Designing with Nature – Integrate Perspectives to Achieve Sustainable Community Design

Presentation to

City of Coquitlam Environment Committee

on

October 14th 2003

Think Outside the Pipe!

Inter-Governmental Partnership

- Who Is A Partner
- What the Mission Is
- Why We Developed the Model
- How the Model Works
- How It Will be Applied

WATER Balance MODEL FOR BRITISH COLUMBIA

Partners ▪ About ▪ Home

www.waterbalance.ca

View Prototype ▪ Resources ▪ Background

- Public Domain
- Web-based

Water Balance Model

Project Development Team and Steering Commi

Inter-Governmental Partnership Forms to Develop a Water Balance Model for BC

The practice of low impact development often involves efforts to reduce the impacts of stormwater runoff using various types of "source controls" designed to minimize runoff volumes. The effectiveness of these source controls varies with their design, with precipitation patterns, and with soil type, among other factors. The overall performance of these source controls is obviously of great interest to developers, homeowners and local governments alike. The Provincial Stormwater Planning Guidebook for BC lays out targets for reducing runoff volume to achieve watershed protection objectives. The Greater Vancouver Regional District ...More

- City of Coquitlam
- City of Kelowna
- City of Chilliwack
- City of Abbotsford
- City of Surrey
- City of North Vancouver
- City of Vancouver
- District of Maple Ridge
- District of North Vancouver
- City of Courtenay
- District of West Vancouver
- Corporation of Delta
- Greater Vancouver Regional District
- Ministry of Agriculture
- Ministry of Water, Land & Air Protection
- Ministry of Sustainable Resource Mgmt
- Environment Canada
- Real Estate Foundation of BC

A GUIDEBOOK FOR BRITISH COLUMBIA

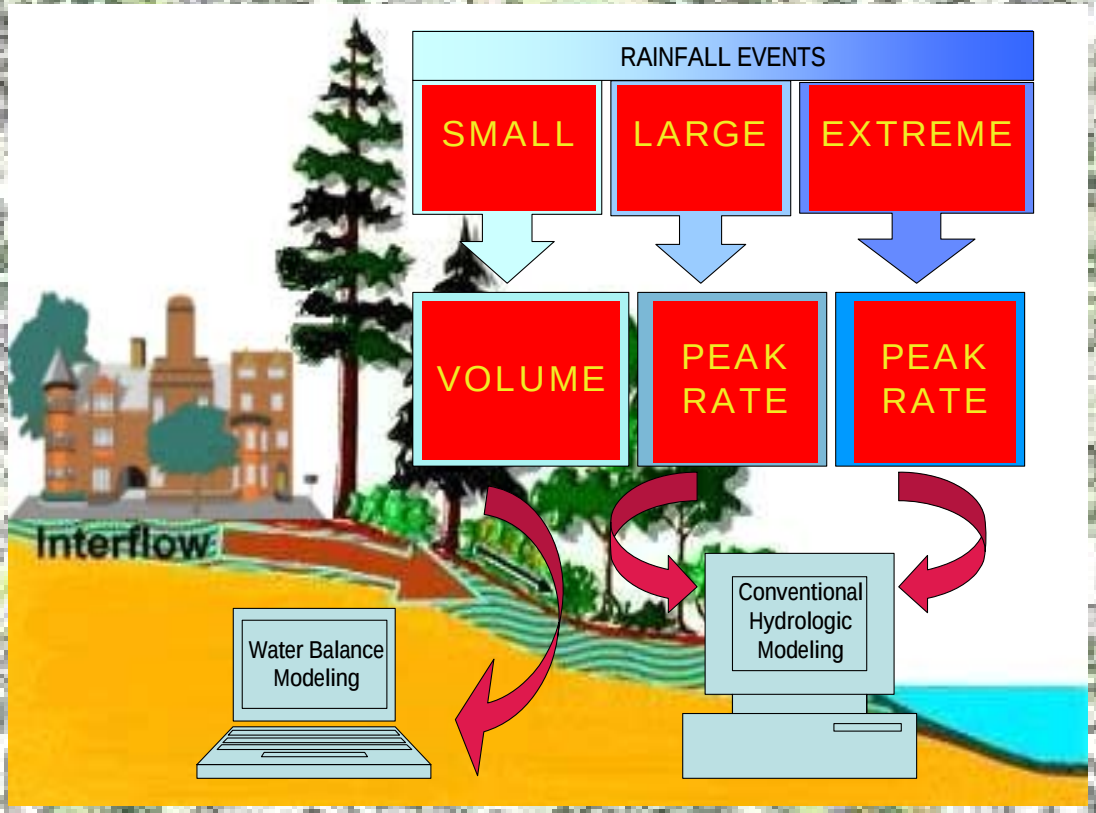
Stormwater Planning

Change Water Management Practices at the Site Level

- WHY?
- WHAT?
- HOW?

BRITISH COLUMBIA Ministry of Water, Land and Air Protection

...and The Missing Mission Link...



A tool to quantify the benefits of reducing stormwater runoff volume, under different land use and soil conditions

Water Balance Model Simulates
Four Source Control Categories
Type 1 - Absorbent Landscaping
Type 2 - Infiltration Facilities
Type 3 - Green Roofs
Type 4 - Rainwater Harvesting
Vancouver Public Library

The Water Balance Model
is about a way of thinking

Enables local government to:

- Integrate perspectives = create understanding!
- Answer questions about effectiveness
- Demonstrate how to meet performance targets
- Assess feasibility and affordability

Over time, we can…
move from cumulative impacts
to cumulative benefits
Graphic from Smart Growth BC

Inter-Governmental Partnership

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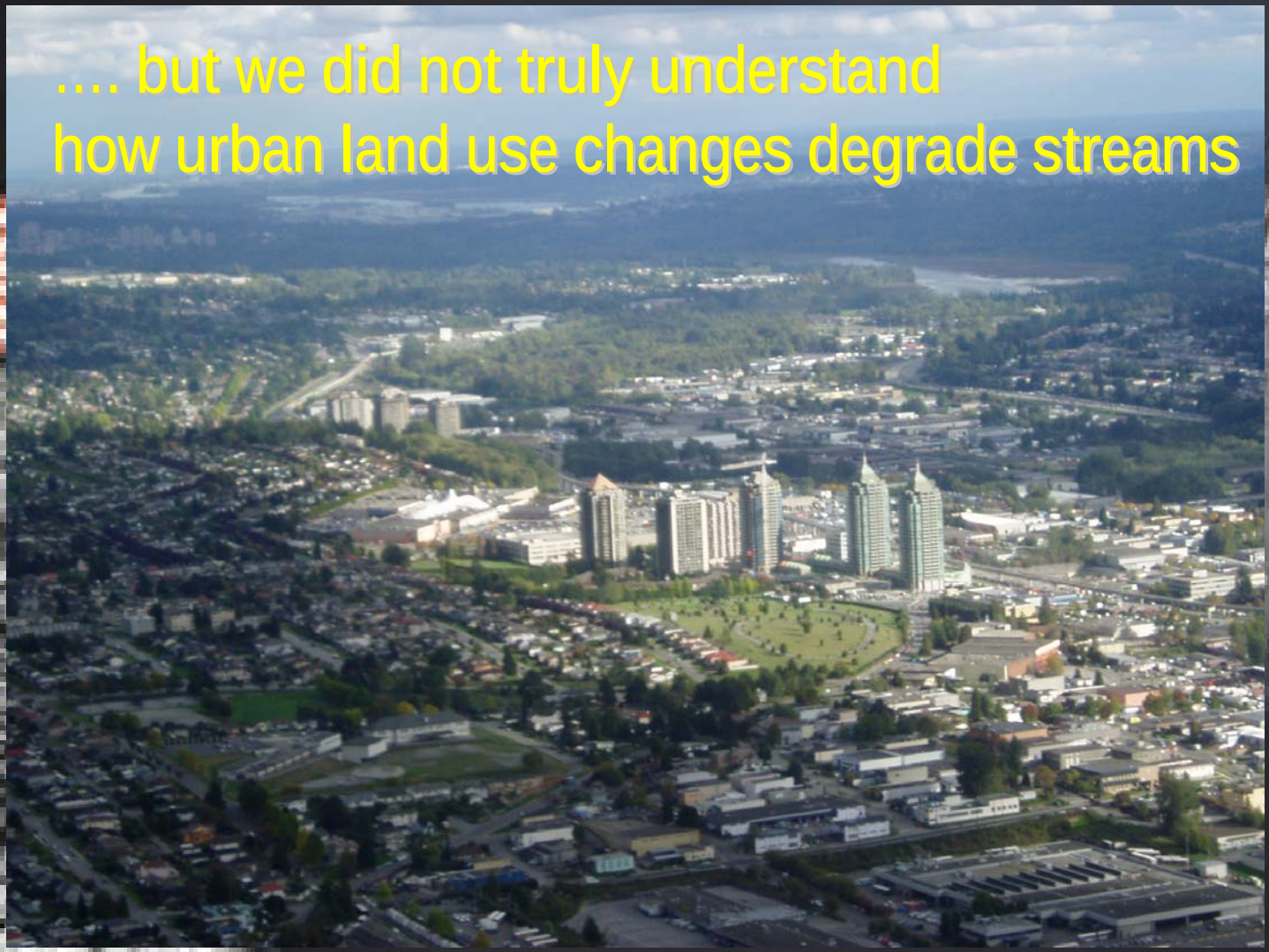
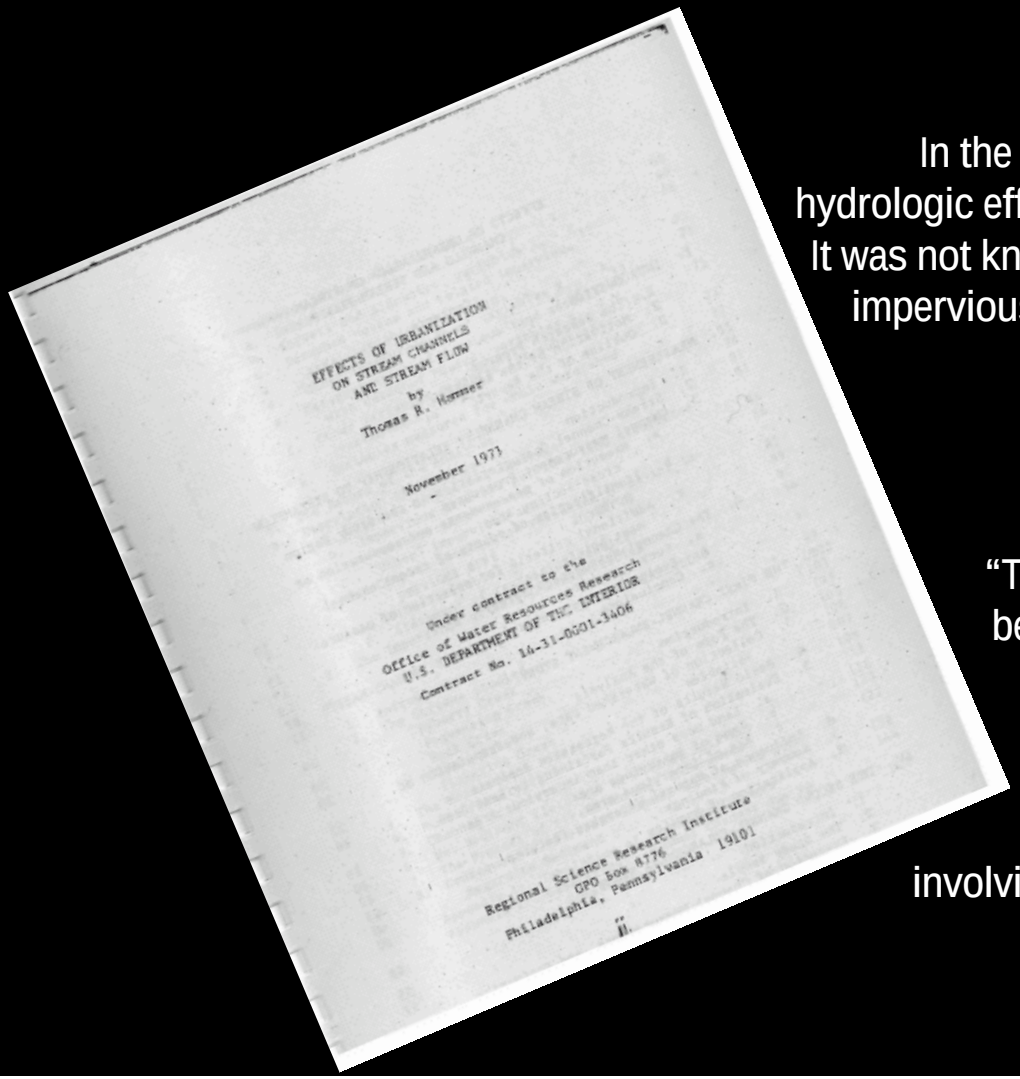
By 1969, we had put a man on the moon…



…. but we did not truly understand
how urban land use changes degrade streams

…. in his landmark 1973 report for the US government, Thomas Hammer researched causes-and-consequences…


EFFECTS OF URBANIZATION
ON STREAM CHANNELS
AND STREAM FLOW
by
Thomas R. Hammer
November 1971
Under contract to the
Office of Water Resources Research
U.S. DEPARTMENT OF THE INTERIOR
Contract No. 14-31-0001-3406
Regional Science Research Institute
GPO Box 8776
Philadelphia, Pennsylvania 19101

In the late 1960s, "…existing knowledge regarding hydrologic effects of urbanization was quite inadequate… It was not known, for example, whether different types of impervious area have different effects on streamflow."

"This lack of knowledge has apparently existed because of the reluctance of natural scientists, on the one hand, to deal with… complex non-natural phenomena, and the reluctance of planners, on the other hand, to conduct research involving physical rather than social relationships."

But only in the past decade have we accepted that,
as forest cover is replaced by an increasing percentage of hard surface
stream quality decreases

Stable & Pristine
(< 5% Impervious)

Start of Erosion
(5% to 10%)

Visibly Impacted
(> 20% Impervious)

Guidebook Premise: Land Development and Watershed Protection can be Compatible

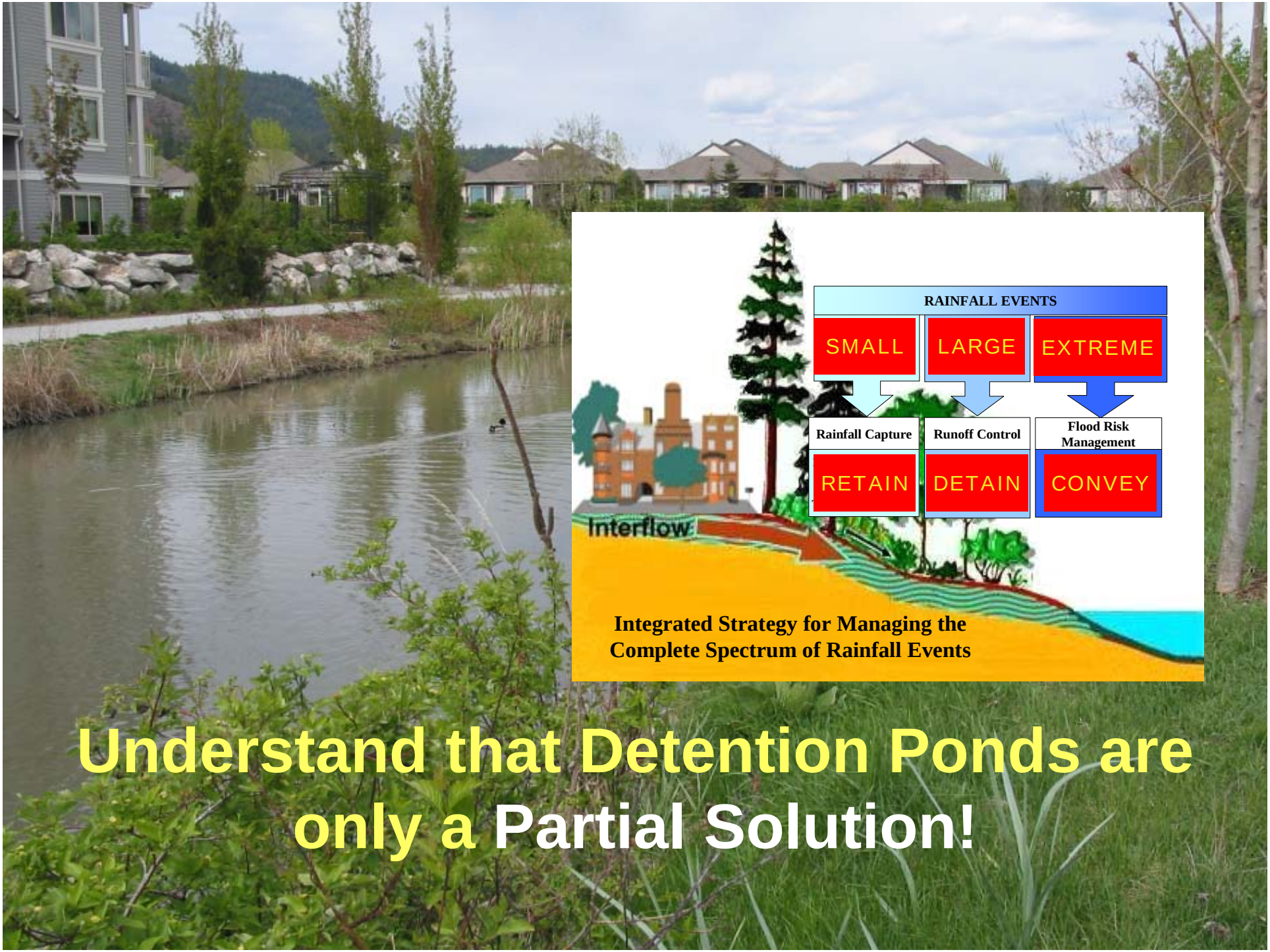
Key Message: Recognize that the Built and Natural Environments are Connected!

Design with Nature to...

Facilitate

Preserve

Avoid

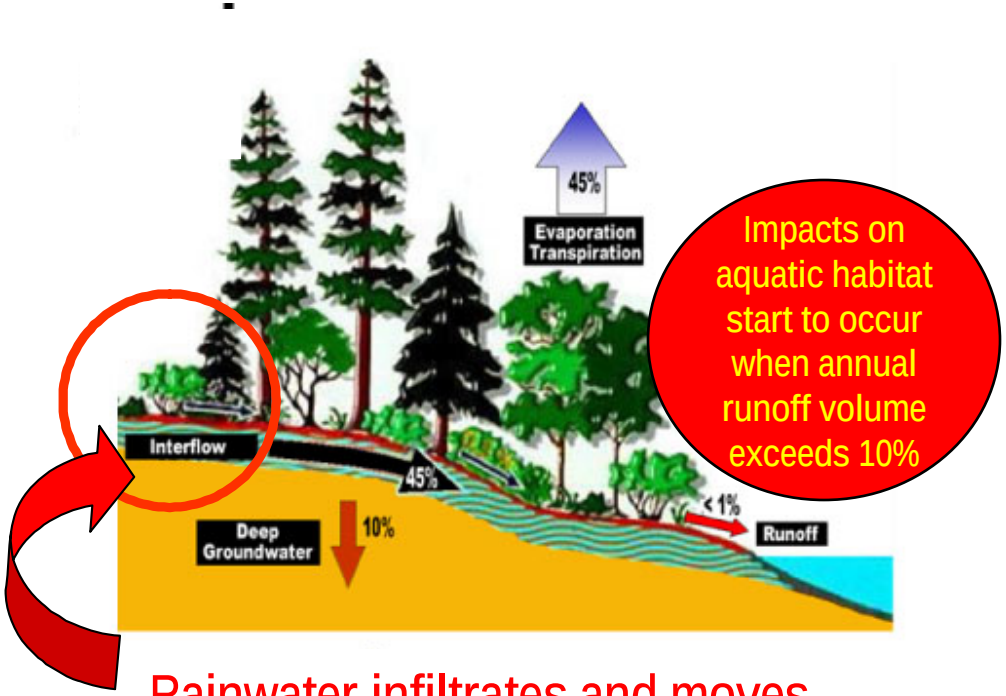


Understand that Detention Ponds are only a Partial Solution!

The Complete Solution includes ‘Volume Management’

Natural Forest

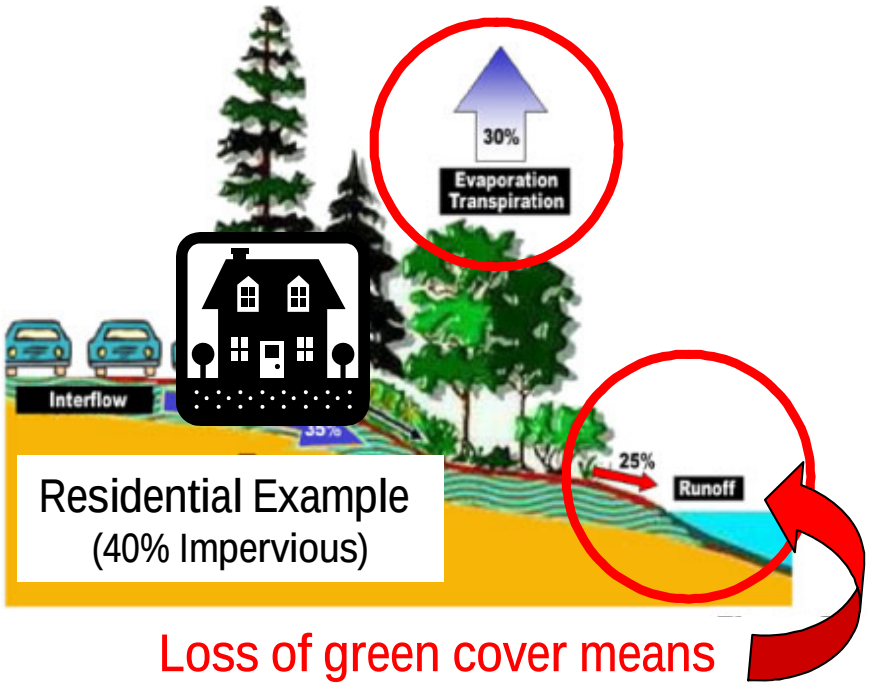
Annual Runoff = 1 to 10 % of Rainfall Volume



Rainwater infiltrates and moves through the ground as ‘interflow’

After Residential Development

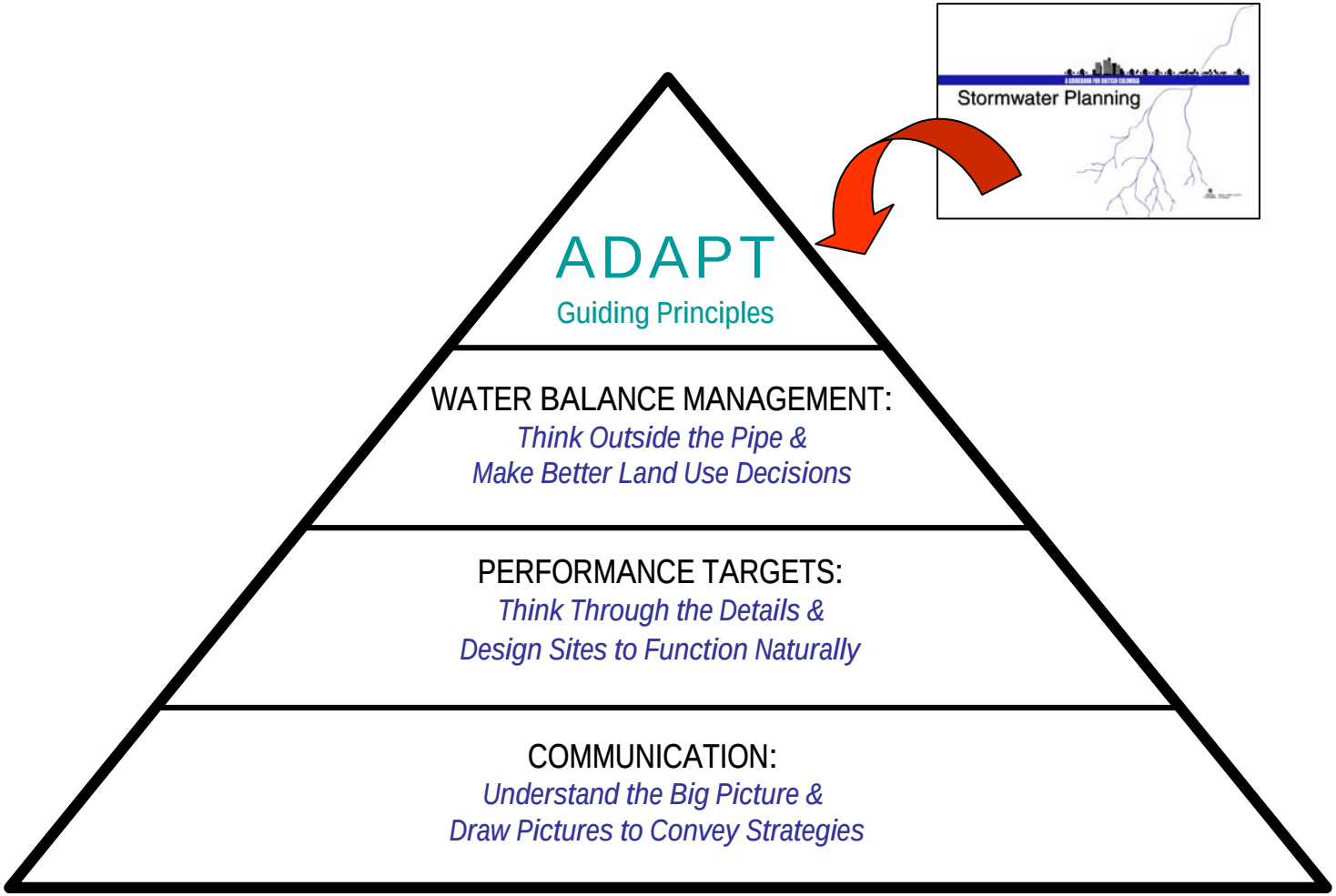
Annual Runoff = >25% Rainfall Volume



Loss of green cover means more runoff volume to manage

WATER Balance MODEL FOR BRITISH COLUMBIA

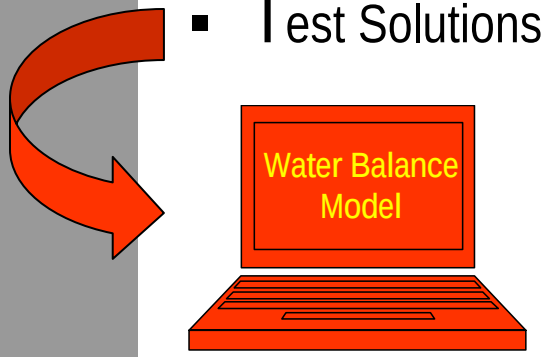
‘Mind Map’



WATER Balance MODEL FOR BRITISH COLUMBIA

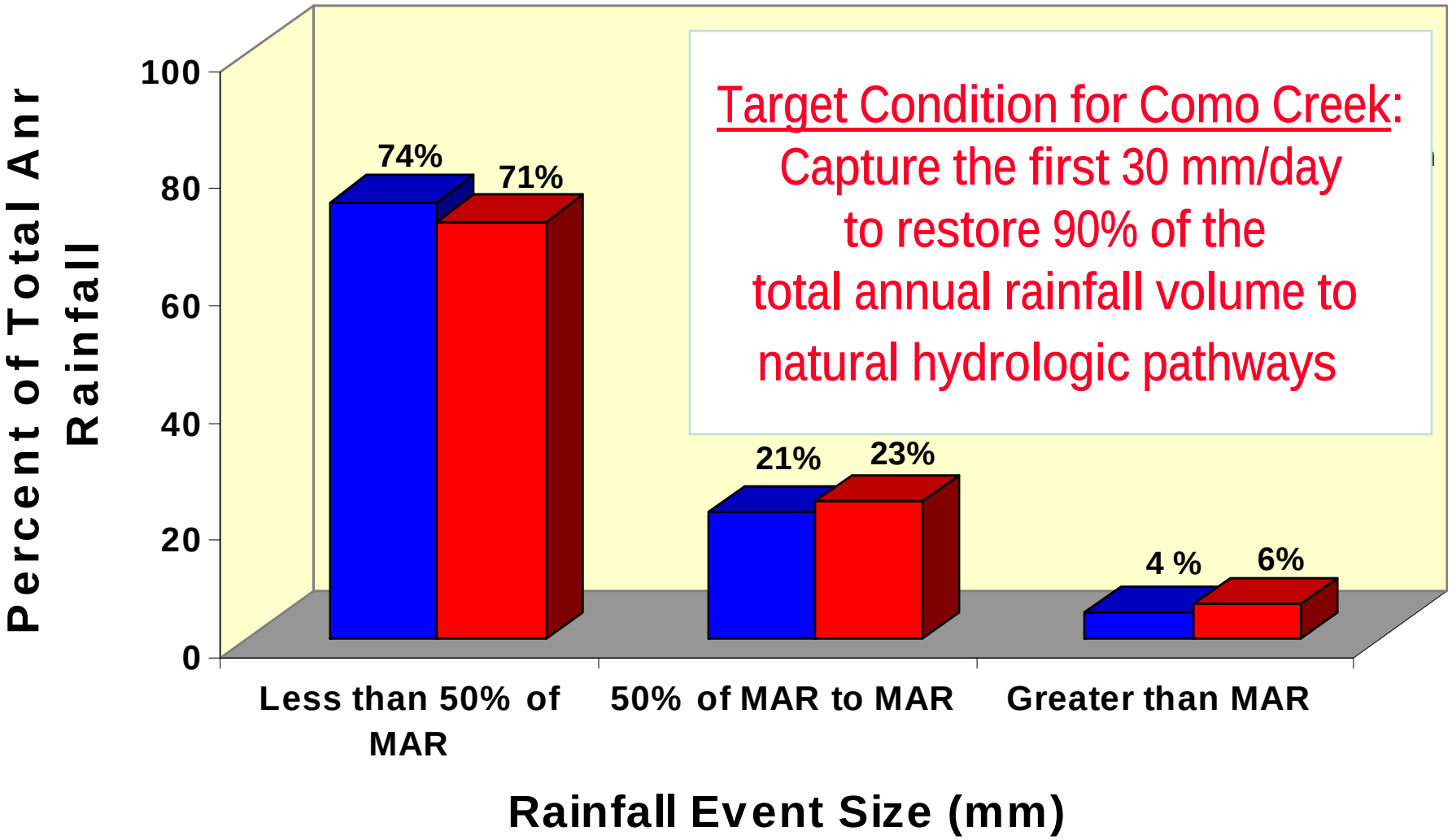
A-D-A-P-T
Guiding Principles

- **A**gree that Stormwater is a Resource
- **D**esign for the Complete Spectrum of Rainfall Events
- **A**ct on a Priority Basis in At-risk Drainage Catchments
- **P**lan at Four Scales – Region, Watershed, Neighbourhood and Site
- **T**est Solutions and Reduce Costs through Adaptive Management



THE GOAL:
design with nature
PERFORMANCE TARGET #1:
annual runoff volume = < 10% rainfall volume

Typical Volume Distribution of Annual Rainfall



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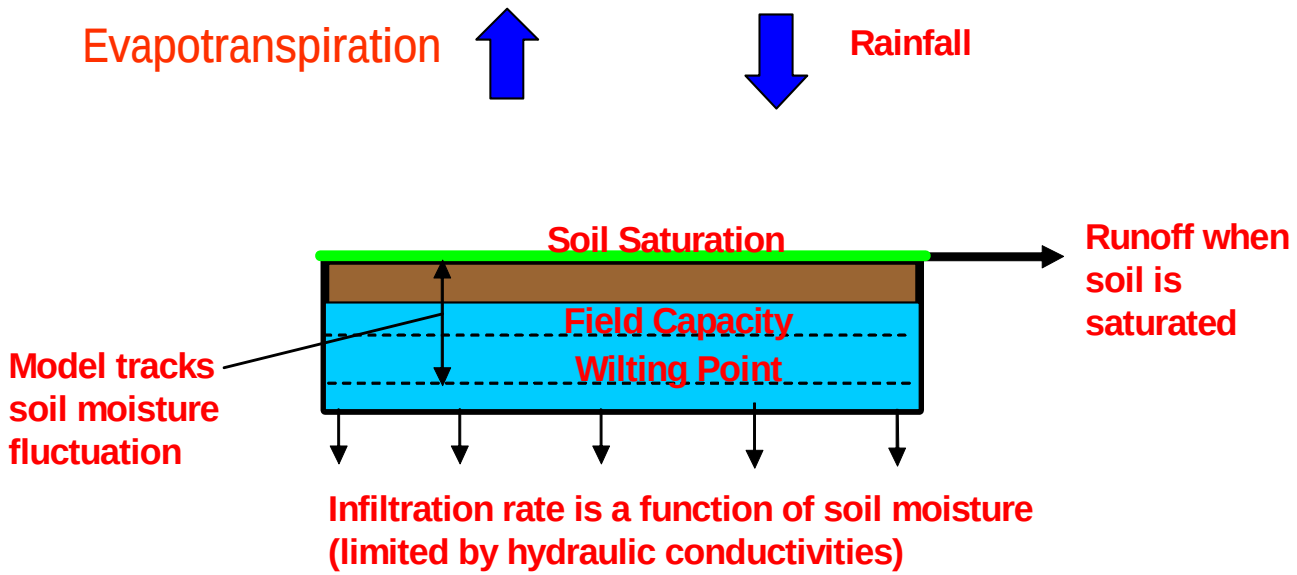
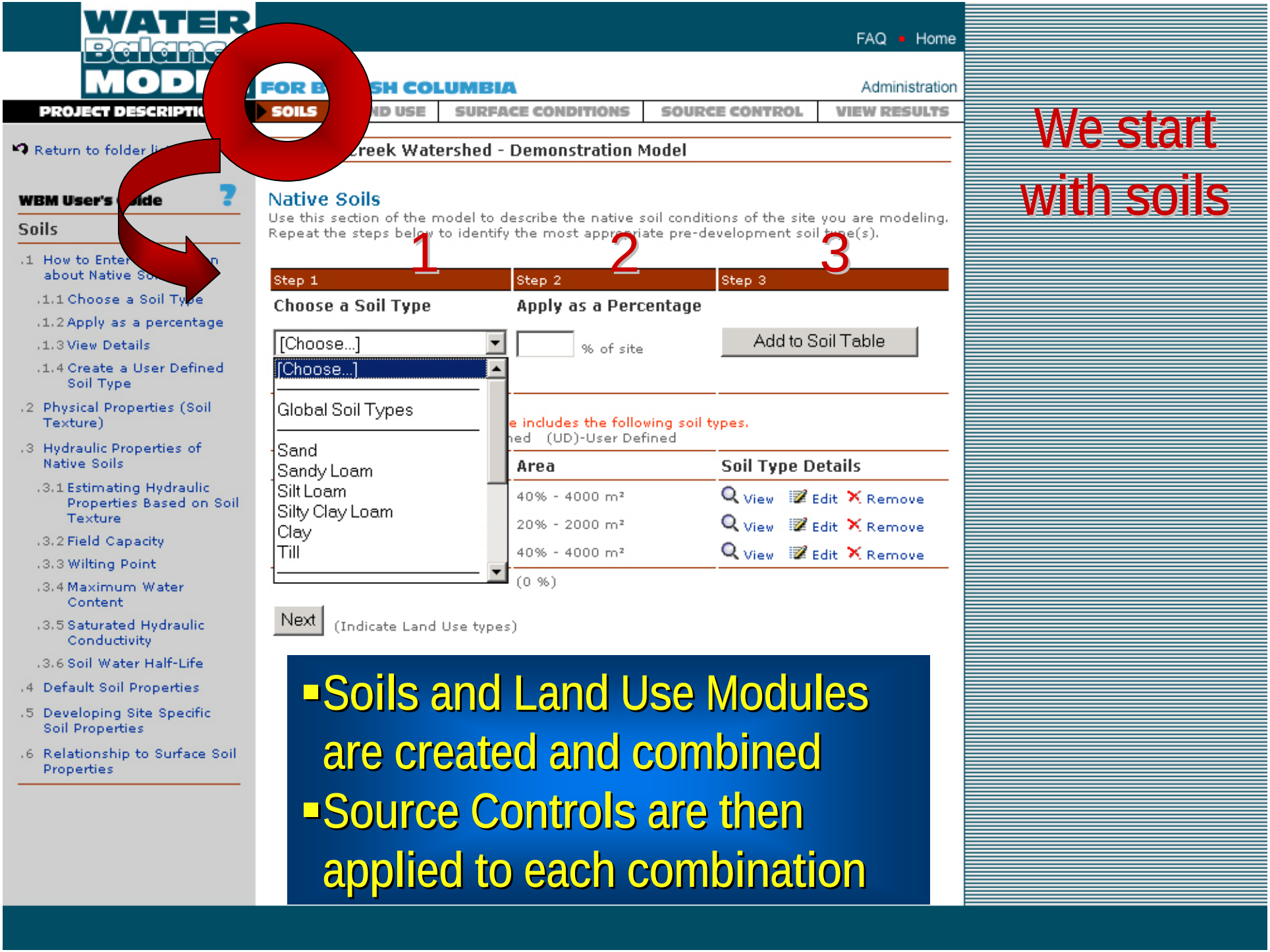
The hydrology engine is built around a continuous Soil Moisture Simulation



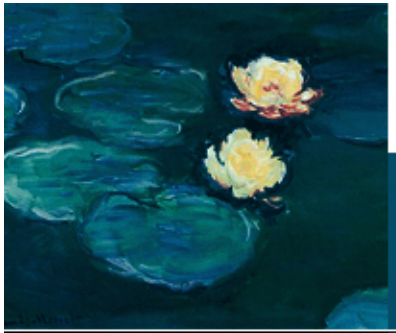
The hydrology engine reflects the wisdom of an international Expert Panel, incorporates established soil science principles, and provides a full accounting of the 'water balance'



We start with soils

- Soils and Land Use Modules are created and combined
- Source Controls are then applied to each combination

WATER Balance MODEL
FAQ • Home
Administration
LAND USE
SOURCE CONTROL
VIEW RESULTS
Return to
Return
WBM User's Guide
Land Use
.1 Land use
- Demonstration Model
Modelling
Use this section of the model to describe the intended land uses of the site you are modeling.
Repeat the steps below to identify the most appropriate land use(s).
1
2
3
Step 1
Choose a Land Use Type
Step 2
Apply as a percentage
of the site being modeled.
Step 3
[Choose...]
%
% Land Use
Add to table
Define / edit a Land Use Type
The model includes the following Land Use types.
(D)-Default; (R)-Regionally Defined (UD)-User Defined
Land Use Type
Area
Actions
(D)-Agricultural Land
45% - 4500 m²
Edit Remove
(D)-Commercial
20% - 2000 m²
Edit Remove
(D)-Parks and Open Space
35% - 3500 m²
Edit Remove
(0 %)
Next
(Assign Land Uses to Soil Types)
Then we go to land use
Each community can customize land use characteristics and the level of site design detail



WATER Balance MODEL FOR BRITISH COLUMBIA

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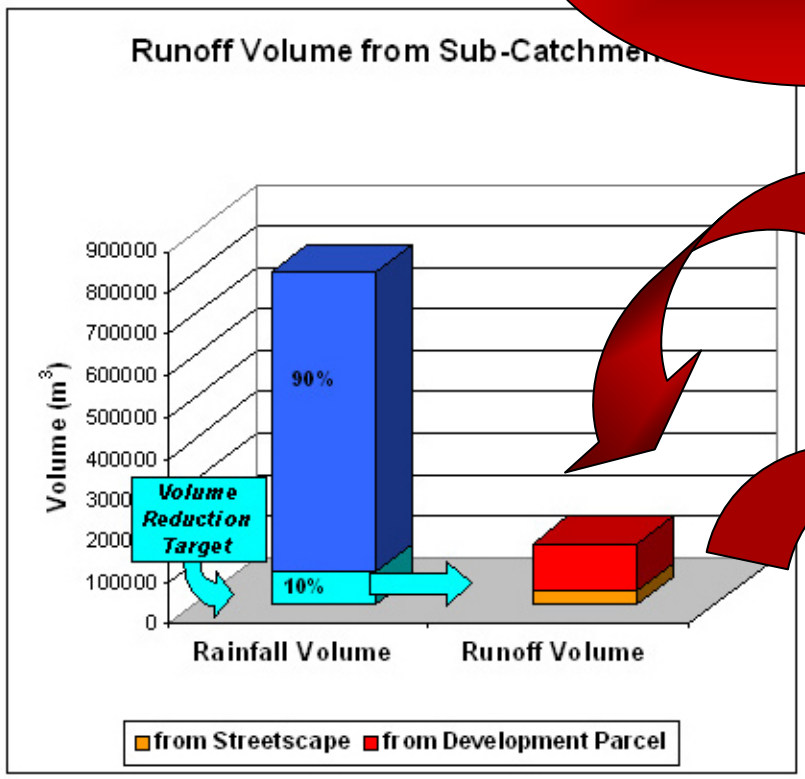
PROJECT DESCRIPTION | SOILS | LAND USE | SOURCE CO... | MODEL PROJECT

{Sidebar}



This shows what level of volume reduction can be achieved

This shows the breakdown between streetscape and development site

Performance Target #1 - Volume

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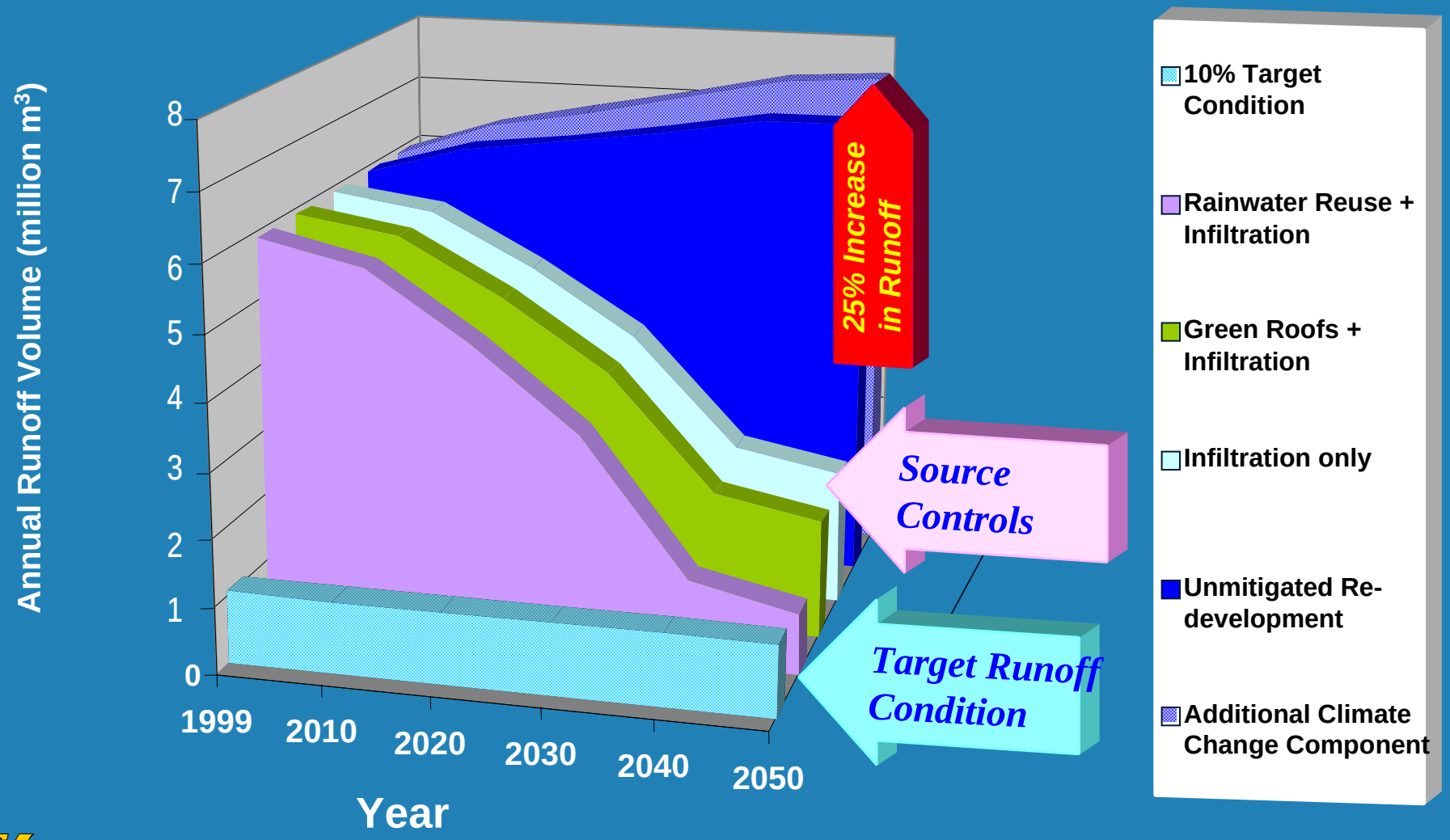
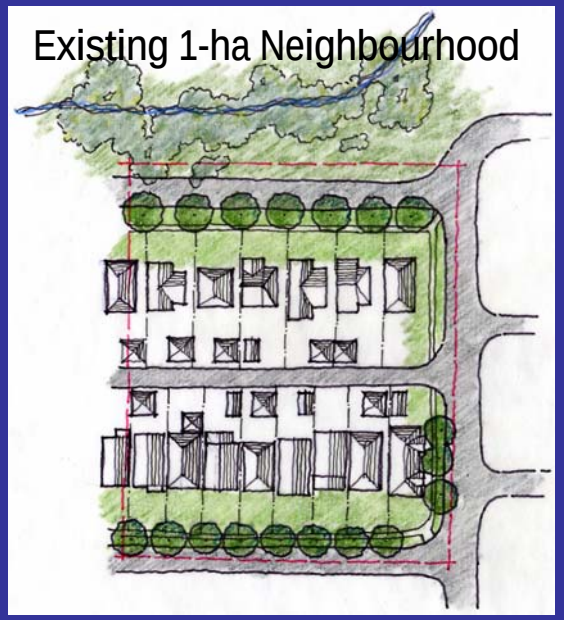
We will make better decisions if we can...
Visualize the ‘how to’ implementation details
Model scenarios at three scales: site, neighbourhood and watershed
Apply an interactive and transparent process

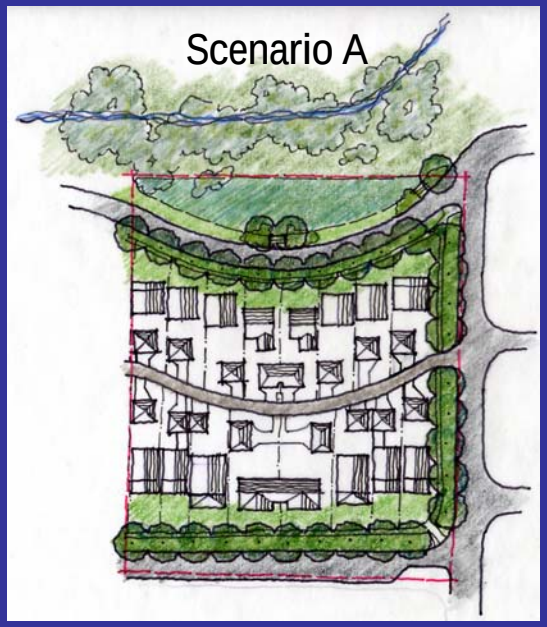
The Big Picture: Watershed Scenarios



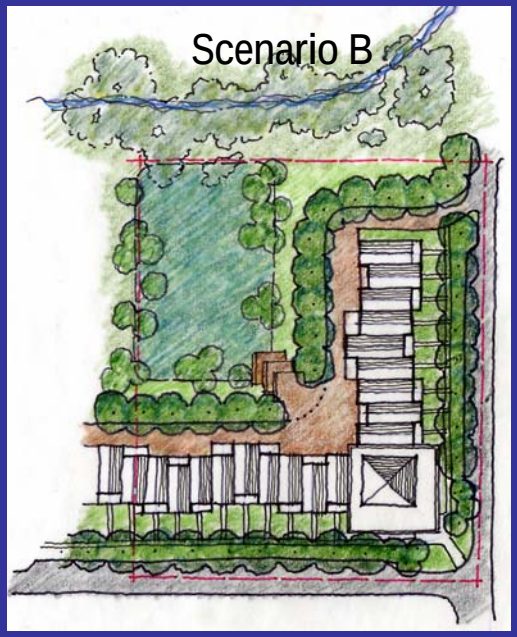
Consolidation Through Land Re-development Can Create Multi-Objective Opportunities



- 14 dwelling units
- 10m to 11m wide lots
- 316 to 416 m^2 lot size
- Average house size: 270 m^2
- Potential volume: nil



- 16 SF + 1 duplex
- 10 m wide lots
- 335 m2 avg lot size
- Average house size: 192 m2
- Potential volume: 900 m^3 (@ 1m depth



- 26 multi-family units
- 8 condos (3-storey)
- 18 townhouses
- Average size units: 150m^2
- Potential Volume: 1800 m^3 (@ 1m depth)

Long-Term Vision

Use of the model will become standard practice in British Columbia for land development decisions

cities^{PLUS} provides context for changing water management practices at the site level