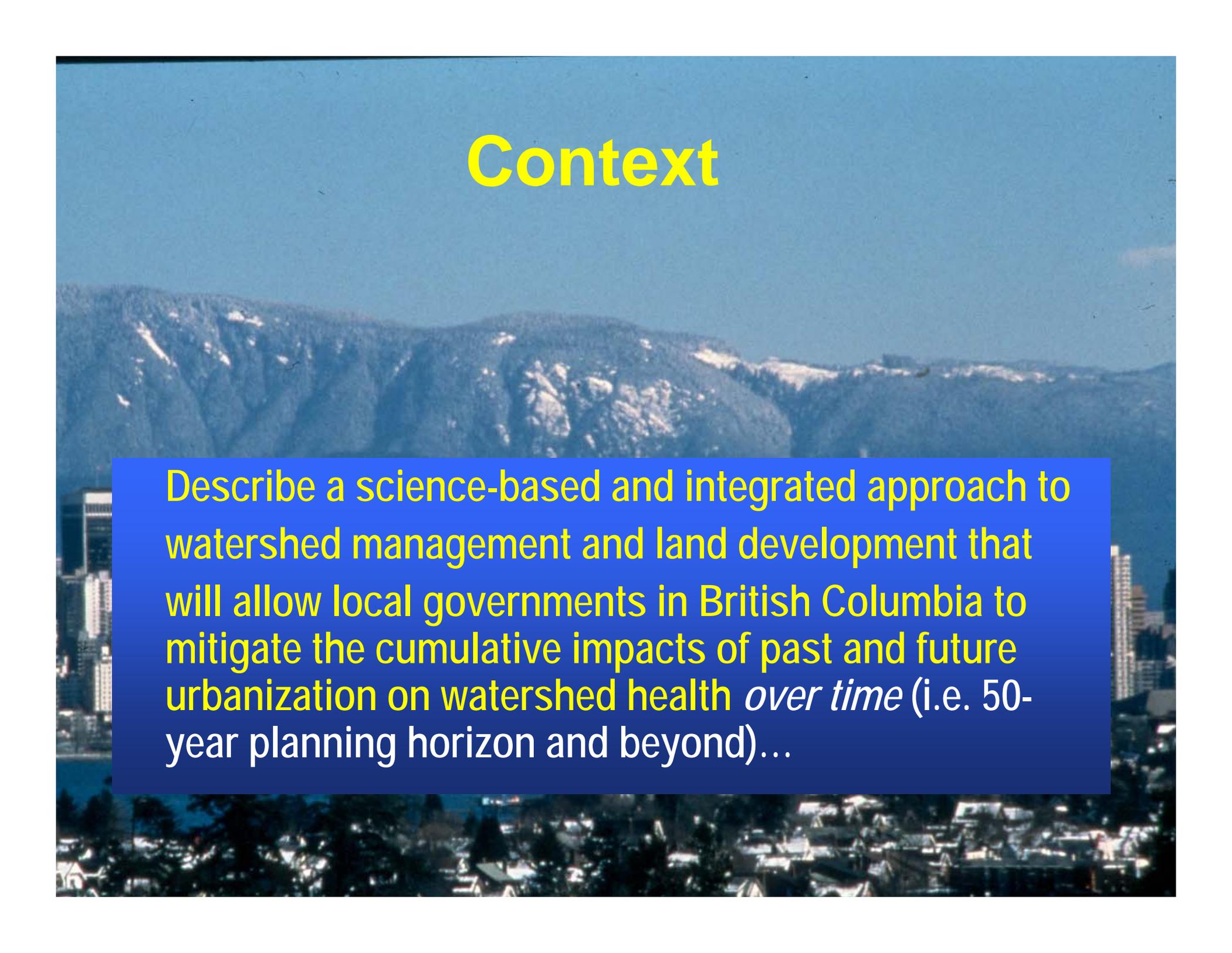




# New Stormwater Planning Tools for British Columbia

Sponsored by the BC Water & Waste Association

# Context

A scenic view of a city, likely Vancouver, with mountains in the background. The city buildings are visible in the lower left and right, and the mountains are in the center and background. The sky is clear and blue.

Describe a science-based and integrated approach to watershed management and land development that will allow local governments in British Columbia to mitigate the cumulative impacts of past and future urbanization on watershed health *over time* (i.e. 50-year planning horizon and beyond)...



## Recent initiatives that are shaping Stormwater Management in British Columbia include:

- Burnaby Mountain Sustainable Community
- East Clayton Sustainable Community
- **Stormwater Planning:  
A Guidebook for British Columbia**
- GVRD Template Terms of Reference for Integrated Stormwater Management Planning
- GVRD Stormwater Source Control Evaluation
- Water Balance Model for BC

# The Desired Outcome for today's presentation is that you....

- will understand why there is a need to:
  - Mimic 10% impervious area
  - Reduce stormwater runoff volume
  - Restore watersheds over time
  - Move from talk to action



A GUIDEBOOK FOR BRITISH COLUMBIA

# Stormwater Planning

- Managing risk
- Why a Guidebook?
- Change to an Integrated Approach
- Setting Performance Targets
- Framework for watershed planning

*Historic "Good Drainage" Paradigm:  
Remove Runoff as Quickly as Possible*



Traditional site design is very efficient in collecting, concentrating, conveying and discharging flow to receiving waters.



Erosion



Sedimentation

When volume increases, the channel erodes to convey the additional volume

A consequence of channel instability is habitat degradation

# IMPACT OF CHANGES IN HYDROLOGY ON WATERCOURSE EROSION AND BASE FLOW RELATIONSHIPS

(WITHOUT BEST MANAGEMENT PRACTICES)

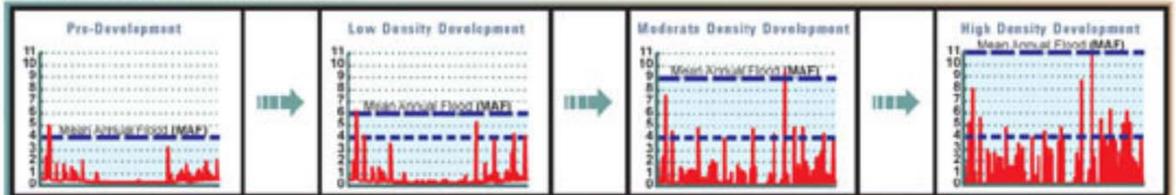
INCREASING URBANIZATION (NO BEST MANAGEMENT PRACTICES)



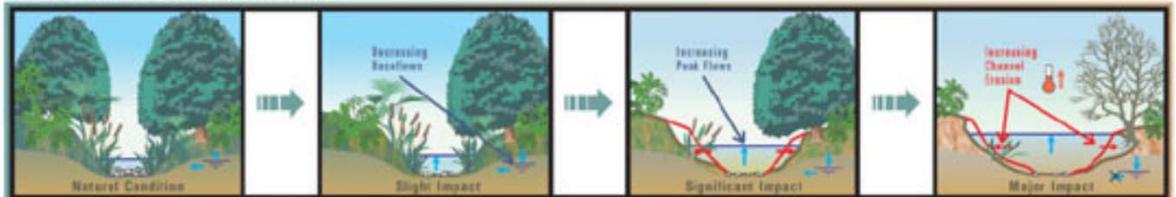
PROPORTION OF IMPERVIOUS LAND AREA (%)



EFFECT ON TYPICAL YEAR HYDROGRAPH



EFFECT ON WATERCOURSE EROSION



NUMBER OF STORM EVENTS AT OR ABOVE PREDEVELOPMENT MEAN ANNUAL FLOOD



RATIO OF MEAN ANNUAL FLOOD TO WINTER BASE FLOW



# The Consequences



**Flood Risk:**  
Threats to Life and Property



**Environmental Risk:**  
Impacts on Habitat & Ecosystems



# Reducing Risk

Engineered Solution



Deal with Consequences:  
Reactive in Solving Problems

OR

Emulate Natural Systems



Eliminate the Causes:  
Proactive in Preventing Problems



**To reduce RISK,  
HOW can we make urban development function  
hydrologically like NATURAL systems?**



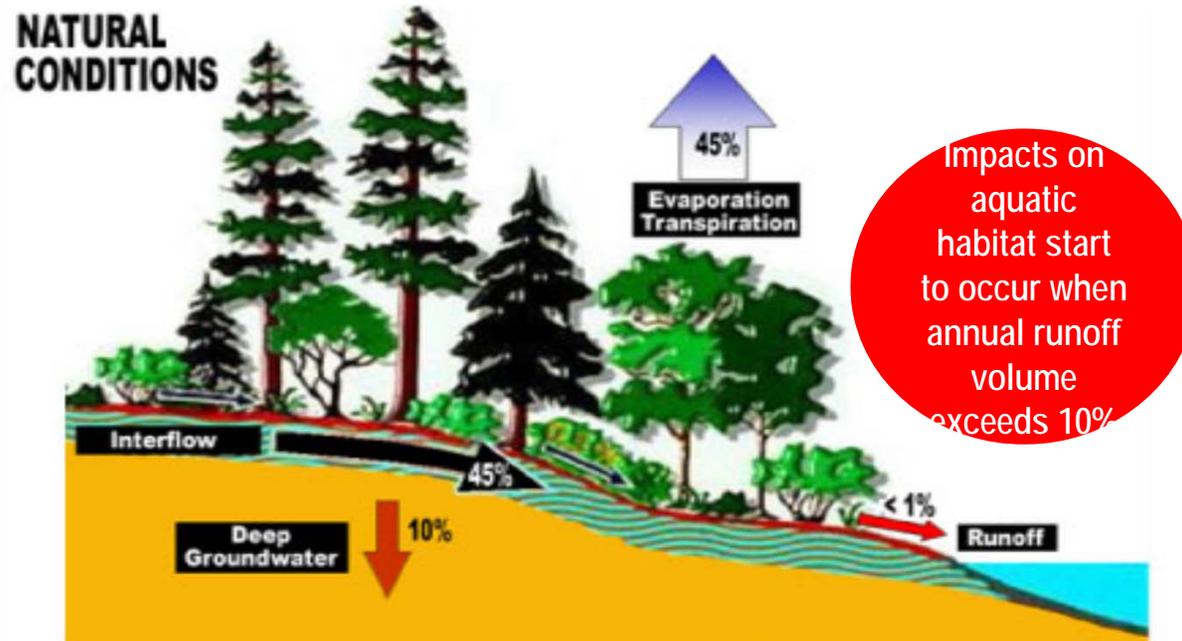
In urban watershed management, the breakthrough in thinking has resulted from recognition that...

....*volume* (rather than *flow rate*) is the governing performance measure for the stormwater component of sustainable urban design, and hence holds the key to protection of stream health.

# The Common Sense Solution is 'Water Balance Management'

*(Capture Rain Where It Falls)*

## Example Annual Water Balance





A GUIDEBOOK FOR BRITISH COLUMBIA

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# So really, why a Guidebook?

The Guidebook was developed by WALP in response to requests from local governments, and is written for:

- professionals who are developing the stormwater component of a Liquid Waste Management Plan
- senior managers who must make the case to Councils to fund watershed planning
- land developers and the consulting community who implement stormwater management solutions

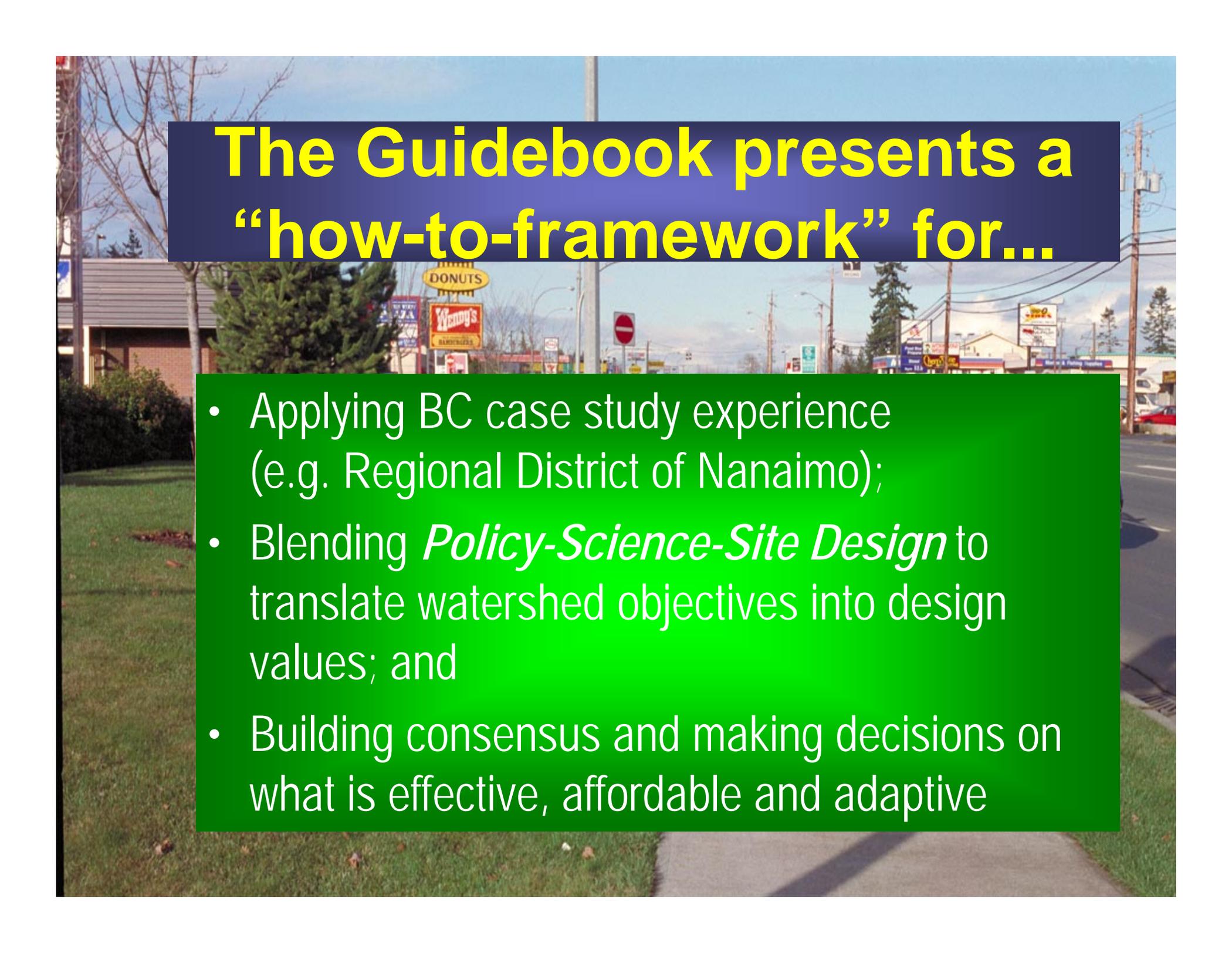
# Premise: Land Development and Watershed Protection can be Compatible

**Policy** Level Development Objectives

**Science-Based Understanding** of  
Development Impacts

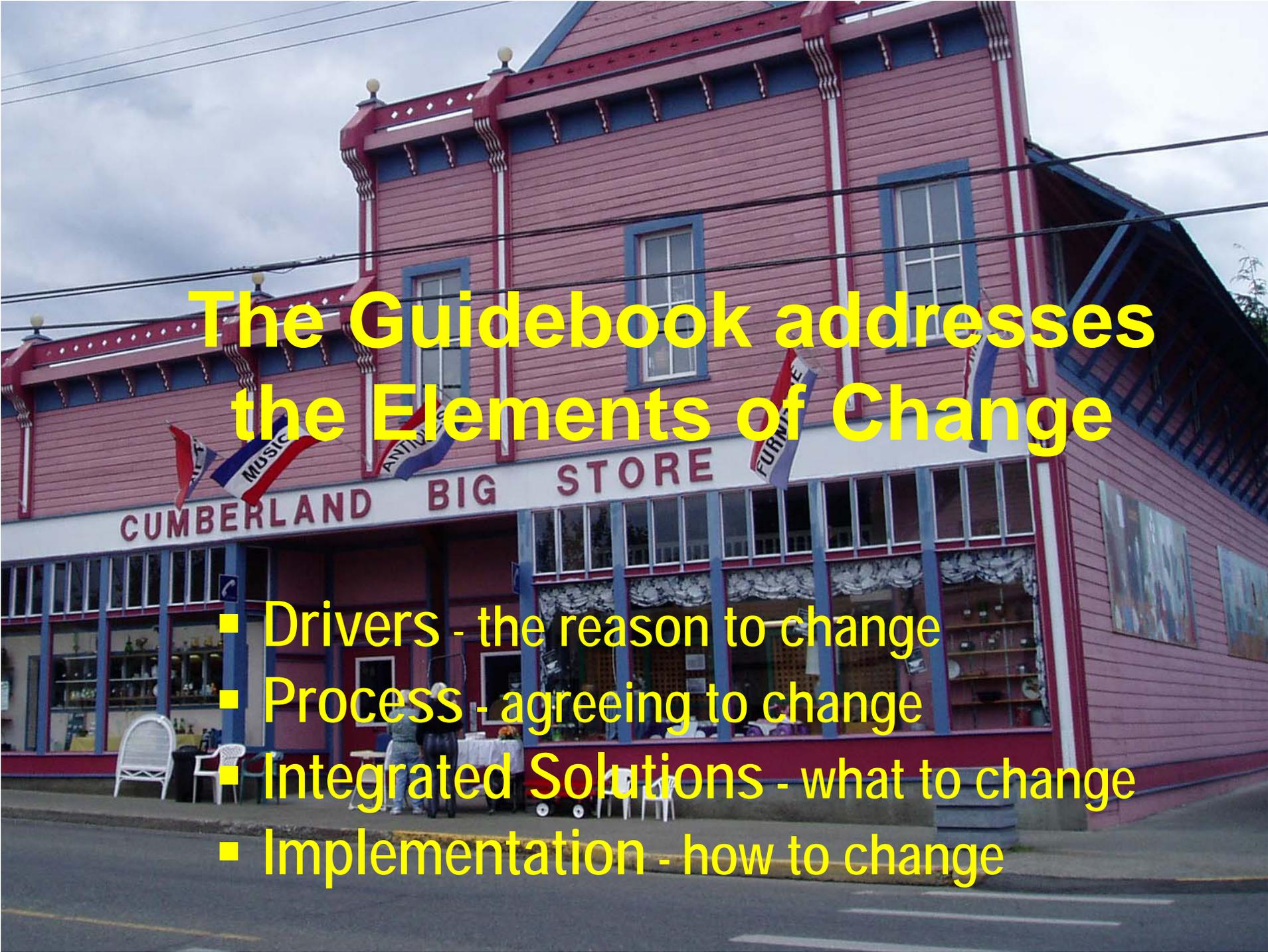
**Site Design** Practices that achieve Objectives



A photograph of a commercial street scene with various signs and buildings, overlaid with text boxes. The background shows a clear blue sky, utility poles, and a road with a sidewalk. In the middle ground, there are several signs, including a prominent yellow 'DONUTS' sign and a red 'Wendy's' sign. A red 'no entry' sign is also visible. The foreground shows a grassy area and a sidewalk.

# The Guidebook presents a “how-to-framework” for...

- Applying BC case study experience (e.g. Regional District of Nanaimo);
- Blending *Policy-Science-Site Design* to translate watershed objectives into design values; and
- Building consensus and making decisions on what is effective, affordable and adaptive



# The Guidebook addresses the Elements of Change

- Drivers - the reason to change
- Process - agreeing to change
- Integrated Solutions - what to change
- Implementation - how to change



# The Guidebook is structured in three parts:

- **Part A (Why)** -  
Why Integrated Stormwater Management?
- **Part B (What)** -  
Integrated Stormwater Management Solutions
- **Part C (How)**-  
Moving from Planning to Action

# The three Parts follow the natural order of...

- **The Problem:** written for elected officials, senior managers, and those wanting a general introduction to stormwater issues
- **The Solutions:** providing answers and examples at both planning and site levels - written mainly for engineers and planners
- **The Process:** defining roles, methods, means and timing - written for administrators and the complete range of stakeholders who will be involved in making the 'move from planning to action'



# Core Concepts that Bind the Three Parts

- **Rainfall Spectrum** - comprises about 100 events per year in the central Okanagan Valley
- **Tiered Approach**- refers to retain, detain, & convey
- **Integrated Solutions**- for property, habitat, quality
- **Constant Improvement Cycle** - monitor Demonstration Projects and adapt
- **Decision Process** – built around integration of technical products + working sessions



# The Key Objectives for the Guidebook are...

- **Part A** - Will this part capture and hold the attention of senior managers and elected officials, and will it convince the skeptics of the need for action?
- **Part B** - Are the methodologies for setting priorities and performance targets clearly explained, do they make sense, and will planners and engineers implement them?
- **Part C** - Is the process of change explained in understandable "how to" terms, and is it clear how *Integrated Solutions* at the site level fit into a watershed planning context?



A GUIDEBOOK FOR BRITISH COLUMBIA

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# Change to an Integrated Approach

From one that only **"Deals with Consequences"**

- ✓ *This is the traditional end-of-pipe engineering approach that is reactive in solving problems after the fact*

To one that also **"Eliminates the Causes"**

- ✓ *This involves an integrated approach to source-control that is proactive in preventing problems from occurring*



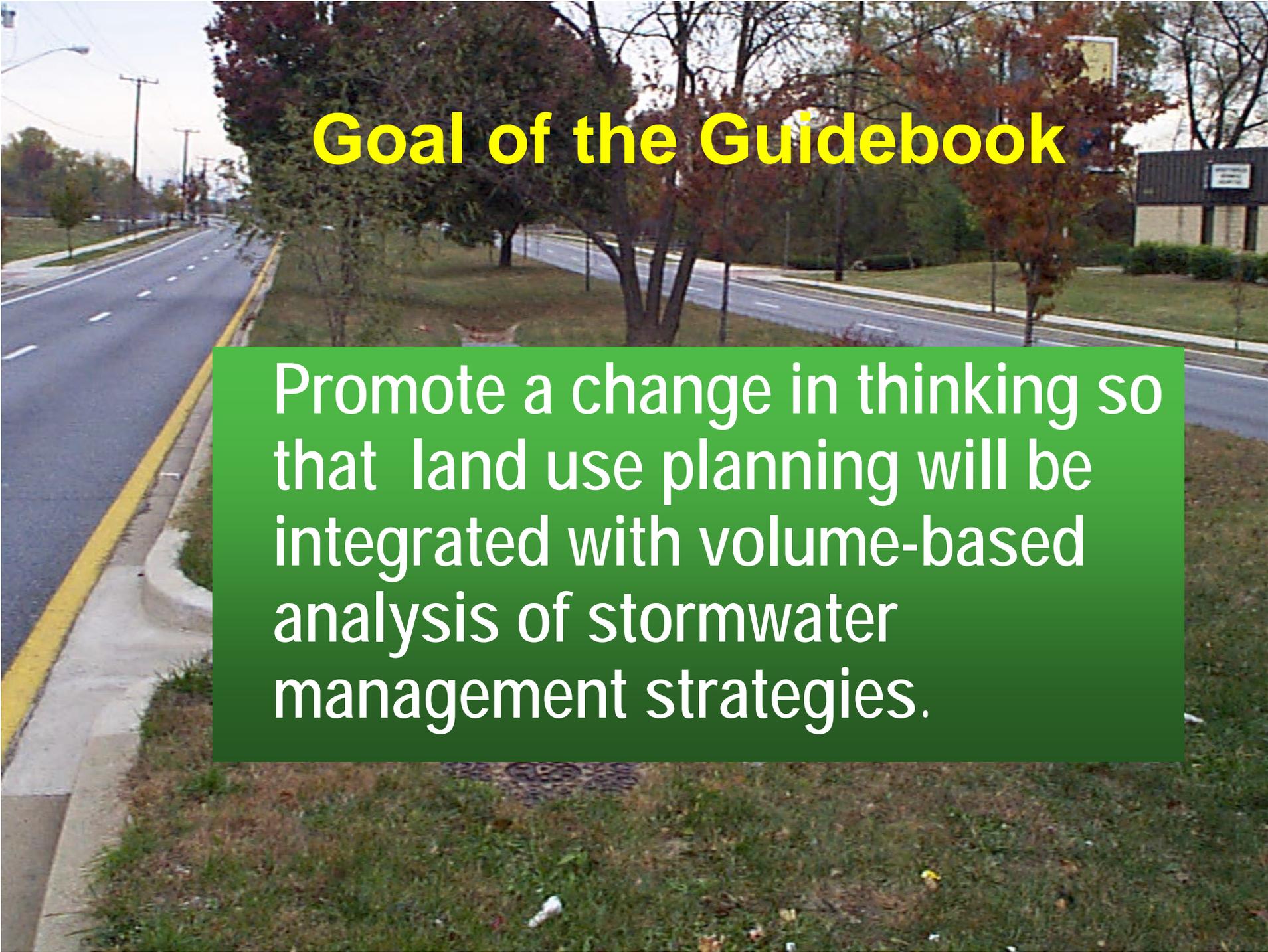
# Integrated Approach Incorporates Traditional Scope of Engineering Work

## TRADITIONAL defined as

- Drainage Systems
- Reactive (Solve Problems)
- Engineer-driven
- Protect Property
- Pipe and Convey
- Bureaucratic Decisions
- Local Government Ownership
- Drainage Focus Only

## INTEGRATED defined as

- Ecosystems
- Proactive (Prevent Problems)
- Interdisciplinary Team-driven
- Protect Property and Resources
- Mimic Natural Processes
- Consensus-based Decisions
- Partnerships with Others
- *Stormwater Integrated with Land Use*

A photograph of a suburban street with trees and a building in the background. The street is paved and has a yellow curb. There are several trees with autumn-colored leaves. In the background, there is a building with a sign.

## Goal of the Guidebook

Promote a change in thinking so that land use planning will be integrated with volume-based analysis of stormwater management strategies.



# “What the Cell is to the Body, the Site is to the Region”

– a unifying theme

So plan at four scales:

- Region
- Watershed
- Neighbourhood
- Site

10. 9. 1999

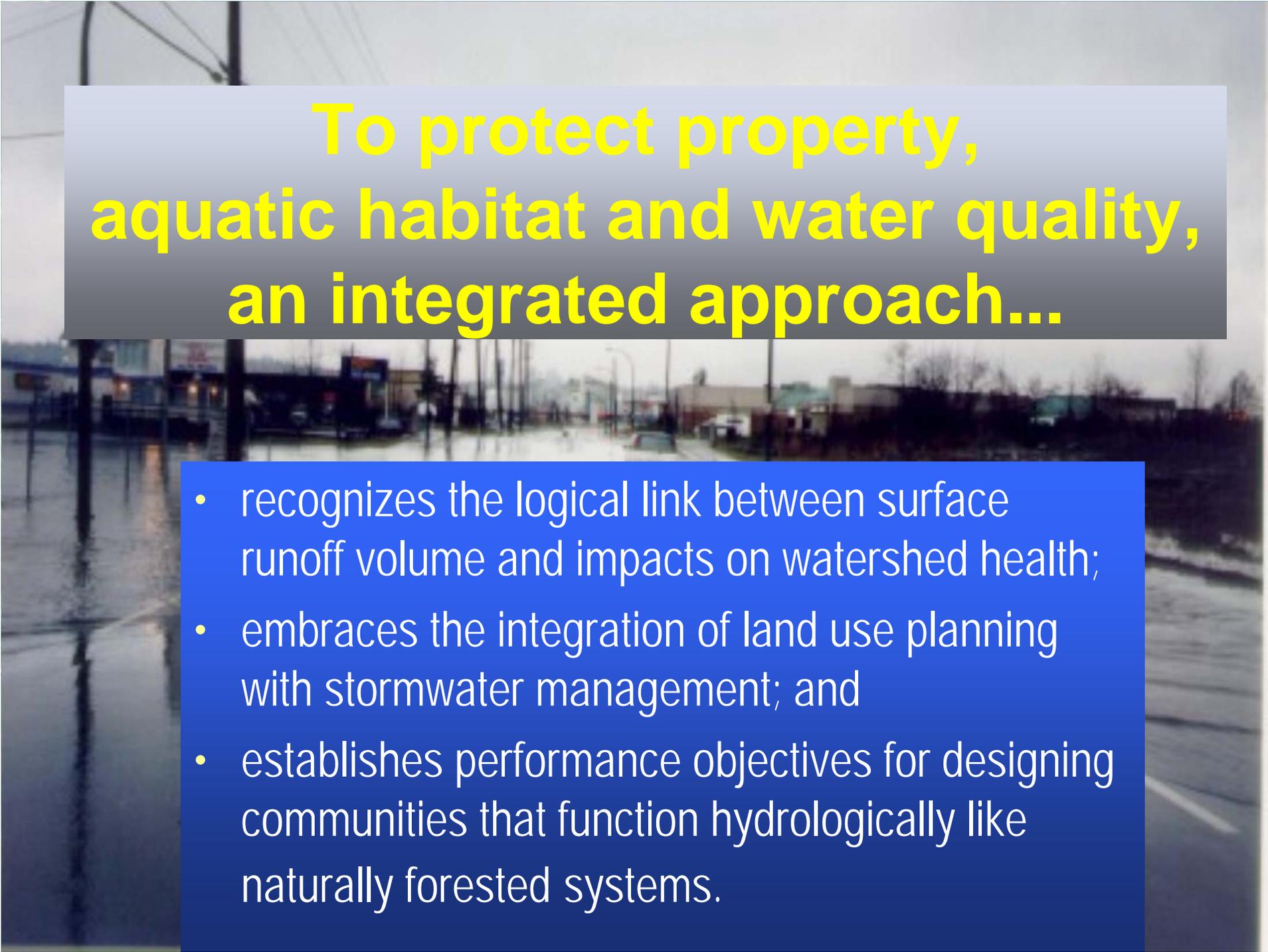
# The Street System and the Stream System are One System!

Local streets are the branch tips in the tree of the watershed.

Treat them as one!



James Taylor Chair in Landscape and Liveable Environments.



# To protect property, aquatic habitat and water quality, an integrated approach...

- recognizes the logical link between surface runoff volume and impacts on watershed health;
- embraces the integration of land use planning with stormwater management; and
- establishes performance objectives for designing communities that function hydrologically like naturally forested systems.



A GUIDEBOOK FOR BRITISH COLUMBIA

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# For a Performance Target to be understood, implemented and effective, it must ....

- Be quantifiable
- Have a feedback loop so that adjustments and course corrections can be made over time
- Synthesize complex factors into a single number that is simple to understand and achieve, yet is comprehensive in its scope

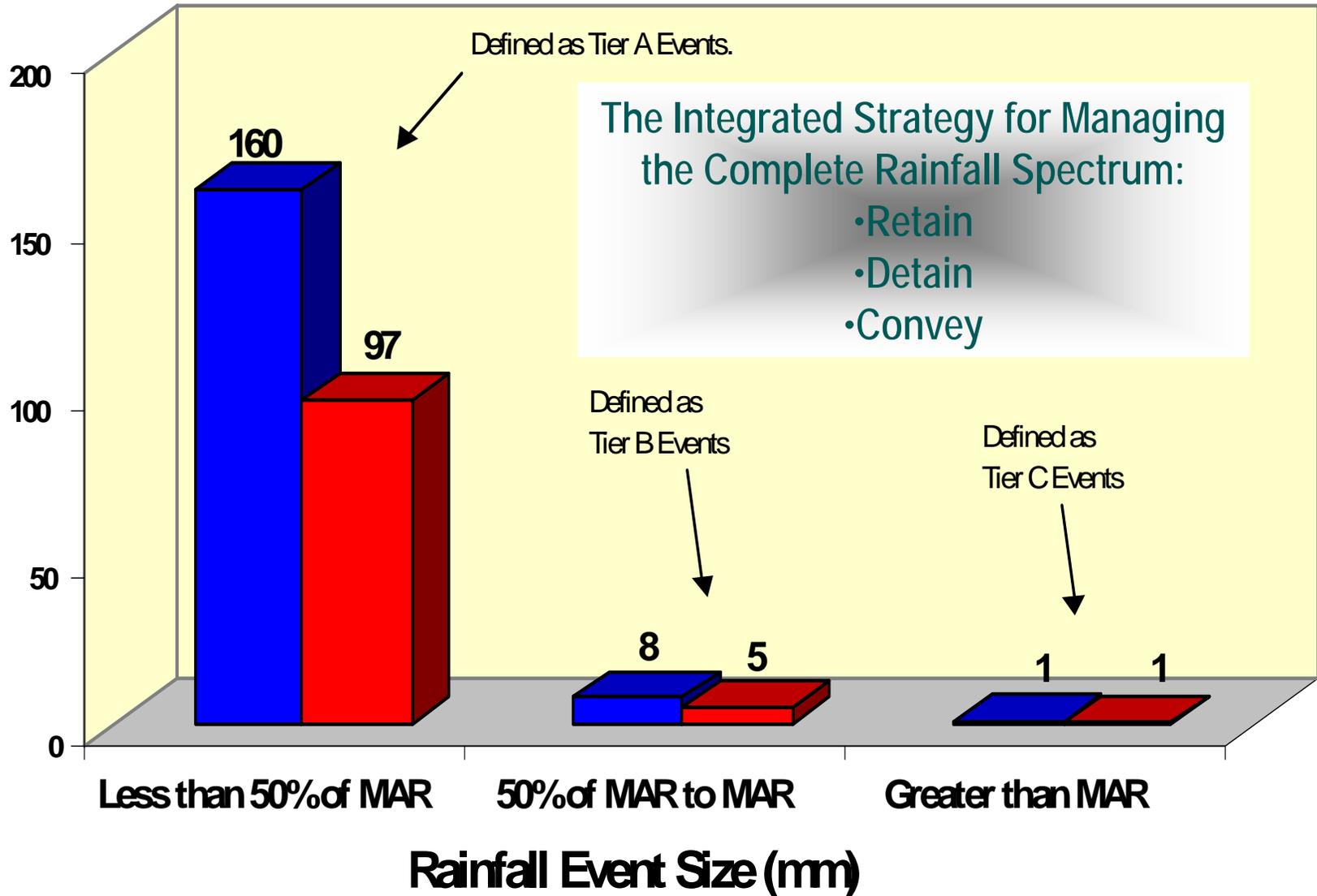
A photograph of a forest stream. The stream flows through a dense forest with tall trees and lush green foliage. The water is clear and reflects the surrounding greenery. On the left bank, there is a stone-lined structure, possibly a riparian habitat or a stream bank stabilization. The overall scene is a natural, healthy watershed environment.

# To Achieve the Target Condition for a 'Healthy Watershed'

Design sites and subdivisions to  
function hydrologically like a  
natural forest

# Typical Frequency Distribution of Annual Rainfall

No. Rainfall Events per Year



■ South Coast (Burnaby Mountain)

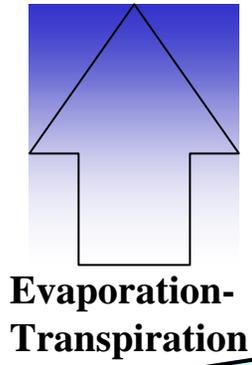
■ Okanagan (Kelowna Airport)

**Site-Specific Rainfall Distribution**  
(relative to MAR, the site-specific mean annual rainfall)

Frequent Small Storms  
(less than half of MAR)

Infrequent Large Storms  
(up to MAR)

Rare Extreme Storms  
(greater than MAR)



**Rainfall Capture**

**Runoff Control**

**Flood Risk Management**

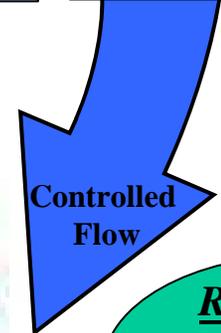
Infiltrate or Reuse Small Storms at the Source to Reduce Total Runoff Volume

Provide Detention Storage to Control the Rate of Runoff from Large Storms

Ensure that the Stormwater System can Safely Convey Extreme Storms



**Volume Target**  
90% of total rainfall volume is returned to natural hydrologic pathways



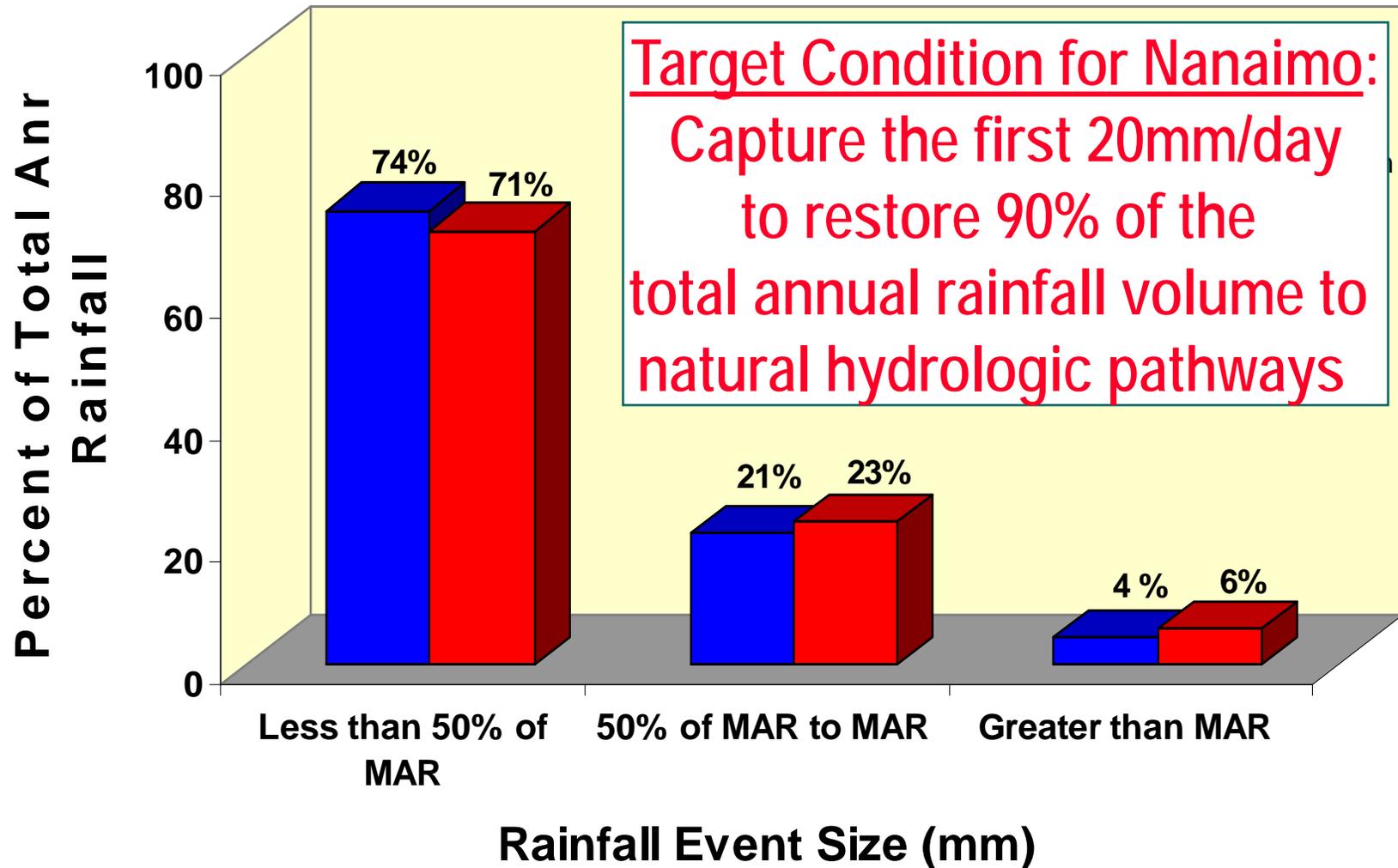
**Rate Target**  
The natural Mean Annual Flood is maintained



Interflow

# Performance Targets

# Typical Volume Distribution of Annual Rainfall



■ South Coast (Burnaby Mountain) ■ Okanagan (Kelowna Airport)



## Translate Performance Targets into Site Design Criteria Using the Rainfall Spectrum:

Use site specific rainfall data (30+ years) to determine the Mean Annual Rainfall (MAR)

Small storms (<50% MAR): RETAIN

Large storms (50% MAR to MAR): DETAIN

Extreme storms (>MAR): CONVEY

**DETAIN:**



**CONVEY:**



# Stormwater Source Control Strategies to **RETAIN** Rainfall Volume On-Site: Low Impact Development Solutions



**Infiltration Facilities**



**Absorbent Landscaping**



**Green Roofs**

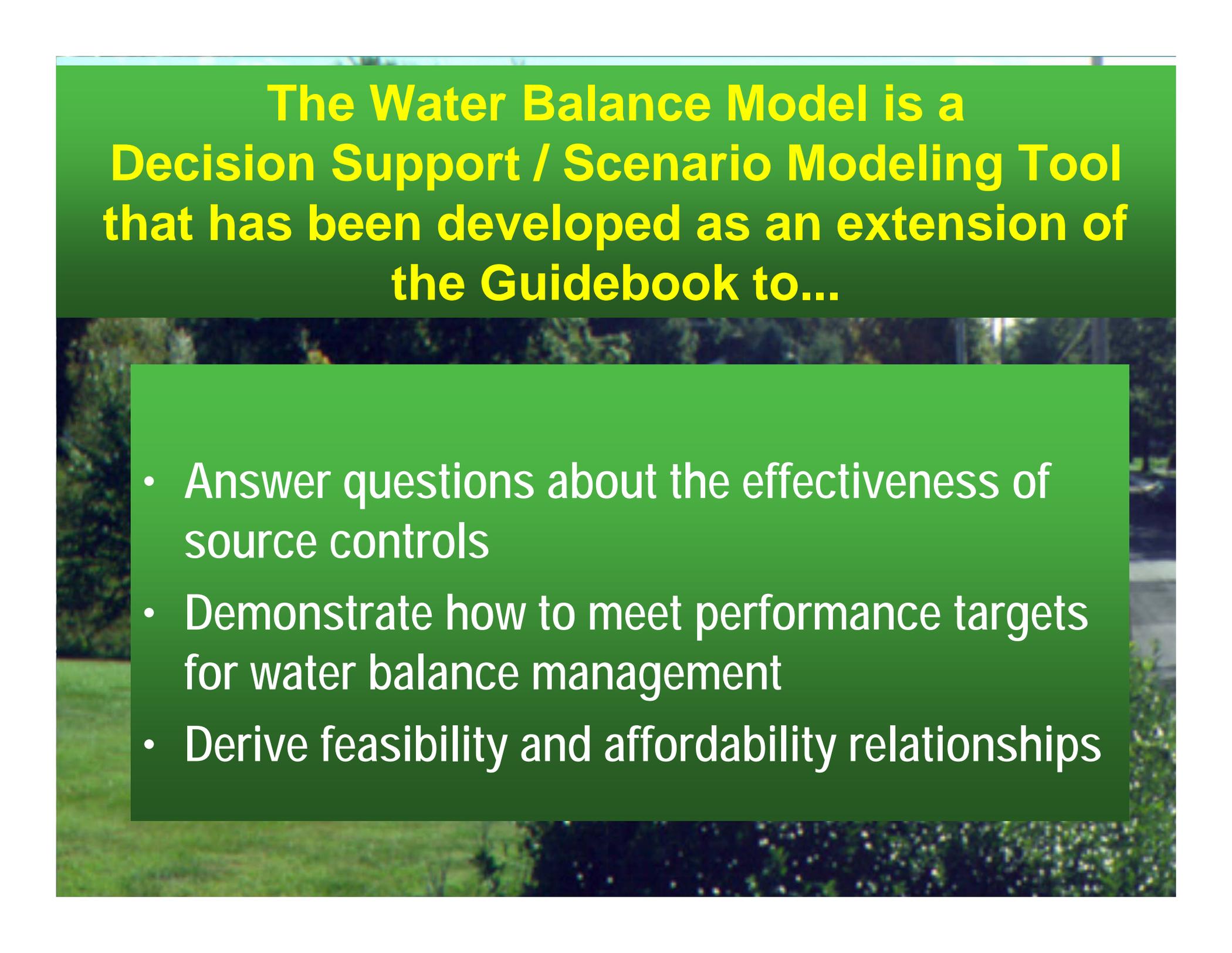


**Rainfall Harvesting**

# The Missing Link in Drainage Planning has been...

A tool that quantifies the benefits, in terms of reducing stormwater runoff volume, of installing source controls under different land use and soil conditions





**The Water Balance Model is a  
Decision Support / Scenario Modeling Tool  
that has been developed as an extension of  
the Guidebook to...**

- Answer questions about the effectiveness of source controls
- Demonstrate how to meet performance targets for water balance management
- Derive feasibility and affordability relationships

# Scenario modeling at the watershed scale enables us to answer these questions:

- What is the existing level of annual runoff volume?
- What actions are needed to prevent any further increase?
- What actions are needed to reduce runoff volume over time?
- Is the 10% volume target achievable over time?
- What level of volume reduction is achievable over time?
- What is an affordable target for volume reduction?



A GUIDEBOOK FOR BRITISH COLUMBIA

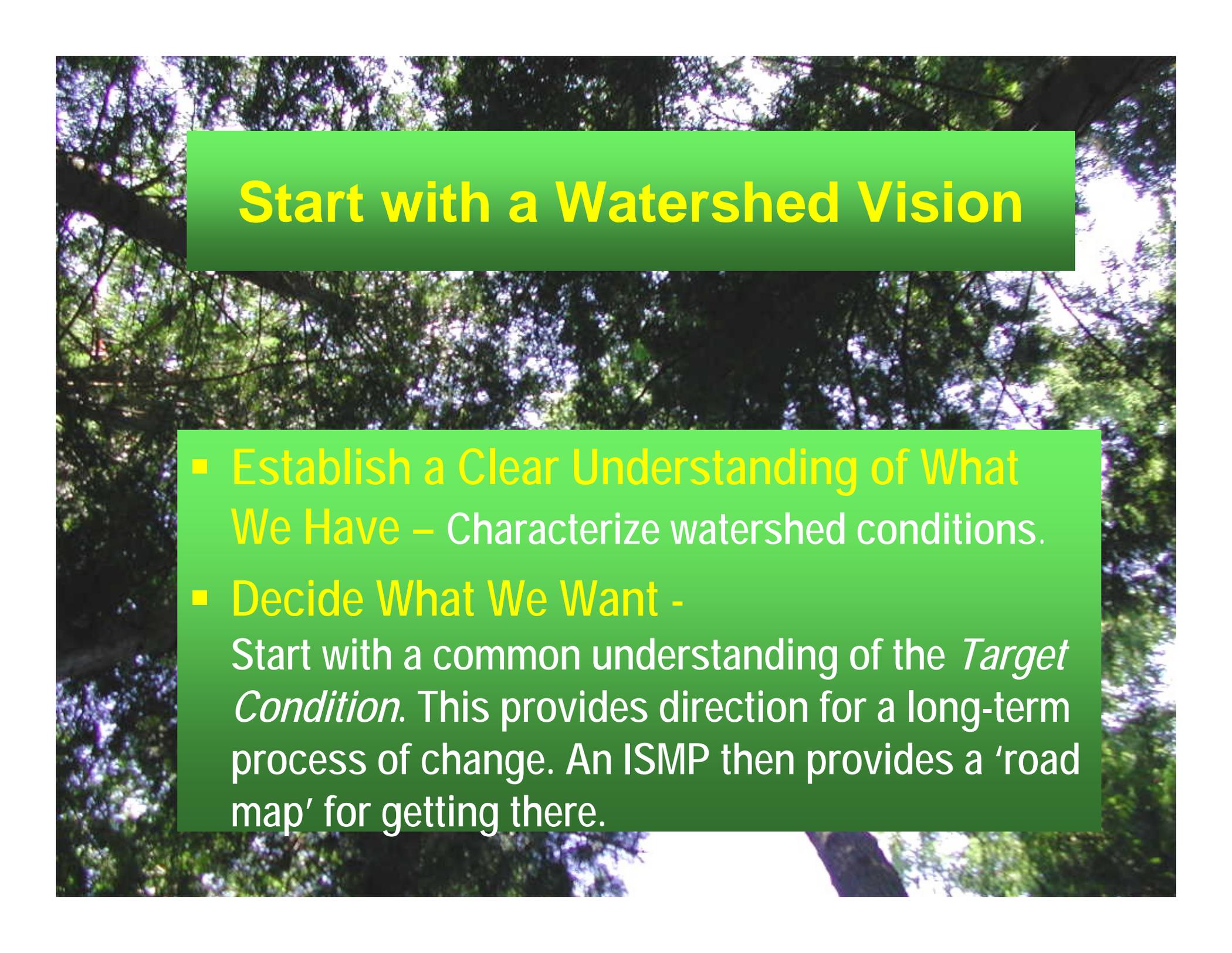
# Stormwater Planning

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An aerial photograph of a residential neighborhood with a green semi-transparent box overlaid on the center. The text is in yellow. The background shows houses, trees, and roads.

# The purpose of an Integrated Stormwater Management Plan (ISMP) is to identify...

- The risks
- What needs to be done to manage the risks
- Who should be responsible
- A time-line for implementation



## Start with a Watershed Vision

- **Establish a Clear Understanding of What We Have** – Characterize watershed conditions.
- **Decide What We Want** - Start with a common understanding of the *Target Condition*. This provides direction for a long-term process of change. An ISMP then provides a 'road map' for getting there.



Secure Political Interest and Support

1

Frame Watershed Problems & Opportunities

2

Develop Objectives & Alternative Scenarios

3

Collect Meaningful Data & Refine Scenarios

4

Evaluate Alternatives & Develop Component Plans

5

Develop an Implementation Program

6

Refine through Adaptive Management

7



## Seven Step Process for Developing & Implementing an ISMP



## An ISMP comprises three core technical products:

- An **inventory** of the physical system
- A **master plan** to protect the resources, resolve identified problems, and accommodate growth
- A management **program**
  - administration
  - monitoring
  - education
  - maintenance
  - financing

An 11x17  
Drawing

**Action!**

## Integrated Stormwater Management Planning

- **Comprises 35 component tasks:**
  - engineering (9)
  - planning (6)
  - environmental (9)
  - integration (11)
- **Emphasis on:**
  - information gathering (15)
  - analysis (9)
- **Municipalities can:**
  - pick and choose
  - customize the level of effort

An aerial photograph of a valley with mountains in the background. The valley is filled with green fields and some buildings. The mountains are in the distance under a clear blue sky.

# To Move from Planning to Action, these factors must be in alignment

- **Political Commitment** – to take action
- **A Champion Within Local Government** – to provide energy and organizational drive and to stimulate willingness to change
- **TRUST** – between individuals, and between levels of government

**“What the Cell is to the Body,  
the Site is to the Region”**

**Will it be Cumulative Impacts  
or  
Cumulative Benefits?**



## Resources:

- Stormwater Planning: A Guidebook for BC available at:  
<http://wlapwww.gov.bc.ca/epd/epdpa/mp/p/stormwater/stormwater.html>
- GVRD Template for ISMP available at:  
[http://www.gvrd.bc.ca/services/sewers/drain/Reports/ISMP Template-Working Draft](http://www.gvrd.bc.ca/services/sewers/drain/Reports/ISMP%20Template-Working%20Draft)