, evaporate and filter rainwater.
- Low Impact Development (LID) is often cheaper than conventional pipes and concrete and offers additional benefits. It adds urban green space and recreational areas, cleans water and air, and makes the community more attractive.
- Specific recommendations made to the CRD by the ELC include:
  - Local governments should require Low Impact techniques for all new developments – and create a long-term plan to retrofit developed areas with green infrastructure.
  - A Regional Rainwater Commission should be set up to create an Integrated Watershed Management Plan for dealing with rainwater.
  - Set mandatory targets.
  - Spend the money to fix the old pipes that allow sewage to mix with stormwater and flow onto beaches. Financing should come from a "user pay" system like Portland's, which encourages homeowners to reduce runoff, saving the homeowner and government money.
  - The strategy must actively involve residents, developers, businesses, and stewardship groups.

The cleaning up of old pipes, financed on a user pay system, was one of the recommendations from the ELC.

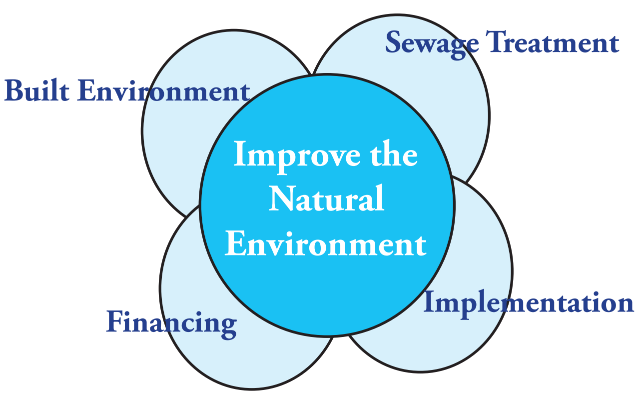
4.3.3 - From stormwater to rainwater management

Case Study: Metro Vancouver

Presented by: Kim Stephens
Chair
Metro Vancouver LWMP Reference Panel

Key Points:

- Metro Vancouver's Integrated Liquid Waste & Resource Management Plan establishes the framework for transitioning beyond regulatory compliance to a method that embraces a regional team approach, implements integrated solutions and achieves the Sustainable Region Vision.
- The Plan has been influenced for the better by the contributions of the community advisory Metro Vancouver Reference Panel, which consists of 10 people representing non-government organizations, technical experts and practitioners.
- The Panel wrote a report entitled "A Recommended Policy Framework for Liquid Resource Management in Metro Vancouver" that comprises 19 recommendations under five theme areas: natural environment, built environment, sewage treatment, financing, and implementation.
- The Panel had concerns over the 'unintended consequences' resulting from Integrated Stormwater Management Plans (ISMPs) completed to date in the region.
- Policy recommendations made by the Panel include: re-focus ISMPs on watershed targets and outcomes; mandate a new Stormwater Interagency Liaison Group to lead a regional team approach; and implement a consistent and integrated approach region-wide.
- The Panel also recommended that an over-arching committee (the Integrated Utility Management Advisory Committee) be established to steward the plan, and ensure ongoing action implementation occurs and stays true to the vision.



The panel stressed an over-riding focus on the goal: Improving the natural environment.
Adapted from Kim Stephens

4.3.4 - Implementing a new culture for urban watershed protection and restoration

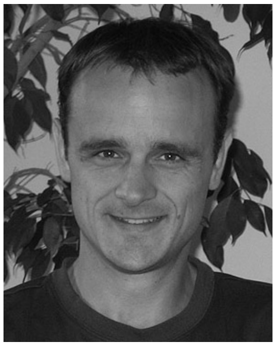
Case Study: Beyond the Guidebook 2010

Presented by: Ted van der Gulik
Senior Engineer
B.C. Ministry of Agriculture and Lands

Key Points:

- In 2002, the Stormwater Planning: A Guidebook for British Columbia was released by the Province and quickly became a catalyst for action to implement a 'design with nature' approach to rainwater management and green infrastructure. Emphasis is on rainfall capture (volume control) at the site scale.
- Beyond the Guidebook 2007 initiated a paradigm-shift from the single function view of traditional stormwater management to the integrated and holistic perspective that is capture by the term rainwater management. Emphasis is on the relationship between volume control and resulting flow rates in streams.
- Beyond the Guidebook 2010 provides local government with the 'how to' guidance for developing outcome-oriented urban watershed plans. It tells the stories of 'convening for action' champions in over 40 local government settings in three regions.
- Convening for Action experience shows that success will follow when local governments:
  - Choose to be enabled
  - Establish high expectations
  - 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

The new culture of urban watershed protection will come from a bottom-up approach.
Adapted from Ted van der Gulik



4.4.1 - Site adaptive planning and design

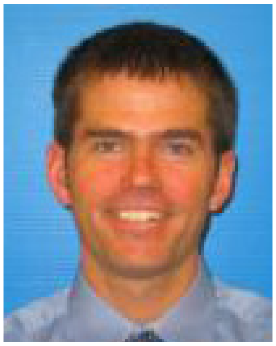
Case Study: Victoria and area

Presented by: Paul de Greeff (left)
Scott Murdoch (right)
Landscape architects
Murdoch de Greeff Inc.

Key Points:

- A paradigm shift from viewing stormwater as a waste product to rainwater as a resource is happening.
- Stormwater management focuses on risk, property/safety and peak flow mitigation. Rainwater management provides the added benefits of rewards, health/enjoyment, and restoration values.
- By studying a site's unique surficial geology, soils, ecology, drainage conditions and its landscape context, we typically find opportunities and value.
- The environmental sciences show us that variations between sites are generally predictable and that forms and features in landscape are not randomly distributed. They help us to understand how landscapes were formed and how they function today, even in urban environments.
- With predictable landscape form and function in mind, value can be derived through understanding and responding to the uniqueness of sites.
- Prerequisites to site adaptive planning should include:
  - context – where you are located in the watershed
  - characterization – sites are unique
  - design – solutions are unique
- Site adaptive planning process is based on:
  - Site analysis plans: synthesizes information collected from the site including vegetation, slope, circulation, sun exposure, water management and wildlife habitat;
  - A framework plan: delivered from site analysis plans and identifies buildable and non-buildable areas and forms the base for future planning and design work; and
  - Site plans: developed to illustrate design options that respond to site opportunities and constraints.

This Victoria Airport parking lot demostrates the added benefits of rainwater management.
Source: Paul de Greef and Scott Murdoch



4.4.2 - Stormwater management techniques for hillside development

Case Study: Turtle Mountain Development, City of Vernon
Presented by: Rob Dickinson
Manager of Engineering and GIS Services
City of Vernon

Key Points:

- Fast paced development of hillside areas has required a change in stormwater management standards and techniques.
- Concerns such as erosion, slope stability, diversion of flows, flooding and capacity of downstream watercourses/systems are associated with hillside development.
- Okanagan has many challenges, including intense summer storms, rain on snow/ice, variable soil conditions from rock to clay and an arid summer that tests the hardiest of soft landscaping.
- Applying a flat land approach to steep slopes has resulted in various pitfalls.
- Communities have learned the hard way and through the trials of others what works and what doesn't.
- Communities have also learned that the best way to deal with many of the issues is not through one solution or arduous standards or legislation, but is through a combination of innovative solutions.
- Turtle Mountain development design provides a mixture of systems and techniques to address the varying constraints of hillside development.

Hillside developments face unique challenges in stormwater management.
Source: Rob Dickinson

4.4.3 - Rainwater management at a local government building

Case Study: Capital Regional District
Presented by: Jody Watson
Harbours and Watersheds Coordinator
Capital Regional District

Key Points:

- The Capital Regional District Headquarters Building is the first LEED Gold Certified building in the Capital Region.
- Rainwater features of the building include a rainwater harvesting and re-use system, extensive and intensive green roofs and the living wall.
- Water efficiency features include low flush toilets, low-flow showers, waterless urinals and micro-drip irrigation or no irrigation.
- Barriers to grey water reuse include: building and plumbing code, building inspectors, backflow preventers, purple pipe system, earthquake procedures require signage by toilets
- Two types of green roofs were installed in different locations on the building:
  - Extensive green roof of sedums and grasses
  - Intensive green roof of vegetables, herbs, and flowers
- Barriers to the green roofs included: board approval (6 staff reports were required), insurance concerns, and cost.
- Benefits of green roofs include: reduce energy costs, moderation of urban heat island effect, high water retention, protection waterproofing, improve air quality, provide wildlife habitat, good use of space, and aesthetics.

The extensive green roof covered much of the CRD building. When dry, the lightweight roof covering can absorb as much as 25 mm of rainfall.
Source: Jody Watson

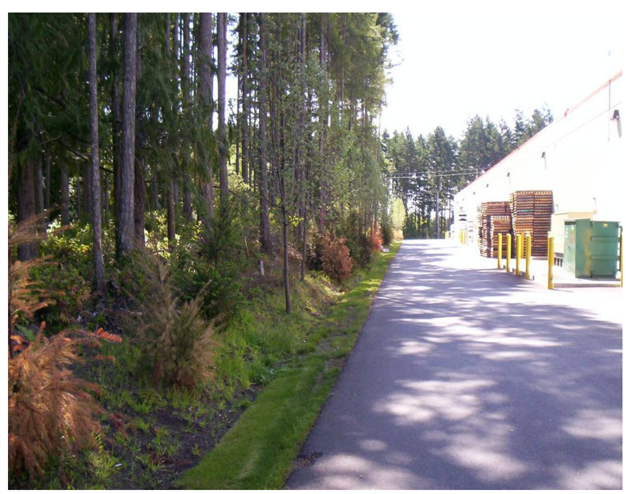
Staff participated in the design workshops of the intensive gardens to maximize its benefit.
Source: Jody Watson

4.4.4 - Rainwater and stormwater measures at a commercial site

Case Study: Home Depot Development, City of Courtenay
Presented by: Kevin Lagan
Director of Operational Services
City of Courtenay

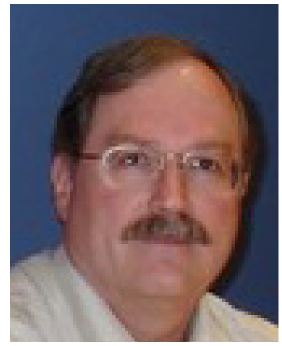
Key Points:

- The Home Depot development application in the City of Courtenay was to build a store and parking lot covering 90% of a four hectare second growth coniferous forest property.
- The City required that post development storm water flows leaving the site were equal to or less than the pre development flows. For this property that was effectively zero.
- Site-specific solutions included:
  - Constructed storm drainage mimics nature
  - Roof detention and shallow aquifer recharge trench
  - East access road slopes away from the building into an infiltration swale
  - Oil/grit interceptor (40 ms3 capacity)
  - Permeable soils and perforated pipes to exfiltrate storm flows
  - Excess storm water into 2 deep well injection pipes
  - Landscaped areas – apply Water Balance Model principles and best management practices
  - Retains 2-year storm on-site, recharges sub-surface ground water & maintains deep sub-surface flows
- Achievements included: minimal impact on nearby creek, groundwater recharged, adherence to Water Balance Model objectives, inter-municipal cooperation.



Swales created alongside the Home Depot development help mitigate post-development stormwater runoff.
Source: Kevin Lagan

4.4.5 - Low impact development techniques in a mixed neighbourhood design



Case Study: East Clayton Development, City of Surrey

Presented by: Jim Dumont
Senior Technical Specialist, Water Infrastructure
AEC OM Canada Ltd.

Key Points:

- First development in the Lower Mainland that utilized Low Impact Development (LID) techniques and facilities.
- Need to embrace LID practices arose from the requirement to prevent further increases in damage to both the environment and the agricultural community resulting from the increases in runoff from urban areas.
- Neighbourhood Concept Plan established rainfall capture objectives that would maintain the predevelopment runoff rates and volumes.
- Clay soils and limited infiltration rates drove innovation in both the calculation methods and the design details to allow the volumetric runoff coefficient to be maintained.
- LID systems at the development include: disconnected roof leaders (downspouts), enhanced top soil (300 to 450 mm depth over entire disturbed pervious area), and infiltration facilities.
- Design also allows for base flows out of infiltration systems to augment reported low summer flows and to allow systems to drain down and refill.
- Predevelopment runoff was 30%; post development runoff is 25%.
- The lessons learned at East Clayton led to “Beyond the Guidebook 2010”.

The lessons learned in the East Clayton Development led to “Beyond the Guidebook 2010”
Source: Jim Dumont

4.4.6 - Stormwater retrofit: planning and design

Case Study: Douglas Creek Watershed, Victoria

Presented by: Scott Murdoch
Landscape Architect
Murdoch de Greef Inc. Victoria

Key Points:

- Stormwater retrofit options such as street tree planting, rain gardens, traffic bulges and vegetation can enhance neighbourhood aesthetics, narrow roads and calm traffic.
- Retrofit solutions will be successful if they:
  - meet stormwater/rainwater objectives,
  - function to meet environmental design objectives,
  - meet the needs and desires of the end users – the public,
  - are easy to maintain, and
  - fit the context of the site.
- A landscape based planning tool was developed to assess the Douglas Creek watershed, an urbanized watershed in Victoria to help answer the following questions:
  - Where and how do you begin to restore a watershed?
  - How do you prioritize and select stormwater retrofit sites?
  - How do you select appropriate BMPs for the site, community or watershed?
  - Is this strictly an engineering problem or are other values important?
- Sub-basins were ranked according to pollution loading, impervious area, land use, and channel density.
- Potential site specific stormwater retrofit types were chosen and given a ranking.
- Based on the sub-basin ranking and the BMP ranking, 3 sites within the watershed were chosen for retrofitting and the BMPs recommended included a rain garden, a stormwater traffic bulge, and swale rehabilitation.

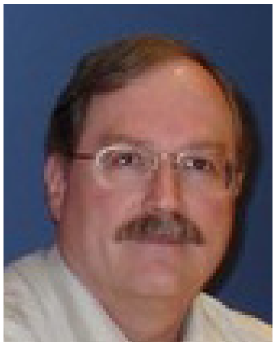
Retrofit options are more likely to be successful when they fit the context of the site.
Source: Scott Murdoch

4.4.7 - Top 10 deisgn considerations for rain gardens

Presented by: Craig Kipkie
Kerr Wood Leidal Associates

Key Points:

- A rain garden is a planted depression that allows rainwater runoff from impervious urban areas like roofs, driveways, walkways and compacted lawn areas the opportunity to be absorbed. This reduces rain runoff by allowing stormwater to soak into the ground (Wikipedia).
- Basic components of a rain garden include: growing medium, vegetation, rock trench (optional for high permeable soils), perforated pipe (optional for high permeable soils), and overflow.
- Benefits of rain gardens include reduction of erosive forces in creeks, protection of fish habitat; protection of water quality and installation of a barrier for point source pollution.
- Top 10 rain garden design considerations are:
    - **Rainwater design criteria**: Should focus on volumetric reduction (capture amount, input volume should equal capture volume). Can calculate capture amount using water balance model, stormwater models or manual methods
    - **Impervious area to rain garden area ratio**: Overloading a rain garden with too much impervious area relative to the receiving rain garden area can overwhelm the plantings. A sediment plume will form and infiltration rates will decrease
    - **Overflow drain heights and soil selection and attributes**: Be careful to match the expected infiltration rate with the incoming rainfall intensities without limiting vegetation growth. Set overflow drain height above rain garden invert to allow for temporary ponding during high intensity events.
    - **Use of under-drains**: Ensures sufficient oxygen remains in the growing area.
    - **Depth of rain garden**: Allow for sediment accumulation.
    - **Curb-edge material**: Grass buffers are far too efficient at trapping sediment, use a drop and slope with non erodible material.
    - **Trees or no trees?** Avoid use of tree canopy because leaves will reduce infiltration rates and interfere with vegetation used to regenerate surface
    - **Where is the infiltrated water going?** Will it pop the road or end up at a foundation wall? Use trench dams to contain water.
    - **Native soil infiltration rates**: Water does infiltrate into rock, clay and glacial till... just slowly. An infiltration test on the native soil before development starts may show extremely low rates, but rates can change with the development of the land.
    - **Depth of rock trenches and pits**: Use caution building rock trenches deeper than 0.8m in low permeable soils.



4.5.1 - Introduction to the Water Balance Model

Case Study: East Clayton Development, City of Surrey

Presented by: Jim Dumont
Senior Technical Specialist, Water Infrastructure
AECOM Canada Ltd.

Key Points:

- Why the Water Balance Model (WBM)?
  - Creation of watershed objectives
  - Quickly establish the predevelopment base line
  - Quickly test alternative LID techniques
  - Measure the performance of future development scenarios
  - Establish the easiest and best ways to achieve the most desirable vision of the future
- Target users of the WBM are engineers, planners, biologists, developers and homeowners.
- The WBM focuses on three measures of impact and mitigation effectiveness:
  - Discharge volume
  - Discharge duration
  - Potential stream erosion
- Three levels of project can be analysed using the WBM: site, development (with or without a stream) and watershed (with a stream).
- The WBM embeds land use zoning from municipal member partners, soil calculator and a calculation engine that utilizes the Environment Canada climate data (i.e, rainfall, snow, temperature and evaporation).
- Typical scenarios include:
  - Pre-development – establish base line for all other scenarios
  - Post-development – establish the worst case
  - Mitigation works – try different mitigation works and sizing
  - Establish best system – performance, then check the cost for local conditions and contractors

4.5.2 - Policy applications of the Water Balance Model

Case Study: North Vancouver District

Presented by: Richard Boase
Environmental Protection Officer
District of North Vancouver

Key Points:

- Local government policy:
    - Usually contains a set of rules or guidelines to ensure that things "undesirable" do not occur anymore
    - Most often is desired to fix a "problem" across all conceivable set of circumstances
    - Will invariably require a number of exemptions due to special circumstances
- Special circumstances can lead to perception that policy is not being fairly and consistently applied.
- What if local government policy:
    - Resulted from something considered desirable
    - Contained a set of rules or guidelines to ensure that things " desirable" continue to occur
    - Was not binding to a rigid and prescriptive set of criteria
- As early as 1997, the North Vancouver District began to realize that rainwater management and not "stormwater" management was the key component to protecting quality of life and property.
- The District turned their attention to the natural landscape comprising their single family zoned lands and neighbourhoods and developed a watershed vision based on the simple objective of leveraging redevelopment and neighbourhood retrofit into opportunities for landscape based watershed restoration.
- The District used the Water Balance Model to help achieve this vision.
- Development of a Water Balance Model "Light" or express version would help to:
    - Use the tool as a mechanism for outreach and education concerning current policy
    - Highlight the things deemed desirable
    - Provide a basis to develop policy that is flexible, provides options and results to sustain desirable things
    - Allow land owners to evaluate their own land from a water sustainability perspective
    - Discover methods to improve their water footprint
    - Get straight forward "how to" guidance and ideas

4.5.3a - Topsoil technical primer for municipal staff and designers

Presented by: Remi Dube
Acting Development Services manager
City of Surrey

Key Points:

- Typical watershed and neighbourhood based standards currently being applied in the City of Surrey provide good examples of the various issues that must be addressed to ensure successful outcomes.
- Enhanced topsoil is a mitigation strategy common to each of Surrey's watershed based performance targets under their Liquid Waste Management Plan.
- In March 2009, the Surrey Water Balance Model Forum led to the development of the Green Infrastructure Partnership (GIP) Topsoil Primer Set.
- The Technical Primer is not intended to be a design guideline or expert system; it is intended to highlight opportunities, constraints and experience.
- Details to consider in setting watershed based performance targets include:
    - Clearly defined need and targets
    - Clearly specified soil mixes
    - Early site design/planning
    - Direct impervious areas
    - Maximum slope, velocity, residency time
    - Safe conveyance
    - Sediment build up
    - Soil handling
    - Subsoil considerations
    - Implementation
- Surrey's experience continues to reinforce the fact that implementing innovative strategies while maintaining the highest level of drainage servicing can only be achieved by setting clear expectations and promoting shared responsibility from design to implementation and operation.

Enhancing topsoil is a mitigation strategy used to help meet Surrey's watershed-based performance targets.
Source: Remi Dube

4.5.3b - Topsoil law and policy primer for municipal staff and designers

Presented by: Deborah Carlson
Staff Counsel
West Coast Environmental Law

Key Points:

- A key challenge common to many green infrastructure projects is that there are many different departments and areas of responsibility engaged around the management of urban watersheds.
- Focusing on a single type of project – in this case " topsoil requirements" – can make it easier to map out the actors involved and the various decisions, actions and regulatory tools required and available to make the project a reality.
- The Topsoil Law and Policy Primer covers:
    - How regional goals (e.g., watershed health) relate to local actions
    - Understanding what the benefits are
    - Internal collaboration at the local level
    - Regulation ideas
    - External collaboration – education and communication
- A "Shared Responsibility Matrix" was developed to identify the actors along with the various instruments that govern their actions.
- Internal collaboration is key to success:
    - need for inter-departmental support
    - leadership required
    - emphasize benefits: cost savings
    - consult early, often and get the details right
    - be aware of political winds
- Things to consider about regulations:
    - key entry points for advancing objective
    - means for securing results & enforcement
    - flexibility in identifying opportunities
    - financial security and performance standards
    - can provide a revenue opportunity to recover costs
    - promote compliance through education and outreach
- External collaboration must include landowners, developers, and builders and must be a two-way communication that emphasizes that outcome depends on all of the pieces coming together.

4.5.4 - Developing a BCWWA position statement

Presented by: Michael MacLatchy
Chair
BCWWA Watershed Management Committee

Key Points:

- The BCWWA has embarked on a process to develop position statements on storm water management to focus on raising awareness of the potential impacts of storm water on receiving waters, risk assessment and mitigation.
- Problem statement for storm water position statement: Should appropriate levels of treatment be required for stormwater?
- It is a multi-faceted issue. The first position statement will focus on water quality issues related to runoff from settlement developed lands (cities and towns).
- Motivation: stormwater is known to be impacting receiving waters, limiting or preventing beneficial uses for recreation, drinking water, agriculture, industry and ecological function.
- Position statement will likely recommend a hierarchy of mitigation strategies:
  - To the extent possible, apply source controls to avoid or prevent impact at site level – apply to new development and re-development as it occurs
  - Use end of pipe approaches to achieve final water quality objectives
    - Especially important for high density areas where land use changes are difficult, or
    - Where existing developments will not be retrofitted or redeveloped for some time, or
    - Where on-site controls are difficult or risky such as steep slopes and/or poor soils.
- There is an opportunity for input to the current analysis/position paper process.
- Future papers to be developed on other aspects of stormwater/rainwater management: volume reduction, reuse, agricultural and industrial runoff

BCWWA
BC WATER & WASTE ASSOCIATION

Appendix A:
Stormwater and rainwater management resources

Climate Modelling Studies – Rainwater Focused (Metro Vancouver)

- Vulnerability of Vancouver Sewerage Area Infrastructure to Climate Change, Metro Vancouver, March 2008 (KWL, AE, Engineers Canada, Ouranos, PCIC)
- Development of GVRD Precipitation Scenarios, Metro Vancouver, October 2002 (KWL)
- GVRD Historical and Future Rainfall Analysis Update, Metro Vancouver, August 2007 (PCIC)
- Climate Change (2050) Adjusted IDF Curves,Metro Vancouver, May 2009 (BGC)

Watershed Protection and Restoration

- Beyond the Guidebook 2010
- Stormwater Planning: A Guidebook for British Columbia, 2002

Web-based provincial tools:

- Water Balance Model
- Water Conservation Calculator
- Agricultural Irrigation Scheduling Calculator
- Landscape Irrigation Calculator
- Okanagan Irrigation Management website
- Waterbucket website

Topsoil Management

- Topsoil: Just How Do You Obtain a Performing Topsoil Layer, to Advance Rainwater Management & Water Conservation Goals? A Law and Policy Primer for Municipal Staff and Designers Available on the West Coast Environmental Law website: www.wcel.org

Climate Change Adaptation

- Pacific Climate Impacts Consortium (PCIC): Climate Change in Prince George – Summary of Past Trends and Future Projections, August 2009
- University of Northern BC and City of PG: Adapting to Climate Change in Prince George: An overview of adaptation priorities, October 2009

Site Adaptive Planning & Design

- Design with Nature, Ian L. McHarg, 1992 – 25th Aniv. Ed.
- Landscape Planning, Environmental Applications, William M. Marsh, fifth edition

Report prepared by

Insight

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