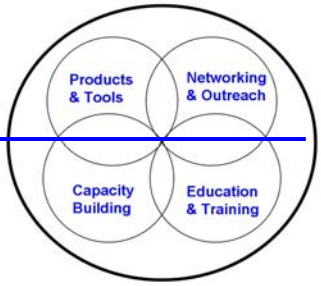
Water Sustainability Action Plan for British Columbia



Beyond the Guidebook:

Context for Rainwater Management and Green Infrastructure in British Columbia

June 2007

BRITISH COLUMBIA
The Best Place on Earth

Fisheries and Oceans Canada
Pêches et Océans Canada

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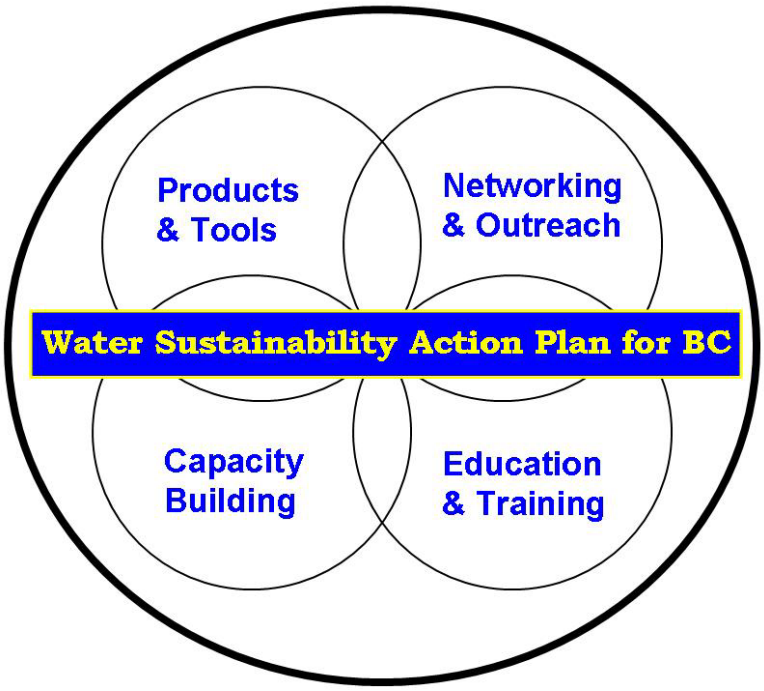
Preface

The British Columbia landscape is being transformed by settlement and economic growth. While the province has been experiencing enhanced social and economic well-being, it has also experienced *avoidable cumulative environmental impacts.* The latter are due to pressures on land and water resources. The desire to mitigate environmental impacts has provided a driver for a 'green infrastructure' movement that is water-centric and is founded on a natural systems approach.

The **Water Sustainability Action Plan for British Columbia** provides a partnership umbrella for an array of on-the-ground initiatives that promote a 'water-centric' approach to community planning and development. One of the tools developed under this umbrella is the **Water Balance Model for British Columbia**.



Developed by an Inter-Governmental Partnership (IGP) as an extension of **Stormwater Planning: A Guidebook for British Columbia**, the Water Balance Model enables users to visualize how to implement green infrastructure solutions that achieve rainwater runoff source control at the site scale. Published in 2002, the Guidebook was a catalyst for change that has resulted in British Columbia achieving international recognition as a leader in implementing a natural systems approach to rainwater management.

The Guidebook's premise that **land development and watershed protection can be compatible** represented a radical shift in thinking in 2002. The Guidebook recognized that water volume is something over which local government has control through its infrastructure policies, practices and standards. **Beyond the Guidebook** is an initiative that builds on this foundation by advancing a runoff-based approach and tool – the **'Water Balance Model powered by QUALHYMO'** – to help local governments achieve desired urban stream health and environmental protection outcomes at a watershed scale.

Ted van der Gulik, P.Eng., Chair
Inter-Governmental Partnership

Paul Ham, P.Eng., Chair
Green Infrastructure Partnership

The **Water Sustainability Action Plan for British Columbia** is sponsored by the Province of British Columbia, and the Action Plan elements are being delivered through partnerships. Through outreach and education, and also by providing tools such as the Water Balance Model, the guiding vision is to influence land and water practitioners to learn about and use practices that better balance the necessary relationships of settlement activity and ecological assets in local and regional landscapes. Under the Action Plan umbrella, the Water Sustainability Committee of the BC Water & Waste Association is the managing partner and is responsible for providing leadership, facilitation and organizational services for program delivery.

Water Balance MODEL Powered By QUALHYMO

MMCD BCWWA BRITISH COLUMBIA WEST COAST environmental law

Green Infrastructure Partnership

WATER Balance MODEL FOR BRITISH COLUMBIA

Vancouver Island Coordinating Team

Partner Organization	Represented By	Position
Inter-Governmental Partnership - Steering Committee		
BC Ministry of Agriculture & Lands	Ted van der Gulik, Chair	Assistant Director / Senior Engineer
Environment Canada	Laura Maclean, Co-Chair	Agri-Environmental Standards Coordinator
Environment Canada	Julia Brydon (alternate)	Pollution Prevention Coordinator
District of North Vancouver	Richard Boase	Environmental Protection Officer
City of Surrey	Remi Dube	Manager, Drainage Planning
City of Surrey	David Hislop (alternate)	Project Engineer, Drainage Planning
Greater Vancouver Regional District	Ed von Euw	Senior Engineer
Greater Vancouver Regional District	Mark Wellman (alternate)	Project Engineer
BC Ministry of Community Services	Glen Brown	A/Director, Municipal Engineering Services
BC Ministry of Community Services	Chris Jensen (alternate)	Infrastructure Resource Officer
BC Ministry of Agriculture & Lands	Jay Bradley	Strategic Land Policy
Department of Fisheries & Oceans	Corino Salomi	Head, Habitat Section, Lower Fraser (West)
Water Sustainability Action Plan	Kim Stephens	Program Coordinator
Inter-Governmental Partnership – Other Partners		
Canada Mortgage & Housing Corp	Cate Soroczan	Policy & Research Division
City of Calgary	Liliana Bozic	Water Quality Research Engineer
District of West Vancouver	Raymond Fung	Manager, Utilities
City of North Vancouver	Tony Barber	Assistant City Engineer
District of Maple Ridge	Andrew Wood	Municipal Engineer
City of Coquitlam	Dave Palidwor	Manager, Park Planning, Design and Construction
City of Vancouver	David Desrochers	Manager, Sewers & Drainage Design
Corporation of Delta	Hugh Fraser	Manager, Utilities
Township of Langley	Sudu Vatagodakumbara	Senior Water Resources Engineer
City of Abbotsford	Art Kastelein	Manager, Transportation and Drainage
City of Chilliwack	Rod Sanderson	Manager, Transportation and Drainage
City of Kelowna	Robin Barnes	Water/Drainage Engineer
City of Courtenay	Kevin Lagan	City Engineer
District of Highlands	Laura Beckett	Planner
District of Metchosin	Joe Martignago	Chief Administrative Officer
Water Balance Model - Vancouver Island Coordinating Team		
BC Ministry of Agriculture & Lands	Jay Bradley, Chair	Strategic Land Policy & Legislative Services Br
BC Ministry of Community Services	Chris Jensen, Co-Chair	Infrastructure Resource Officer
BC Ministry of Environment	Peter Law	Habitat Biologist
Department of Fisheries & Oceans	Al Magnan	Project Assessment Biologist
City of Courtenay	Sandy Pridmore	Engineering Technologist
Green Infrastructure Partnership - Steering Committee		
Master Municipal Construction Documents Association	Paul Ham, Chair	General Manager, Engineering, City of Surrey
BC Water & Waste Association	Raymond Fung	Chair, BCWWA Water Sustainability Committee
BC Ministry of Community Services	Dale Wall	Assistant Deputy-Minister, Local Government
BC Ministry of Community Services	Meggin Messenger	Intergovernmental Relations & Planning Division
West Coast Environmental Law	Susan Rutherford	Staff Counsel
Water Sustainability Action Plan	Kim Stephens	Program Coordinator
BCWWA Water Sustainability Committee - Steering Group		
District of West Vancouver	Raymond Fung, Chair	Manager, Utilities
BC Ministry of Agriculture & Lands	Ted van der Gulik, Vice-Chair	Assistant Director / Senior Engineer
Water Bucket Website Partnership	Mike Tanner, Vice-Chair	BC Hydro PowerSmart (retired)
BC Water & Waste Association	Eric Bonham	Leadership Council
Water Sustainability Action Plan	Kim Stephens	Program Coordinator

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1. What is Rainwater Management, Really?

In British Columbia, the technical vocabulary of drainage practitioners is in transition as the single function view of traditional **'stormwater management**' gives way to the integrated and comprehensive perspective that is captured by the term '**rainwater management**'.

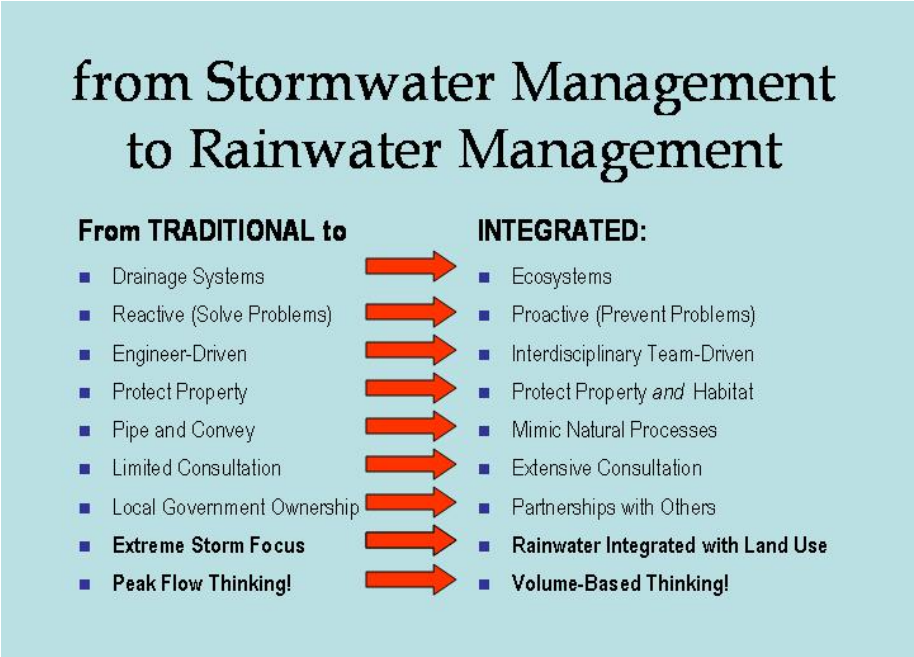
Stormwater suggests there is a problem, whereas rainwater is a resource. The evolution to an integrated approach over the past two decades is summarized in the graphic below.

Scope: The purpose of this document is to provide context for comprehensive **rainwater management** by connecting the dots between *Stormwater Planning: A Guidebook for British Columbia*, published in 2002, and:

- the rainfall spectrum;
- performance targets;
- adaptive management;
- the Water Balance Model;
- the Green Infrastructure Partnership;
- the UBC Tree Canopy Research Project; and
- the *Beyond the Guidebook* initiative.

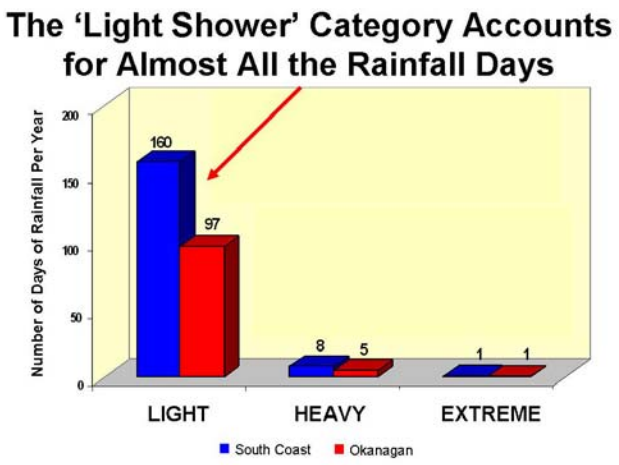
The Guidebook established the framework for rainfall capture and a performance target way-of-thinking and designing. *Beyond the Guidebook* will take the Guidebook to the next level of evolution. Now that practitioners are becoming comfortable with what 'rainfall capture' means in practice, local governments and the development community are in a position to turn their attention to what is an achievable outcome that makes sense and results in net environmental benefits at a watershed scale.

Why Beyond the Guidebook: Through implementation of 'green infrastructure' policies and practices, the desired outcome in going *Beyond the Guidebook* is to apply what we have learned at the site scale over the past five years…so that we can truly protect and/or restore stream health in urban watersheds.



2. Integrated Strategy for Managing the Rainfall Spectrum

The Guidebook introduced the concept of an **integrated strategy** for managing all the 'rainfall-days' that occur each year. In 2002, this represented a major shift in thinking, from reactive to proactive. The Guidebook also highlighted the universality of certain relationships.



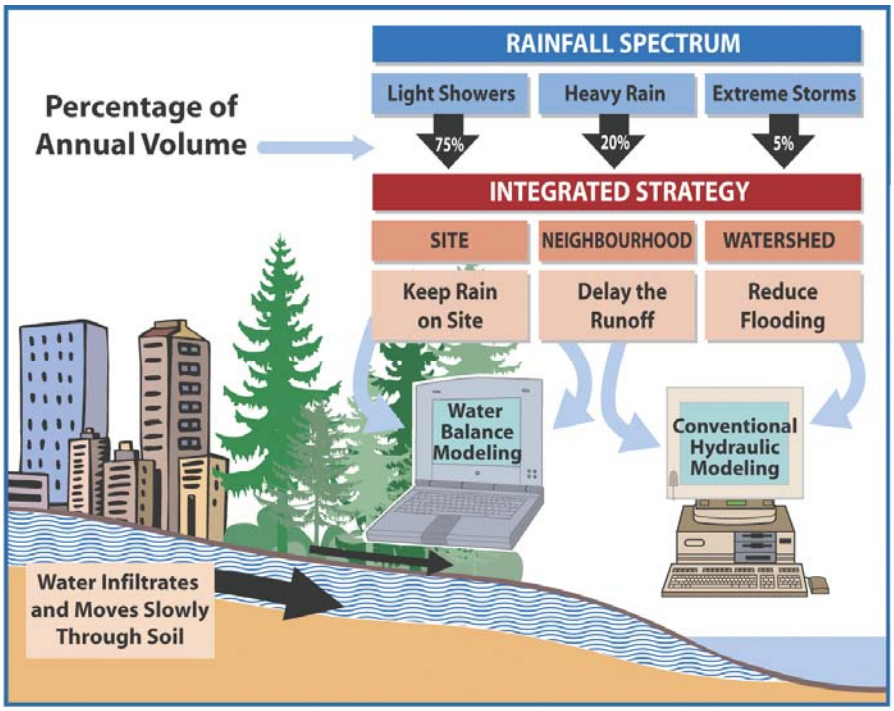
Educational Context: At the time of Guidebook publication, these two graphics proved to be powerful education tools because they:

- helped to change the way drainage practitioners and others view rainfall;
- focussed attention on the distinction between *rainfall capture* and *runoff control*; and
- promoted understanding of why infiltration is achievable for much of the year.

Circa 2000, there was fear and doubt that anything could be done to prevent rainwater runoff. These graphics were a key to changing the core beliefs of drainage practitioners.

Key Message: The graphic opposite illustrates the *integrated strategy* for protection of life, property and the environment that is being implemented throughout British Columbia as a result of publication of the Guidebook and development of the Water Balance Model.

A key message is that 'light showers' account for most of the annual rainfall volume; and therefore 'green' or landscape-based solutions will achieve a variety of objectives encompassing both the site and watershed scales in the urban environment



3. Performance Targets

The Guidebook also introduced the concept of **performance targets** to facilitate implementation of the *integrated strategy* for managing the complete rainfall spectrum. To create a mind-map for practitioners, the rainfall spectrum was defined in terms of three tiers, with each tier corresponding to a component of the integrated strategy, namely:

- **Rainfall Capture** - keep rain on site by means of 'rainfall capture' measures such as rain gardens and infiltration soakaways
- **Runoff Control** - delay overflow runoff by means of detention storage ponds which provide 'runoff control'
- **Flood Mitigation** – reduce flooding by providing sufficient hydraulic capacity to 'contain and convey'

Defining rainfall tiers simply enabled a systematic approach to data processing and identification of rainfall patterns, distributions and frequencies.

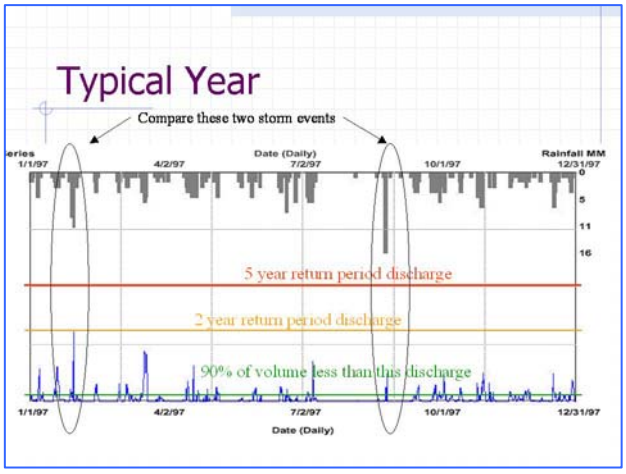
Historical Context: For convenience, and to provide a starting point for analysis, the Guidebook referenced the three tiers to a value defined as the **Mean Annual Rainfall** (MAR). As our understanding of what is achievable through 'rainwater management' has grown, we have moved beyond this early concept. Looking back:

- The MAR concept was introduced in part to provide consistency with the *1992 Land Development Guidelines.*
- It established a point of departure that was familiar to practitioners so they would readily make the transition to a new way of thinking.
- In 2002, focussing attention on the MAR facilitated a paradigm-shift in the state-of-the-practice.

Introduction of the MAR focused attention upon the site level while assuming there would be benefits to the watershed and streams. Our knowledge is progressing and we now see a need to begin to evaluate the total spectrum of rainfall and the flows entering the streams from the watershed.

Role of Performance Targets: Rainwater runoff capture targets provide a starting point to guide the actions of local government and the development community in the right direction.

A simple chart of rainfall and stream flow for a typical year follows and shows some of the complex processes involved in the watershed between the time rain falls and when it reaches the stream. This leap in our knowledge plus the development of the tools available to assess these relationships allows us to go *Beyond the Guidebook* in establishing reasonable and achievable performance targets. The next step in advancing our knowledge allows us to focus upon the stream, the critical item that is so important to the environment.

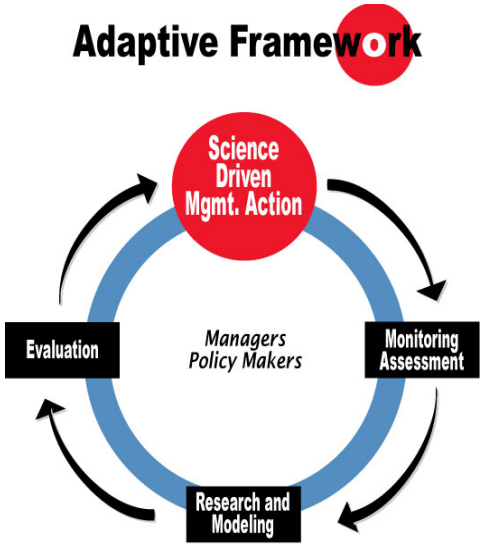


Volume-Based Approach: To be understood and effective, a performance target needs to synthesize complexity into a single number that is simple to understand and achieve, yet is comprehensive in scope. A **runoff volume-based** performance target fulfills these criteria.

For a performance target to be implemented and effective, it must then have a feedback loop so that adjustments and course corrections can be made over time. Volume-based thinking leads directly into landscape architecture, green roofs, urban reforestation, groundwater recharge, and rainwater harvesting.

4. Adaptive Management

The Guidebook is a pioneer application in North America of 'adaptive management' in a rainwater management setting. In the Guidebook, *adaptive management* means: **We change direction when the science leads us to a better way**.



Building on the concept of tiers, the Guidebook developed a **6-step methodology** for setting performance targets and site design guidelines (Reference: Chapter 6). The Guidebook emphasis, however, is on the last two steps in the 6-step methodology, namely:

- **Evaluate source control options through *continuous simulation* water balance modeling (Step #5)** – because continuous simulation provides a tool to evaluate site design options under a full range of operating conditions (i.e. the complete rainfall spectrum).
- **Optimize rainwater system design through adaptive management - 'learning by doing' - (Step #6)** – because performance monitoring would be expected to confirm that initial assumptions based on the Water Balance Methodology are conservative; and if so, this would provide the certainty needed to reduce the size of facilities installed in subsequent developments.

Learning by Doing: The goal of adaptive management is to learn from experience and constantly improve rainwater management practices.

When *Stormwater Planning: A Guidebook for British Columbia* was published in 2002, its success and acceptance were keyed to the fact that the water balance methodology had been vetted through the case study experience of local governments and the development community.

The concepts and methodologies in the Guidebook were intended to stimulate a change in the mindset of practitioners and others, rather than cast in stone a set of prescriptive rules.

The Guidebook emphasizes that rainfall capture targets will depend on site and watershed-specific conditions.

Implicit in an adaptive management approach is recognition of the need to both **accept and manage risk** if the state-of-the-practice is to be advanced. Accepting risk opens the door to engineering creativity and resulting innovation.

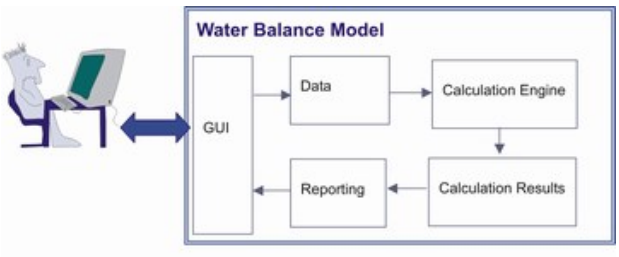
Performance Monitoring: Major projects - such as *UniverCity* on Burnaby Mountain, *East Fraserlands* in the City of Vancouver, and *Westhills* in the City of Langford - lend themselves to adaptive management when they are implemented in phases over a multi-year period. Phasing creates opportunities to monitor performance of rainwater capture facilities, assess effectiveness over time, and refine design criteria as may be needed or desired in subsequent phases.

Over the past five years, experience has shown that landscape-based measures for rainfall capture are typically low risk, especially when they reflect an understanding of how to employ soil depth and planting coverage to best advantage. This experience has set the stage for the next leap forward – which is to apply a 'runoff-based approach' to rainwater management at a watershed scale.

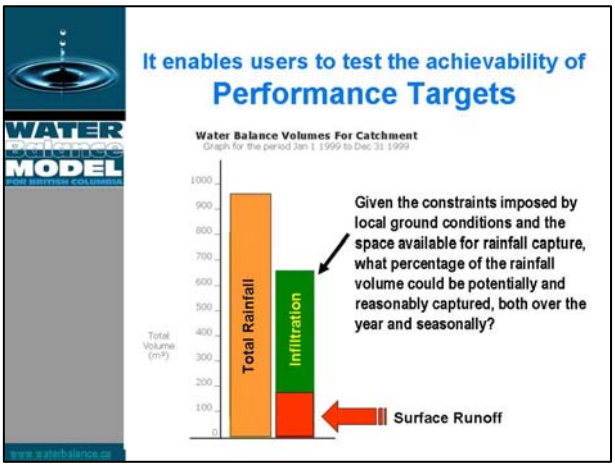
5. Water Balance Model

To enable practitioners to undertake continuous simulation (Step #5) and adaptive management (Step #6) as introduced on the previous page, the Inter-Governmental Partnership developed the **Water Balance Model for British Columbia** (WBM) in 2003 as an online decision support and scenario modeling tool.

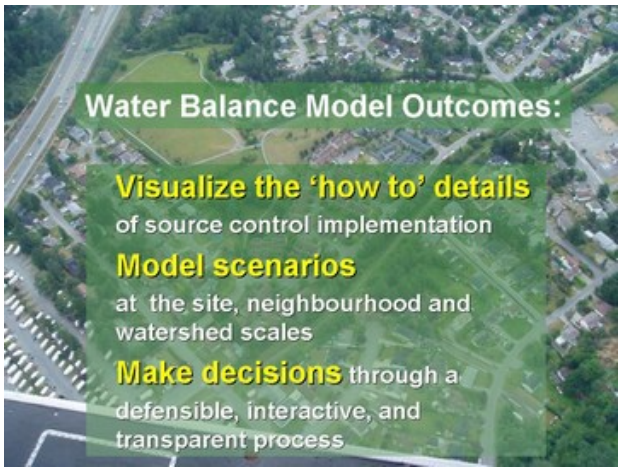
Achieve a Light Hydrologic Footprint: Because the WBM demonstrates how to achieve a light 'hydrologic footprint', the tool helps planners and designers wrap their minds around how to implement 'green solutions' on-the-ground.



The power of the WBM process lies in the conversations that result from users generating a single number – the percentage of rainfall that becomes runoff - that represents the synthesis of each scenario. Comparison of scenarios creates understanding, especially when the focus is on the hydrologic implications of the assumptions that underpin those percentages.



Improve the Built Environment, Protect the Natural: The WBM quantifies the effectiveness of site designs that incorporate rainwater source controls such as rain gardens, tree canopy, green roofs, absorbent soil, and infiltration facilities. It does a continuous simulation over one or more years to test facility performance under different combinations of land use, soil and rainfall.



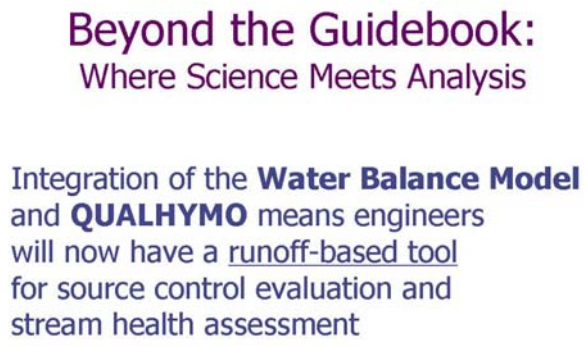
Integrate Perspectives: Another outcome associated with the WBM is that it facilitates an interdisciplinary approach that enables planning and design professionals to collaborate to achieve community liveability objectives.

6. Beyond the Guidebook

A goal of the Inter-Government Partnership is to build on the Guidebook foundation by providing practitioners with the tools and experience to advance the state-of-the-practice in rainwater management. Accordingly, the Partnership has launched an initiative called **Beyond the Guidebook**.

The purpose of this initiative is to help local governments and the development community establish what level of rainwater runoff volume reduction makes sense at the site, catchment and watershed scales.

Under the *Beyond the Guidebook* umbrella, the WBM is being integrated with QUALHYMO, a continuous simulation tool developed by the Ontario Ministry of the Environment in the early 1980s for rainfall-runoff modelling.



The *Beyond the Guidebook* methodology will allow practitioners to assess both site-level rainwater management measures AND flood relief projects so that they can develop a watershed approach that addresses stream protection and/or restoration. In the process, practitioners will view the watershed and its streams from a much more holistic perspective.

The Department of Fisheries and Oceans (DFO) is a participant in the 'Beyond the Guidebook' process, in part because this runoff-based approach is intended to resolve performance concerns arising from misapplication of a 4-page document originally released by DFO in 2000 and titled *Urban Stormwater Guidelines and Best Management Practices for Protection of Fish and Fish Habitat*.

Mind-Map: The '*Water Balance Model powered by QUALHYMO*' will enable engineers to go 'Beyond the Guidebook' in developing truly integrated solutions for protecting life, property and the aquatic environment. A synopsis or mind-map of the direction in which rainwater management is heading is described by these sound-bites:

- **2002 Stormwater Guidebook:** *"thinking like a site"* – i.e. reduce runoff volume
- **QUALHYMO:** *"one-stop shopping"* – i.e. so engineers can model what overflows from source controls
- **Beyond the Guidebook:** *"thinking like a watershed"* – i.e. protect stream health

Milestones: The process of rolling out *Beyond the Guidebook* started in June 2006 with the Showcasing Innovation event hosted by the City of Surrey as part of the *Celebrating Green Infrastructure Program*.

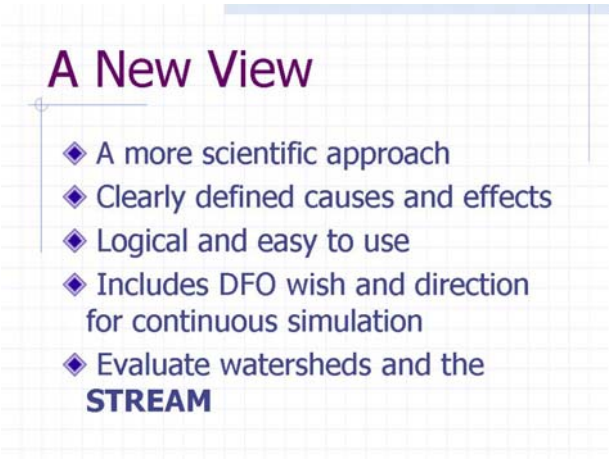
It continued with the article published in the September/October 2006 issue of *Innovation Magazine*, the journal of the Association of Professional Engineers and Geoscientists of British Columbia.

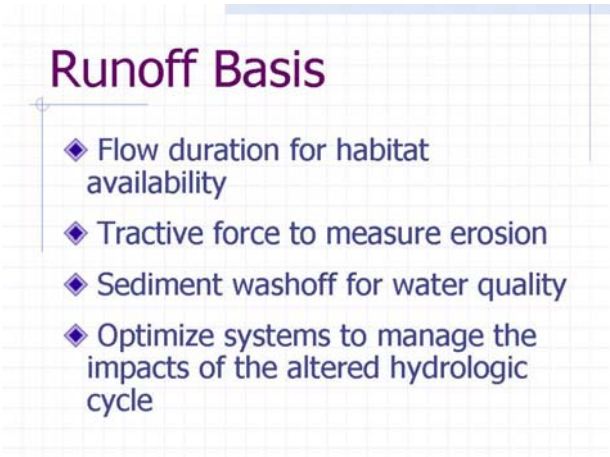
The third milestone was the Water Balance Model Partners Forum in March 2007, at which time the 'runoff-based approach' was formally unveiled.

The target date for completion of the beta-testing for the *"Water Balance Model powered by QUALHYMO"* is late 2007.

Case Studies: The *Beyond the Guidebook* rollout process is being informed by the experience gained from two Greater Vancouver projects: the *Fergus Creek watershed plan* by the City of Surrey; and the *East Fraserlands project* in the City of Vancouver. The former demonstrates how to protect stream health in the suburban environment; the latter demonstrates how to maximize rainfall capture in a high density urban development.

Fergus Creek Pilot: The pilot for *Beyond the Guidebook* is the City of Surrey Fergus Creek watershed plan that is in the final stages of completion. The plan is based on implementing 'green solutions' as an alternative to conventional engineered 'blue solutions'. There will be no large-scale storage ponds. Rather, rainwater runoff volume will be mostly managed through the creation of contiguous large-scale greenways.





Application of DFO Guidelines: Drainage practice is at a crossroad in the path defining the methodologies and applications used in rainwater management. *Beyond the Guidebook* enables practitioners to make a clear distinction between a **rainfall-based approach** and a **runoff-based approach**. Furthermore, the science-based analytical methodology that has been validated through the Fergus Creek pilot now enables local governments to explore the fundamental requirements implicit in the DFO Guidelines for stream health and environmental protection.

Further to the above, a basic tenet of hydrology is that rainfall and runoff have different return periods. Yet drainage practitioners persist in applying a rainfall-based approach that assumes rainfall will always result in the same magnitude of runoff. The *Rainfall-Based Approach* grew out of simple to use methodologies that address the reduction of flood risk for drainage conveyance systems. The *Runoff-Based Approach*, on the other hand, leads to the analysis of runoff and its interaction with the physical aspects considered important to the aquatic environment.

Water Balance Model powered by QUALHYMO: The principal focus of the existing Water Balance Model is on source controls for runoff volume reduction. For drainage engineers, however, a practical modelling tool must also concentrate on the overflows from the site. This is the significance of integrating the Water Balance Model with QUALHYMO. The integrated tool will have the capability to store and route the overflow from a subdivision and/or neighbourhood through a detention pond or down a stream channel.

The Fergus Creek experience is being ported into the integrated tool so that the *Water Balance Model powered by QUALHYMO* will enable correlation of runoff volume management with desired stream erosion and water quality outcomes. The methodology for assessing the potential for erosion or sediment accumulation within a watershed is based upon shear stress as applied to the stream banks over time. This is a measure of the energy available to cause erosion in a stream. Continuous simulation is the key to generating scenario comparisons.

7. Green Infrastructure Partnership

Formed in 2003, the *Green Infrastructure Partnership* is promoting an integrated approach to land development and infrastructure servicing that addresses the need for coordinated change at different scales – that is: region, neighbourhood, site and building.

Under the umbrella of the Water Sustainability Action Plan, the *Green Infrastructure Partnership* mission is to facilitate implementation of infrastructure practices and regulation province-wide that embody a 'design with nature' way-of-thinking and acting. An over-arching goal is to protect and/or restore the natural environment by improving the built environment. This is the essence of why we *design with nature*.

Because use of the *Water Balance Model* can facilitate better land use decisions and 'greener design', the Green Infrastructure Partnership has embraced the tool as an element of its Outreach and Continuing Education Program; and is collaborating with the Inter-Governmental Partnership to promote use of the tool province-wide.

Showcasing Innovation Series: As an outcome of the 2005 Consultation Workshop, organized in collaboration with the Greater Vancouver Regional Engineers Advisory Committee (REAC), the Green Infrastructure Partnership undertook to organize **Celebrating Green Infrastructure: Showcasing Innovation in the Greater Vancouver Region**.

The program was initiated in 2006 with a series of three events – each comprising a seminar in the morning followed by a field tour in the afternoon – with the first two hosted by the District of North Vancouver and the City of Surrey; and the third co-hosted by the City of Vancouver and UBC.

In 2006, the City of Surrey showcased the Fergus Creek plan to demonstrate what it believes can be systematically accomplished on-the-ground, at a watershed scale, now and over the next 50 years by building on the experience gained from the East Clayton Sustainable Community.

In 2007, the Showcasing Innovation program has been expanded to Vancouver Island. Three regional districts (Nanaimo, Comox-Strathcona, and Cowichan Valley) are partnering with their member municipalities under the umbrella of the **Convening for Action on Vancouver Island** (CAVI) partnership to host events.

8. UBC Tree Canopy Interception Research Project

The tree canopy is an important component of the water balance, with rainfall interception easily accounting for up to 35% of gross annual precipitation.

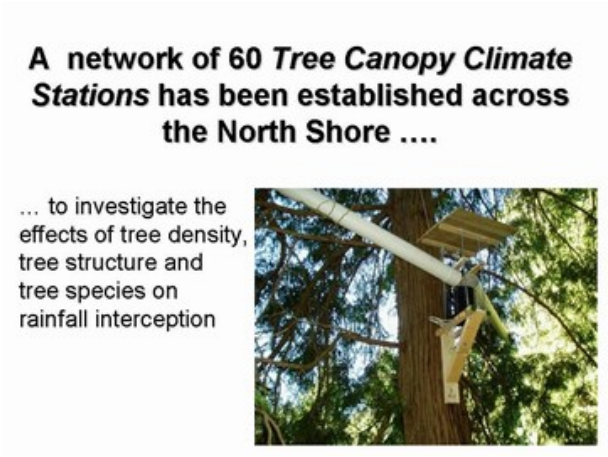
Research Need: The genesis for the *UBC Tree Canopy Interception Research Project* was provided by the initial collaboration between the University of British Columbia (UBC) and the Inter-Governmental Partnership in 2005 to develop a 'Tree Canopy Module' for the *Water Balance Model for British Columbia*.

While considerable research has been undertaken in forest stands in the natural environment to quantify rainfall interception, very little has been done in an urban setting anywhere in North America.

The project is therefore precedent-setting in its scope and will directly inform urban planning in British Columbia. The research results will also be used to populate the Tree Canopy Module with rainfall interception data.

A Regional Partnership: Collaboration between the University of British Columbia (UBC), the Greater Vancouver Regional District, the three North Shore municipalities, the Province, the Real Estate Foundation, and the Inter-Governmental Partnership has opened the door to a long-term partnership to bring science into the community:

- Because of the urban context for the research program, a principal focus is on quantifying the interception effectiveness of a single tree versus that for a cluster of trees.
- The variables influencing the interception process will be explored and quantified.
- Researchers will investigate the effects of tree density, tree structure and tree species on rainfall interception.



The Right Trees in the Right Places: There may be an optimum of tree density and structure whereby the interception is largest for a certain tree density. If this density can be determined, or even the relation of tree density to interception loss, local governments could provide urban developers with guidance as to how many trees need to be maintained within a residential lot to maintain a certain interception effect.

9. Summary

Over the past two decades, drainage vocabulary has been evolving as the planning focus has progressively expanded: from the channel in the 1980s…to the riparian corridor in the 1990s…and to land development practices in the 2000s.

In the 2000s, rainwater management practitioners are advancing the design of green infrastructure so that *cumulative benefits* rather than *cumulative impacts* can accrue over time at a watershed scale.

The First Paradigm-Shift:

When *Stormwater Planning: A Guidebook for British Columbia* was published in 2002, it set in motion a chain of outcomes that has resulted in British Columbia being recognized internationally as a leader in implementing a natural systems approach to rainwater management in the urban environment.

One of the Guidebook outcomes was the *Water Balance Model for British Columbia*. This tool has helped practitioners from different disciplines wrap their minds around how to achieve a light 'hydrologic footprint' and implement 'green solutions'.

The lasting impact of the Guidebook is that it changed how people view site development practices, and it got them thinking about how to change those practices for the better.

The Next Paradigm-Shift:

Beyond the Guidebook is a runoff-based approach to urban drainage modeling that connects the dots between source control evaluation and stream health assessment. This approach is 'where science meets analysis' because **rainwater runoff volume management** is directly linked to **stream erosion** and **water quality**.

Integration of the Water Balance Model with QUALHYMO will enable hydrological engineers to go *Beyond the Guidebook* in achieving stream health protection and water quality objectives. The integrated tool - the *'Water Balance Model powered by QUALHYMO'* - will enable assessment of source control performance plus simulate what happens to 'overflows' once source controls have reached their absorptive capacity.

Finally, this is what *adaptive management* means: **We change direction when the science leads us to a better way**.

Appendix A
Resources

Local Government Responsibility for Drainage

The Guidebook included a synopsis of drainage law and the authority of local government to implement rainwater management solutions. Local governments have extensive and very specific tools available to them. They also have the discretion to use them or not. Decisions about a local government's appropriate level of involvement in rainwater and stream corridor management must therefore be guided by a set of clear, broadly agreed-upon objectives, as well as an understanding of the need for balance with other competing objectives and interests.

British Columbia Case Law: The courts see the impact of drainage on property as a 'nuisance', where a landowner's use and enjoyment of his or her lands are interfered with as a result of actions or conduct on neighbouring lands. The courts have established precedents concerning the following:

- Right to drain land (allowing surface water to escape in a way provided by nature)
- Right to block drainage (surface water draining from higher land, as opposed to water in a natural stream)
- Measures of damages (damages will be awarded where liability is established)

In British Columbia, the *Local Government Act* has vested the responsibility for drainage with municipalities. This *Act* also enables local governments to address rainwater management much more comprehensively than in the past. The challenge is to use this legislation to achieve comprehensive goals and objectives in appropriate and effective ways. Division 6 of the Act (Sections 540 – 548) gives local government the direct power to manage rainwater: http://www.qp.gov.bc.ca/statreg/stat/L/96323_17.htm#part15_division6

Liability for Downstream Impacts Due to Changes in the Water Balance: With the statutory authority for drainage, local governments can be held liable for the nuisance caused by drainage to downstream property owners. To assist in understanding the scope of local government liability, three relatively recent cases were presented in the Guidebook.

- **Case 1 - Indexed as: Kerlenmar Holdings v. Matsqui (District) and District of Abbotsford**

  Judgement - June 1991 (From British Columbia Law Reports 56 B.C.L. R. (2d) p. 377 – 387.)

- **Case 2 - Indexed as: Medomist Farms Ltd. v. Surrey (District)**

  Judgement – December 1991 (From British Columbia Law Reports 62 B.C.L. R. (2d) p. 168-177.)

- **Case 3 - Indexed as: Peace Portal Properties Ltd. v. Corporation of the District of Surrey**

  Judgement - May 1990 (From Dominion Law Reports 70 D.L. R. (4th) p. 525-535.)

In all three cases, the Court of Appeal in the Province of BC has upheld the decisions. These cases underscore the responsibility of local government for rainwater volume management.

Authority to Implement Rainwater Management Solutions:

Some key *Local Government Act* planning, regulation, development approval and servicing provisions applicable to rainwater management are summarized below:

Regional Growth Strategy and Official Community Plan Goals

Section 849 (2) provides goal statements for:

- Protecting environmentally sensitive areas
- Reducing and preventing air, land and water pollution
- Protecting the quality and quantity of groundwater and surface water

Prohibition of Pollution

Section 725.1 enables local governments to enact bylaws prohibiting water pollution and to impose penalties for contravening these.

Soil Deposit and Removal (Erosion Control)

Section 723 enables local governments to include erosion control and sediment retention requirements associated with soil deposition and removal.

Zoning

Section 903 enables the prohibition or siting of regulated land uses that, for instance, generate non-point source pollution.

Environmental Policies

Section 879 enables *Official Community Plans* (OCPs) to include "policies of the local government relating to the preservation, protection and enhancement of the natural environment, its ecosystems and biological diversity".

Development approval information areas or circumstances (Section 879.1) enable the designation of areas or circumstances, or areas for which in specified circumstances, development approval information may be required.

Runoff Control

Section 907 enables local governments to set maximum percentages of areas that can be covered by impermeable material and to set requirements for ongoing drainage management.

Landscaping

Section 909 enables local governments to set standards for and regulate the provision of landscaping for the purposes of preserving, protecting, or restoring and enhancing the natural environment (e.g. requiring streamside vegetation).

Development Permit Areas

Development permit areas designated in an Official Community Plan (see Section 919.1) cannot be altered, subdivided, or built on without a development permit. The permit can contain conditions for the protection of the environment.

Subdivision Servicing Requirements

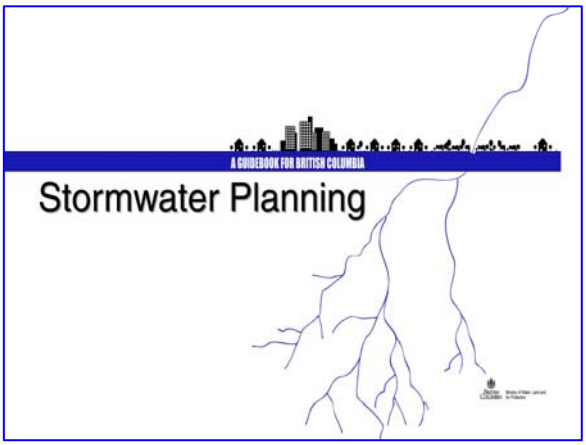
Section 938 enables a local government to "require that, within a subdivision"… "a drainage collection or a drainage management system be provided, located and constructed in accordance with the standards established in the bylaw"

In addition to the above, other rainwater management powers can be found in provisions dealing with building regulations, contaminated sites, development cost charges, ditches and drainage, dikes, development works agreements, flood protection, farming, highways, improvement districts and specified areas, park land, regional district services, sewage systems, subdivision, temporary commercial and industrial use, tree cutting, utilities, water and waste management.

Rainwater Management Tools in British Columbia

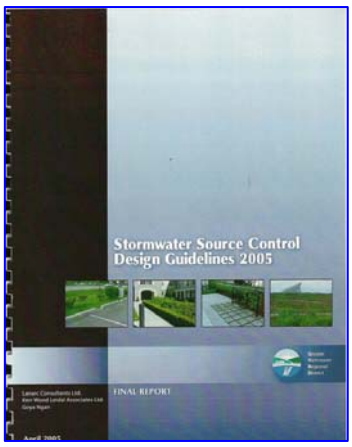
Rainwater management is a key component of protecting quality of life, property and ecosystems. Rainwater management is a requirement for approved *Liquid Waste Management Plans (LWMP).* LWMPs are created by local governments under a public process in cooperation with the Province. In the Greater Vancouver region, for example, municipalities are legally obligated to fully implement integrated rainwater management policies, plans and practices by 2012.

GUIDEBOOK: In 2002, the Province published ***Stormwater Planning: A Guidebook for British Columbia***. The Guidebook formalized a science-based understanding to set performance targets for reducing rainwater runoff volumes from individual sites.



WATER BALANCE MODEL: Also in 2002, an Inter-Governmental Partnership was formed to develop the web-based ***Water Balance Model for British Columbia*** as an extension of the Guidebook. The Partnership recognized that practitioners and others needed an easy-to-use tool so that they could readily calculate annual runoff volumes under different combinations of building coverage, rainfall, soil type and depth, tree canopy coverage, and source controls.

DESIGN GUIDELINES: To complement the Water Balance Model, the Greater Vancouver municipalities commissioned a set of ***Source Control Design Guidelines*** for landscape-based solutions – that is, absorbent landscapes, rain gardens, pervious pavers, infiltration swale systems, infiltration trenches and green roofs – for reducing rainwater runoff volumes. Published in 2005, the Guidelines are supplemented by a set of posters that display the results of the applied research. The Guidelines were adapted from design standards from areas of England, Europe, Australia, New Zealand and North America with comparable soil and climate conditions to southwest British Columbia.



WATER BALANCE MODEL POWERED BY QUALHYMO: In 2005, the Inter-Governmental Partnership initiated integration of the Water Balance Model with QUALHYMO.

Web links for the foregoing are listed as follows:

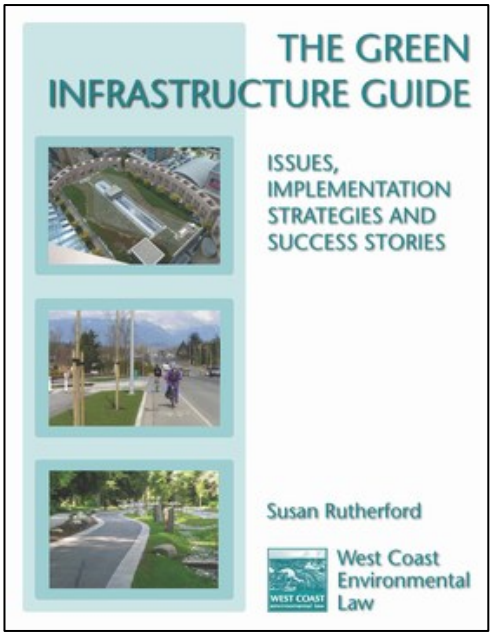
- Stormwater Planning: A Guidebook for British Columbia
  http://www.env.gov.bc.ca/epd/epdpa/mpp/stormwater/stormwater.html
- Water Balance Model for British Columbia:
  http://www.waterbalance.ca
- Stormwater Source Control Design Guidelines 2005
  http://www.waterbucket.ca/rm/index.asp?sid=18&id=236&type=single

The Green Infrastructure Guide

Published in 2007, *The Green Infrastructure Guide: Issues, Implementation Strategies and Success Stories* was developed by West Coast Environmental Law and is a deliverable under the Outreach and Continuing Education Program of the Green Infrastructure Partnership.

The Guide builds on a body of work that has preceded it, and is designed to be used in conjunction with the range of important resources available from various organizations and government to support a sustainable approach to community development of infrastructure.

The Guide is designed to complement *Stormwater Planning: A Guidebook for British Columbia* and serve as a useful backdrop for conversations to take place both within and beyond the local government's planning department and legal advisors.



Distinguishing Natural from Engineered Green Infrastructure: Two complementary strategies can "green" a community and its infrastructure: first, preserving as much as possible of the natural green infrastructure; and secondly, promoting designs that soften the footprint of development.

Green infrastructure design is engineering design that takes a 'design with nature' approach, to both mitigate the potential impacts of existing and future development and growth and to provide valuable services.

The Guide provides guidance on how local governments may, using legal and policy strategies, encourage or require more sustainable infrastructure designs. It refers readers to strategies, and highlights case studies of local governments that have already taken steps to incorporate a green infrastructure approach. The focus is on implementation mechanisms, issues and barriers, and on what lessons have been learned from experiences to date.

Legal and Policy Strategies to Support Green Infrastructure: The Guide traces some of BC's local government experience in implementing engineered green infrastructure designs. The Guide's purpose is to encourage successful designs, by reporting on what the legal and policy strategies are, what some of the implementation hurdles (and solutions) have been, and how they have been effective in achieving sustainability goals.

The intent is to support the efforts of local government officials and decision-makers to green their community's infrastructure, by sharing the tools and the collective wisdom that have been gained as a result of implementation experiences from around the province.

The web link for downloading the Guide is:
http://www.wcel.org/wcelpub/2007/14255.pdf

Water Bucket Communities-of-Interest

For stories and information on the latest developments in BC relating to the state-of-the-art, go to either of these communities-of-interest (COI):

- www.rainwater-management.ca or
- www.greeninfrastructure.ca

Funding for the *Rainwater Management COI* was provided by the Greater Vancouver Regional District through the Stormwater Interagency Liaison Group, a technical committee that is constituted under provisions of the Liquid Waste Management Plan for the GVRD.

The *Green Infrastructure COI* was funded by the Province of British Columbia in order to provide the Green Infrastructure Partnership with a communication vehicle

For a historical perspective on the British Columbia experience, and to understand the changes that have seen the single function view of traditional 'stormwater management' give way to the integrated and comprehensive perspective that is captured by the term 'rainwater management', go to:

- http://www.waterbucket.ca/rm/index.asp?sid=43&id=13&type=single
- http://www.waterbucket.ca/rm/index.asp?sid=49&id=320&type=single

For more on the Tree Canopy Research Project that is being undertaken by the University of British Columbia in collaboration with the three North Shore municipalities (District of North Vancouver, District of West Vancouver, and City of North Vancouver), the Water Balance Model Partnership, the Greater Vancouver Regional District, the Province of British Columbia, and the Real Estate Foundation of British Columbia, go to:

- http://www.waterbucket.ca/rm/index.asp?sid=43&id=328&type=single
- http://www.waterbucket.ca/rm/index.asp?sid=43&id=292&type=single