Innovations in Urban Development Conference
October 18, 2006 at Cochrane, Alberta
Water Sustainability &
"Green" Subdivision Design:
Land Development and Watershed Protection
Can be Compatible
Presentation Team: Bert van Duin, Kim Stephens, Doug Backhouse & Richard Boase

The Mission is to
Create a Legacy
Influence choices by individuals and organizations
Use the term "sustainability" as a lens for
considering approaches that influence choices

How Urban Runoff Adversely Affects Water Resources

Land development alters the natural balance between runoff and natural absorption

- **areas are replaced with greater amounts of impervious surface**
- **resulting in increased rates and volumes of surface runoff**

<u>Other negative impacts include:</u>

- **increased susceptibility of eroded land to flooding,**
- **which results in damage to public and private property**
- **jeopardizing public safety, and leads to**
- **in-stream and wetland habitat degradation**

What is the problem with urban runoff?

Runoff captures pollutants and debris as it travels overland through developed areas

- For example - parking lots and streets.

Pollutants enter directly into local lakes, creeks, and streams, without being filtered by the soil or natural vegetative cover.

Pollution can have many adverse affects on water quality.

Better pollution control is needed to reduce the amount of contamination affecting water bodies.

WHY the ALIDP?

In 2004, the Alberta Low Impact Development Partnership was created.

In response to:

- The needs of municipalities, planners, engineers, landscape architects, and developers to improve stormwater management practices and watershed health in Alberta.
- The need to establish opportunities for Low Impact Development (LID) practices in Alberta to address land management practices and associated stormwater runoff affecting urban watersheds.

MISSION

To protect and maintain the integrity of the natural environment while promoting the growth, prosperity and quality of life of Alberta's communities. Implementation of Low Impact Development practices will lead to healthier, more sustainable watersheds.

ALIDP Stakeholders

The membership is open to all Alberta municipalities, individuals and organizations with interest in land development and environmental protection

- The City of Calgary
- The City of Edmonton
- The City of Red Deer
- The City of Lethbridge
- The City of Airdrie
- The Town of Cochrane
- The Town of Okotoks
- The Town of Black Diamond
- The Town Turner Valley
- Town of Canmore
- MD of Rocky View
- City of Medicine Hat
- City of Grande Prairie
- City of Brooks
- Strathcona County
- Red Deer County
- Ducks Unlimited, Trout Unlimited
- Department of Fisheries & Oceans
- Alberta Environment
- Bow River Basin Council
- North Saskatchewan Watershed Alliance
- Elbow River Watershed Partnership
- University of Calgary
- UDI Alberta
- Alberta Real Estate Foundation
- Alberta Chapter of CMHC
- Alberta Lake Management Society

Water for Life Strategy Linkages

LID initiatives offer Alberta's municipalities one of the greatest opportunities to achieve key outcomes of the Water for Life Strategy.

Including:

- preservation and protection of healthier, more sustainable watersheds;
- water conservation; and
- ensuring a high quality of life in urban environments.

Workshop Road Map

- Think Beyond the Pond
- Build the Vision, Create the Legacy
- Tour of Water Balance
- Demonstration of the Model
- Where To Now?

‘Design with Nature’ because…

How We Develop Land Determines:

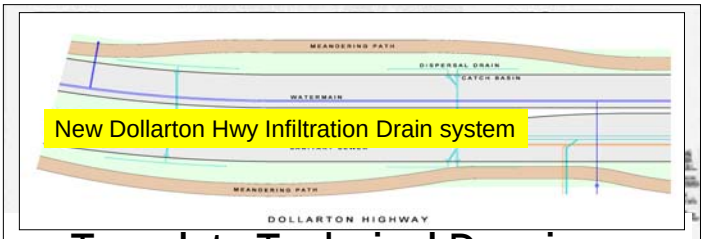
➔How Water is Used

➔How Water Runs Off the Land

WATER Balance MODEL FOR BRITISH COLUMBIA

www.waterbalance.ca

Key Message:



New Dollarton Hwy Infiltration Drain system

Translate Technical Drawings Into Understandable Language:
Explain How Your Rainwater Plan Will Achieve Environmental Objectives!

Key Issues & Themes

1. **Streamlined Review & Approval Process:**
   - *"Time is Money"*

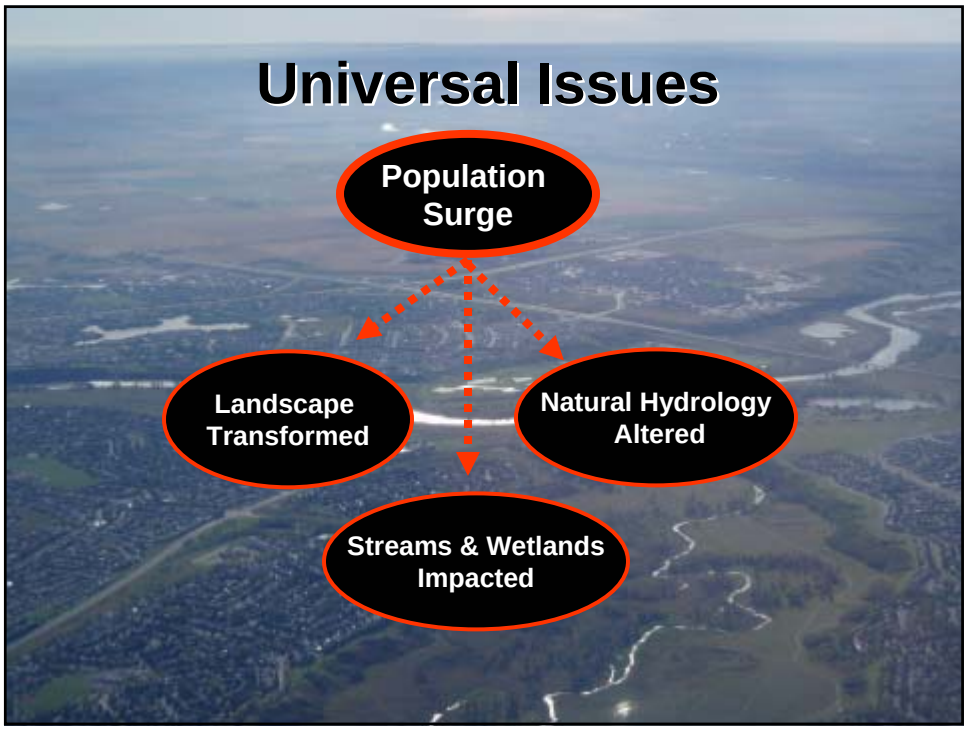
2. **Develop Municipal Capacity & Confidence to Embrace New Designs:**
   - *"What You Don't Know May Actually Help"*

Key Issues & Themes (cont'd)

3. **Promote Information Exchange Amongst the Design Community:**
   - *"It's Nice to Share"*

4. **Provincial Support of Local Watershed-Based Drainage Planning:**
   - *"One Size Does Not Always Fit All"*

What Are Your Expectations For This Workshop?



Stormwater Management in Alberta

Traditional stormwater strategies and infrastructures focused on designs and solutions that could:

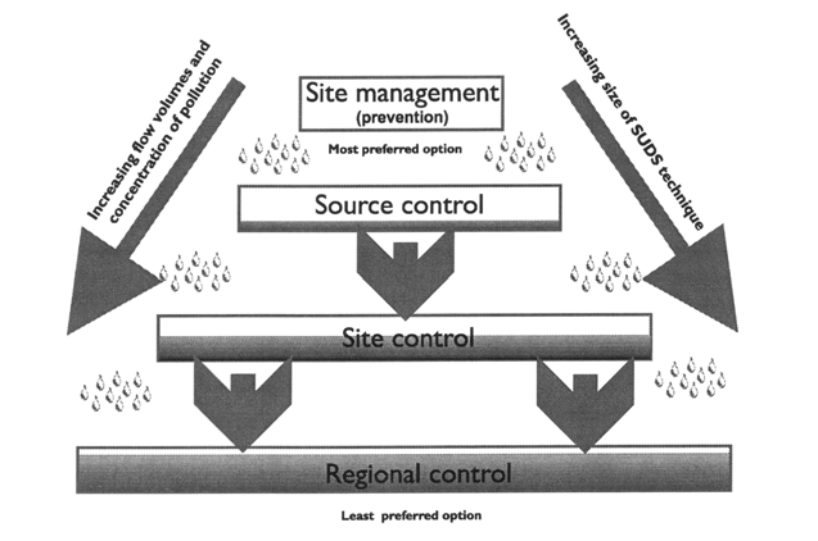
- address flood management and public safety for 1 in 100 year storm events
- ensure moving and treating stormwater was convenient for urban planning and development

Constructed Wetland in Saddleridge (Bernie Amell)

Traditional Stormwater Management Thinking ...

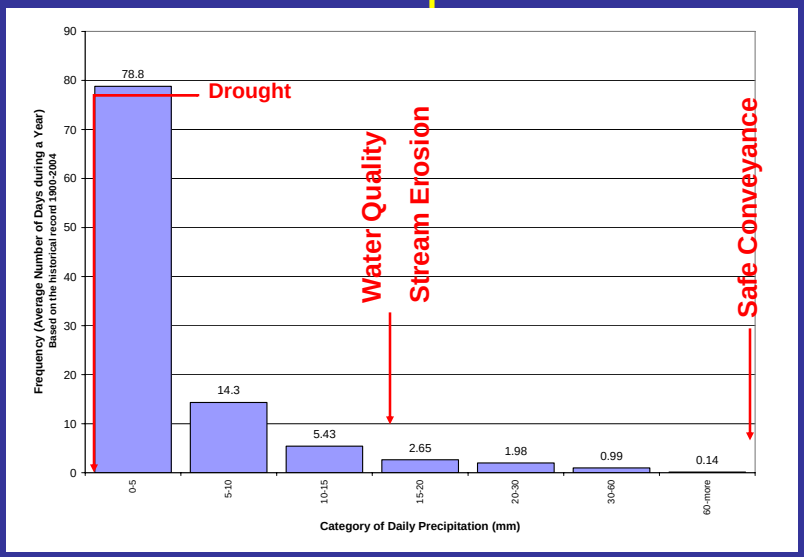
As long as we divert and treat runoff from new developments through stormwater ponds, won't all environmental needs be met?

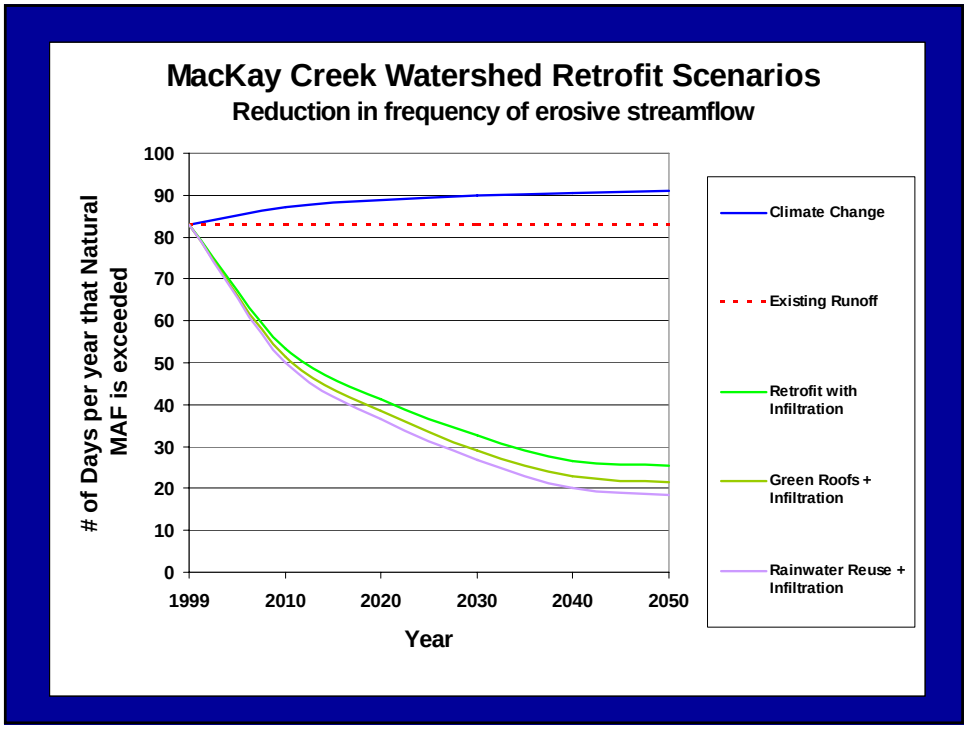
We have learned that … stormwater ponds are only part of the solution … we need more strategies and tools in the "treatment train".



Why are some of the creeks in urbanizing regions (e.g., Whitemud Creek in Edmonton or West Nose Creek in Calgary) showing accelerated stream erosion while the peak runoff rates are controlled to pre-development 1:100 year flow rates?

Rainfall Spectrum




MacKay Creek Watershed Retrofit Scenarios
Reduction in frequency of erosive streamflow
# of Days per year that Natural MAF is exceeded
100
90
80
70
60
50
40
30
20
10
0
1999
2010
2020
2030
2040
2050
Year
Climate Change
Existing Runoff
Retrofit with Infiltration
Green Roofs + Infiltration
Rainwater Reuse + Infiltration

Fence previously in bank
Erosion Examples Denver

Why Manage Volume?

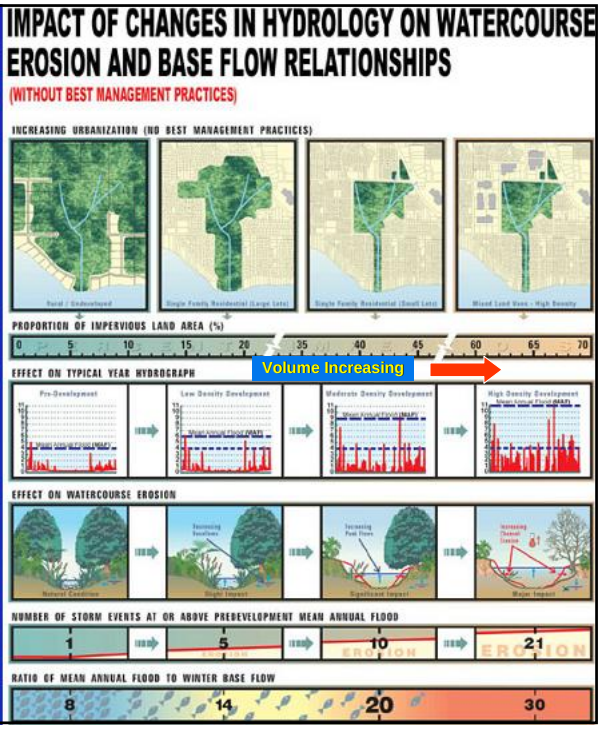
Erosion

Sedimentation

The Mean Annual Flood (MAF) is the 'channel-forming event'

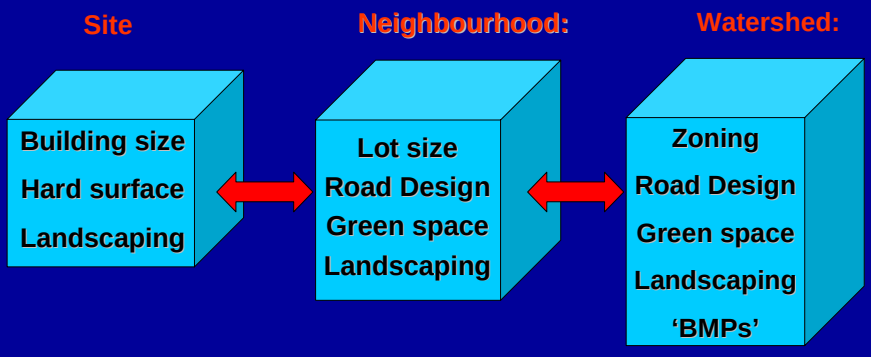
When the MAF increases, the channel erodes to convey the additional volume

A consequence of channel instability is habitat degradation



Key Message:

Integrate Actions at Three Scales: Improve Site Practices to Enhance Community Livability



The City of Courtenay was the first BC municipality to adopt a Minimum Soil Depth Policy

Conventional Ponds for peak flow control are only a Partial Solution!

The Complete Solution includes 'Volume Management'

Workshop Road Map

- Think Beyond the Pond
- Build the Vision, Create the Legacy
- Tour of Water Balance
- Demonstration of the Model
- Where To Now?

Building a Vision & Creating a Legacy

- Issue: How We Manage Population Growth
- Impact: Growth Resulting in Urban Densification (Land Constraints; Smaller Lots)
- Sustainability: *Means Design with Nature*
- Built Environment: We Can Improve It
- Natural Environment: We Can Protect It
- Cumulative Benefits: Accrue Over Time
- Outcome: Sustain Community Livability

In BC, change on-the-ground is being advanced through partnerships:

- **Convening for Action in British Columbia**
- **Green Infrastructure Partnership**
- **Water Bucket Website Partnership**
- **Water Balance Model Partnership**

When 'convening for action', we build capacity through a 3-step process:

1. **Vision:** What do you want this place to look like in 20 years, 50 years?
2. **Starting Point:** What are you doing to achieve this?
3. **Strategy:** What are you going to do better or differently to get from here to there?

When 'convening for action', we build capacity through a 3-step process:

1. **Challenge** practitioners and others to step back from existing paradigms
2. **Inform** them regarding alternatives
3. **Provide** the tools & experience to develop land and use water differently

WATER Balance MODEL FOR BRITISH COLUMBIA

www.waterbalance.ca

Inter-Governmental Partnership:
Vision

To promote changes in land development practices so that:

- The built environment will preserve and/or restore the natural water balance over time
- Performance targets will be achieved for runoff volume and flow rate reduction at the source, *where rain falls*

WHY is LID Different?

Supports growth management strategies

- such as Smart Growth, that emphasize the saving of green space and the redevelopment of existing urban regions

Does not sacrifice the environmental quality of dense urban watersheds for greater protection of conservation areas.

Has retrofit capability to promote ecologically-restorative infill and brownfields development in impaired stream areas.

WHY is LID Different?

Uses many of the same conservation and impact minimization principles inherent in other stormwater management strategies.

Including:

- **encourage conservation measures**
- **impervious surface**
- **slowing flow using the landscape**
- **practices to reduce and cleanse runoff**
- **pollution prevention measures**

The LID approach provides basic tools:

LID is simple and effective.

Reduces large investments in centralized conveyance/treatment infrastructure

Integrates treatment and control strategies

Mimics a watershed's hydrology and water quality regime.

Creates hydrologically functioning landscapes

Generates less:

- **surface runoff, less pollution, less erosion, and less overall damage to lakes, streams, and rivers.**

LID is economical

Costs less to construct and maintain.

Land can be used for additional development.

Lot level landscaping / vegetation offers "quality of life" opportunities.

Other benefits include:

- enhanced property values and re-development potential
- greater marketability, improved wildlife habitat
- thermal pollution reduction, water conservation,
- energy savings, smog reduction/climate change,
- enhanced wetlands protection, and decreased flooding.

LID is flexible

Uses structural and nonstructural techniques.

Adaptable for highly urbanized constrained areas, as well as open regions and environmentally sensitive sites.

Principles and practices are practically infinite

Any feature of the urban landscape can be modified to control runoff and / or reduce the introduction of pollution.

Can create a "customized" watershed management design.

LID is a balanced approached

Advances stormwater management opportunities.

Ecologically-based land development technology promotes a “watercentric approach”.

Integrates the built environment with the natural environment.

Principles and practices allow the developed site to maintain its predevelopment watershed and ecological functions.

LID is a balanced approached

Advances stormwater management opportunities.

Ecologically-based land development technology promotes a “watercentric approach”.

Integrates the built environment with the natural environment.

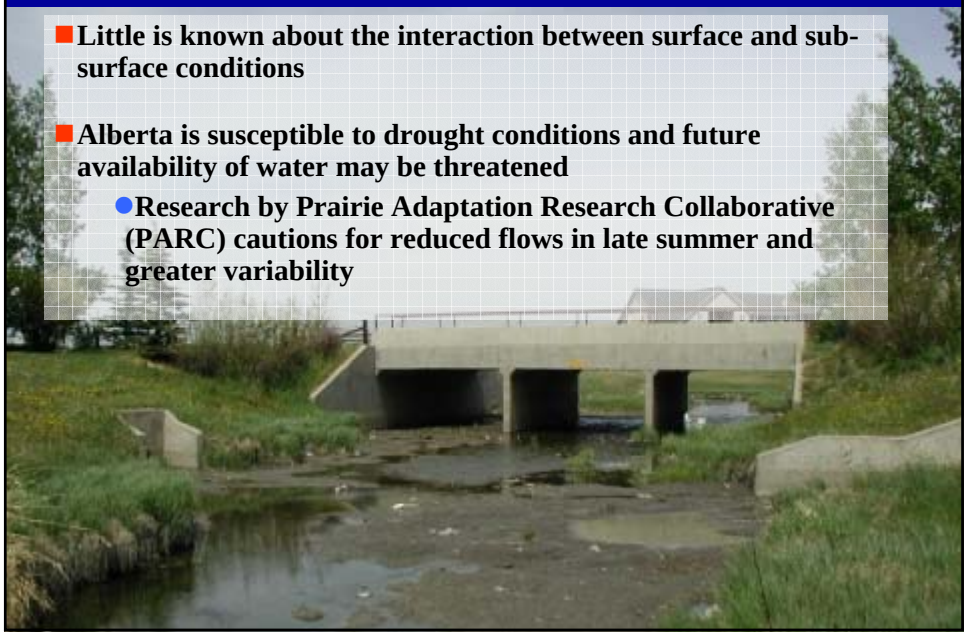
Principles and practices allow the developed site to maintain its predevelopment watershed and ecological functions.

Alberta Challenges

- Population and urban growth are leading to deterioration of our environment.
- For instance, Calgary has grown by over 25% in the last decade
- Differences in servicing strategies
  - Edmonton has combined and separated drainage systems
  - Other communities have fully separated drainage systems

Alberta Challenges

- Little is known about the interaction between surface and sub-surface conditions
- Alberta is susceptible to drought conditions and future availability of water may be threatened
  - Research by Prairie Adaptation Research Collaborative (PARC) cautions for reduced flows in late summer and greater variability

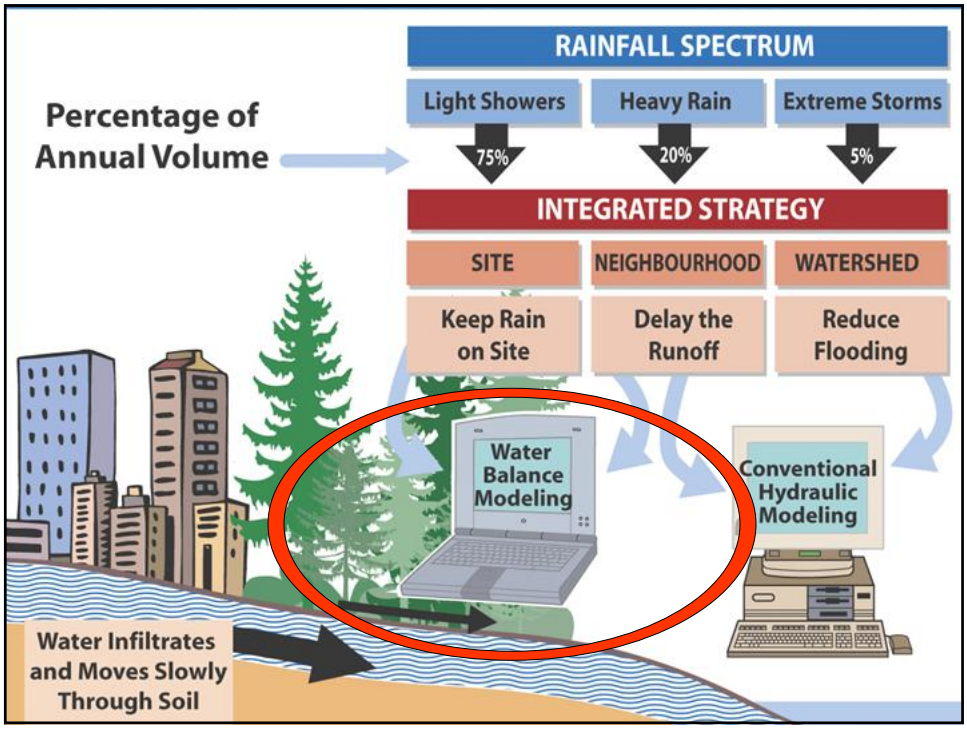


So, to build the vision and create the legacy….

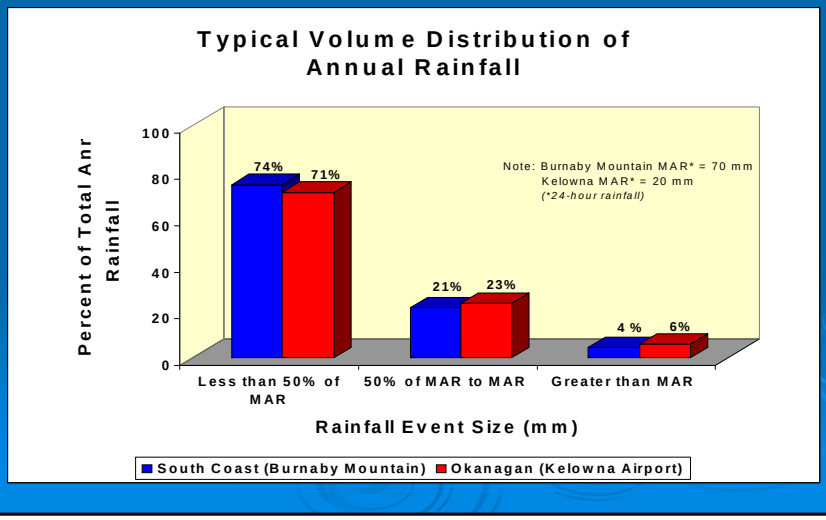
Inform, inspire and enable people to work together through partnerships to act now

Workshop Road Map

- Think Beyond the Pond
- Build the Vision, Create the Legacy
- **Tour of Water Balance**
- Demonstration of the Model
- Where To Now?



Light Showers Account for Most of the Annual Rainfall Volume



KEY MESSAGE #2:
Anybody with a computer and internet connection can access the model

KEY MESSAGE #3:
Water Balance Model promotes Integration of Perspectives

- Planners: Tool for Better Use of Space
- Engineers: Tool for Pre-Design
- Landscape Architects: Tool for Green Solutions
- Ecologists: Tool for Watershed Function
- Educators: Tool for Social Marketing

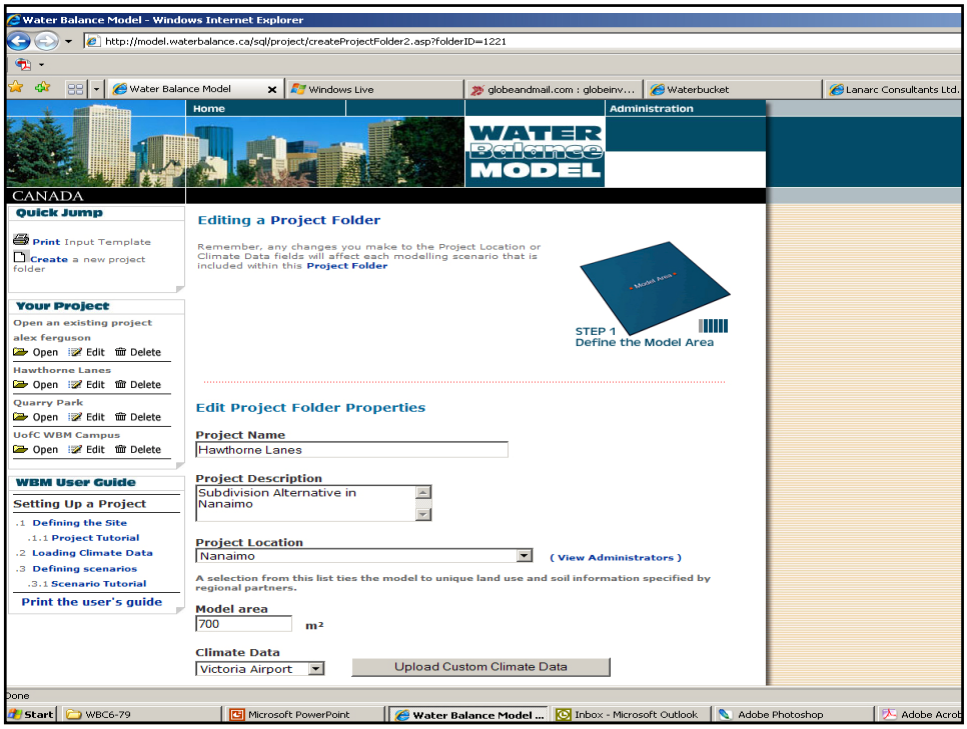
ALIDP
Alberta Low Impact Development Partnership

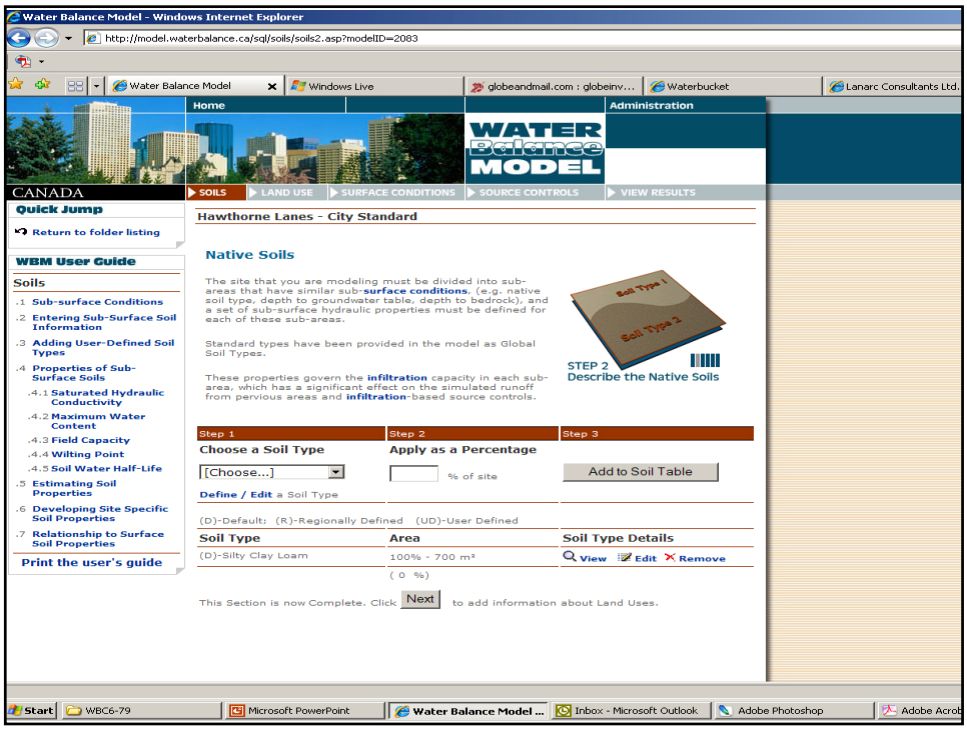
WaterBalance Model Demonstration

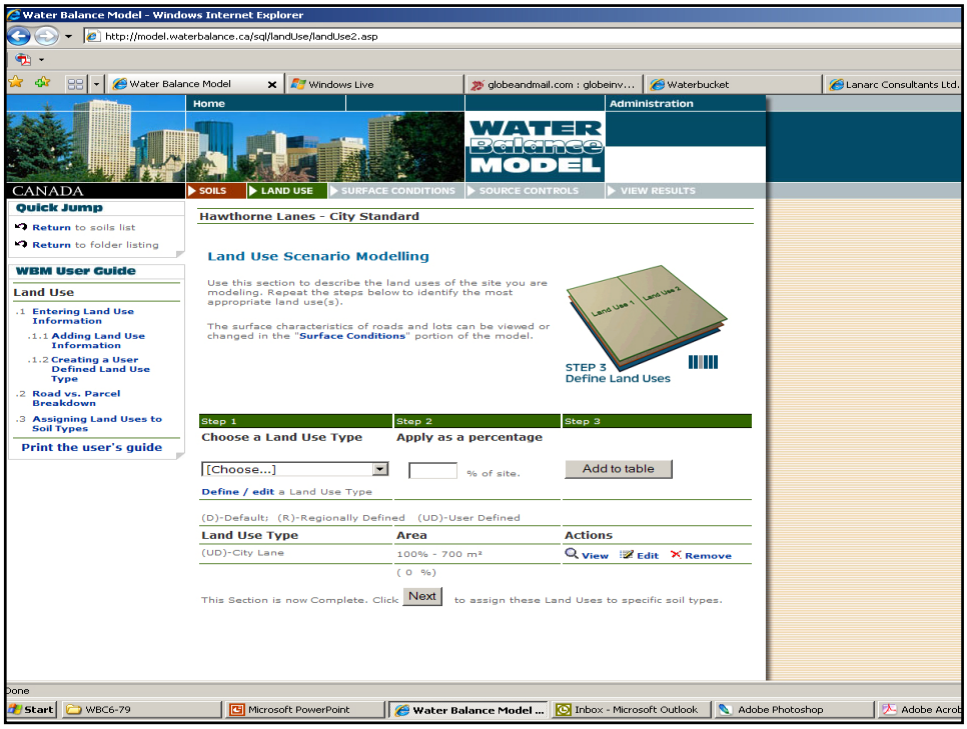
Hawthorne Lane Example
Sample Screenshots

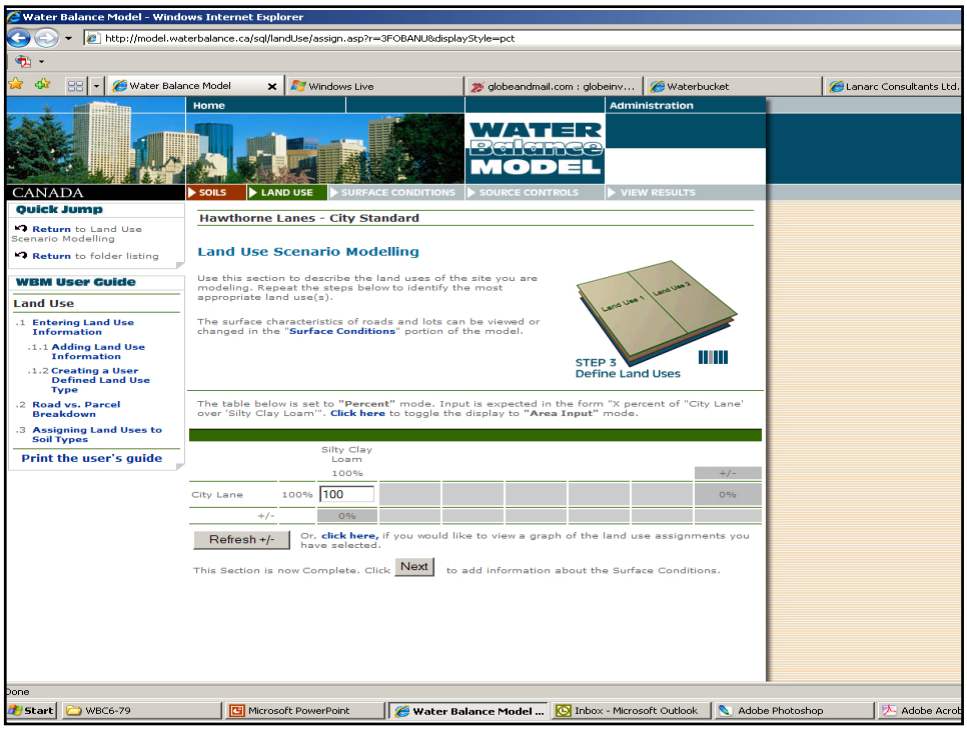
October 18, 2006

Conference Account
Username: cochrane
Password: Alberta


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/project/createProjectFolder2.asp?folderID=1221
Home
Administration
WATER Balance MODEL
CANADA
Quick Jump
Print Input Template
Create a new project folder
Your Project
Open an existing project
alex ferguson
Open Edit Delete
Hawthorne Lanes
Quarry Park
UofC WBM Campus
WBM User Guide
Setting Up a Project
.1 Defining the Site
.1.1 Project Tutorial
.2 Loading Climate Data
.3 Defining scenarios
.3.1 Scenario Tutorial
Print the user's guide
Editing a Project Folder
Remember, any changes you make to the Project Location or Climate Data fields will affect each modelling scenario that is included within this Project Folder
STEP 1
Define the Model Area
Edit Project Folder Properties
Project Name
Hawthorne Lanes
Project Description
Subdivision Alternative in Nanaimo
Project Location
Nanaimo
(View Administrators)
A selection from this list ties the model to unique land use and soil information specified by regional partners.
Model area
700
m²
Climate Data
Victoria Airport
Upload Custom Climate Data
Done


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/soils/soils2.asp?modelID=2083
Home
Administration
WATER Balance MODEL
CANADA
SOILS
LAND USE
SURFACE CONDITIONS
SOURCE CONTROLS
VIEW RESULTS
Quick Jump
Return to folder listing
WBM User Guide
Soils
.1 Sub-surface Conditions
.2 Entering Sub-Surface Soil Information
.3 Adding User-Defined Soil Types
.4 Properties of Sub-Surface Soils
.4.1 Saturated Hydraulic Conductivity
.4.2 Maximum Water Content
.4.3 Field Capacity
.4.4 Wilting Point
.4.5 Soil Water Half-Life
.5 Estimating Soil Properties
.6 Developing Site Specific Soil Properties
.7 Relationship to Surface Soil Properties
Print the user's guide
Hawthorne Lanes - City Standard
Native Soils
The site that you are modeling must be divided into sub-areas that have similar sub-surface conditions, (e.g. native soil type, depth to groundwater table, depth to bedrock), and a set of sub-surface hydraulic properties must be defined for each of these sub-areas.
Standard types have been provided in the model as Global Soil Types.
These properties govern the infiltration capacity in each sub-area, which has a significant effect on the simulated runoff from pervious areas and infiltration-based source controls.
Soil Type 1
Soil Type 2
STEP 2
Describe the Native Soils
Step 1
Choose a Soil Type
[Choose...]
Define / Edit a Soil Type
Step 2
Apply as a Percentage
% of site
Step 3
Add to Soil Table
(D)-Default; (R)-Regionally Defined (UD)-User Defined
Soil Type
Area
Soil Type Details
(D)-Silty Clay Loam
100% - 700 m²
(0 %)
View Edit Remove
This Section is now Complete. Click Next to add information about Land Uses.


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/landUse/landUse2.asp
Home
Administration
WATER Balance MODEL
CANADA
SOILS
LAND USE
SURFACE CONDITIONS
SOURCE CONTROLS
VIEW RESULTS
Quick Jump
Return to soils list
Return to folder listing
WBM User Guide
Land Use
.1 Entering Land Use Information
.1.1 Adding Land Use Information
.1.2 Creating a User Defined Land Use Type
.2 Road vs. Parcel Breakdown
.3 Assigning Land Uses to Soil Types
Print the user's guide
Hawthorne Lanes - City Standard
Land Use Scenario Modelling
Use this section to describe the land uses of the site you are modeling. Repeat the steps below to identify the most appropriate land use(s).
The surface characteristics of roads and lots can be viewed or changed in the "Surface Conditions" portion of the model.
STEP 3
Define Land Uses
Step 1
Choose a Land Use Type
Step 2
Apply as a percentage
Step 3
[Choose...]
% of site.
Add to table
Define / edit a Land Use Type
(D)-Default; (R)-Regionally Defined (UD)-User Defined
Land Use Type
Area
Actions
(UD)-City Lane
100% - 700 m²
(0 %)
View
Edit
Remove
This Section is now Complete. Click Next to assign these Land Uses to specific soil types.
Done
Start
WBC6-79
Microsoft PowerPoint
Water Balance Model ...
Inbox - Microsoft Outlook
Adobe Photoshop
Adobe Acrob


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/landUse/assign.asp?r=3FOBANU&displayStyle=pct
Home
Administration
WATER Balance MODEL
CANADA
SOILS
LAND USE
SURFACE CONDITIONS
SOURCE CONTROLS
VIEW RESULTS
Quick Jump
Return to Land Use Scenario Modelling
Return to folder listing
WBM User Guide
Land Use
.1 Entering Land Use Information
.1.1 Adding Land Use Information
.1.2 Creating a User Defined Land Use Type
.2 Road vs. Parcel Breakdown
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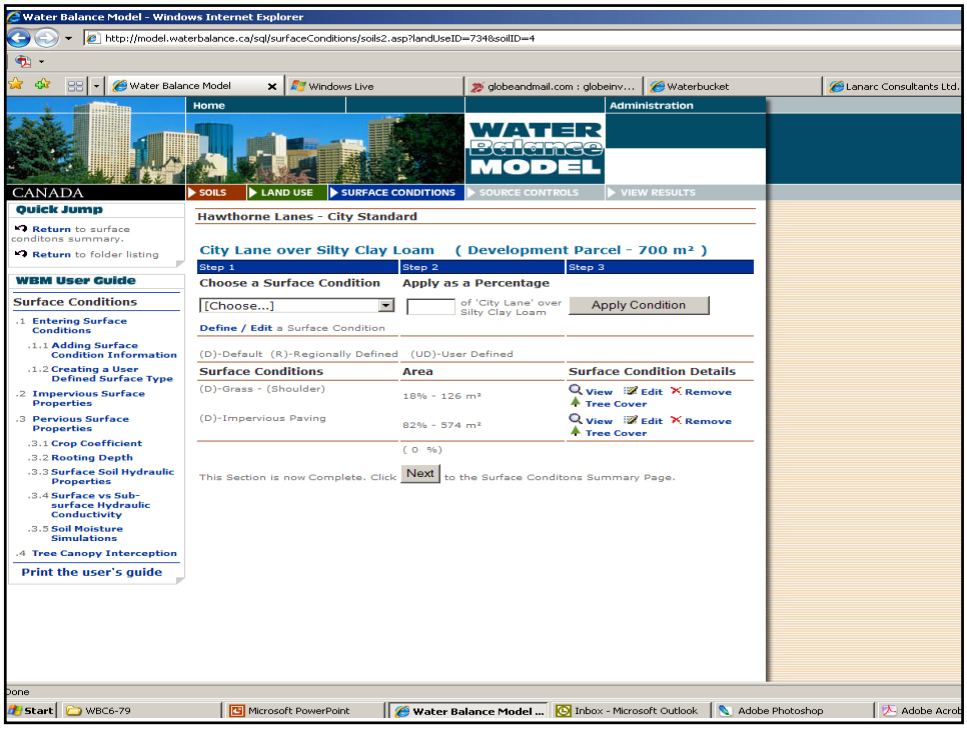
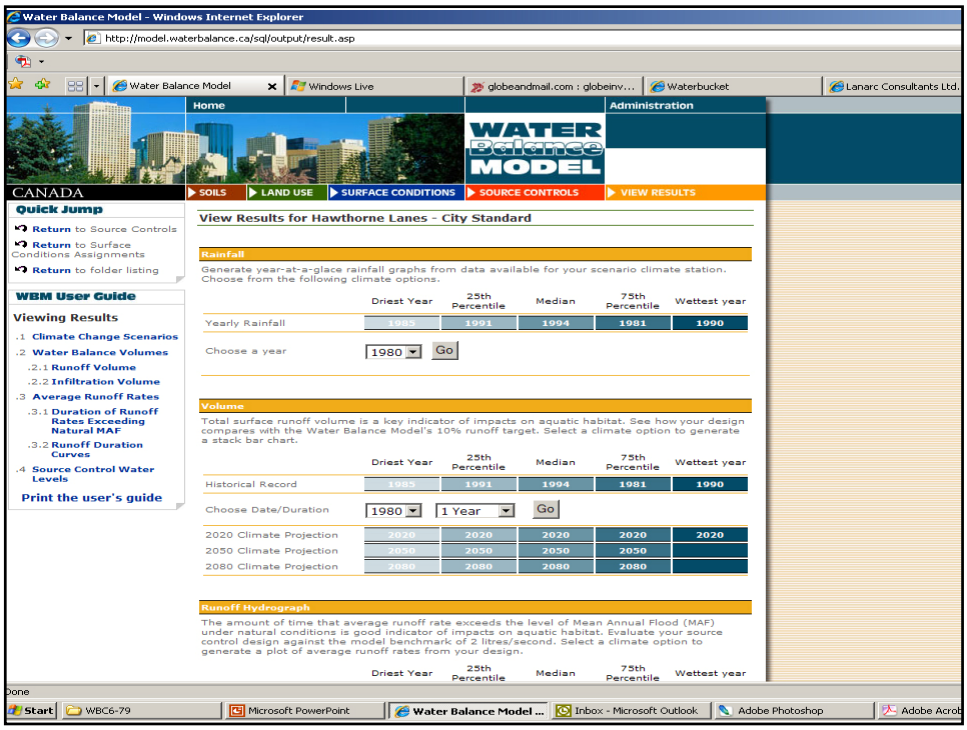
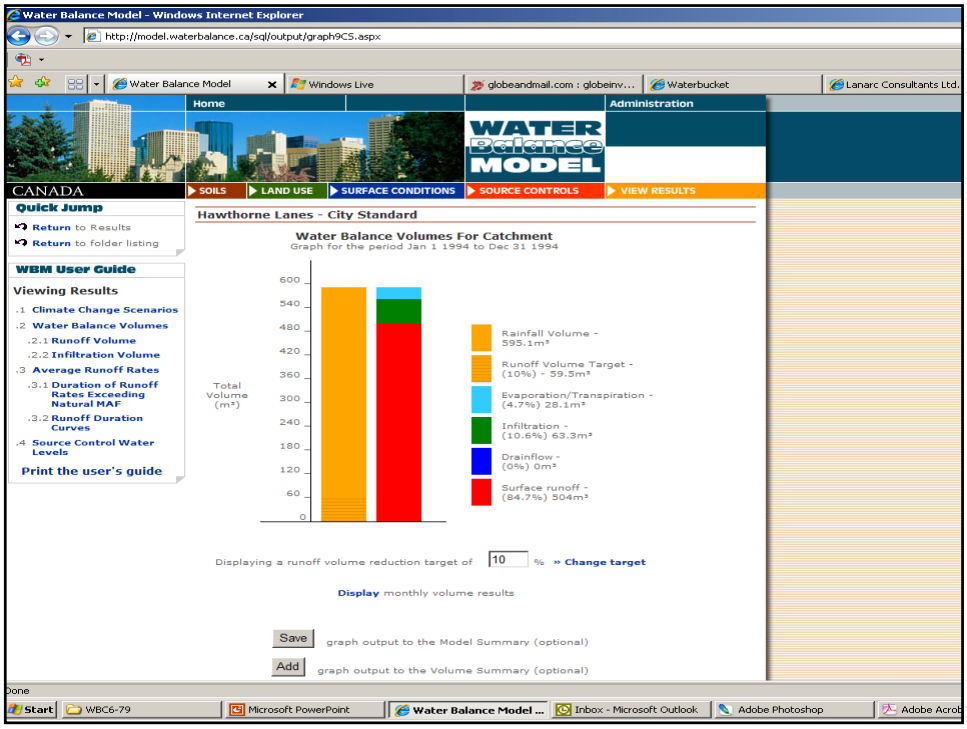
Print the user's guide
Hawthorne Lanes - City Standard
Land Use Scenario Modelling
Use this section to describe the land uses of the site you are modeling. Repeat the steps below to identify the most appropriate land use(s).
The surface characteristics of roads and lots can be viewed or changed in the "Surface Conditions" portion of the model.
STEP 3
Define Land Uses
The table below is set to "Percent" mode. Input is expected in the form "X percent of "City Lane' over 'Silty Clay Loam'". Click here to toggle the display to "Area Input" mode.
Silty Clay Loam
100%
+/-
City Lane
100%
100
0%
+/-
0%
Refresh +/-
Or, click here, if you would like to view a graph of the land use assignments you have selected.
This Section is now Complete. Click Next to add information about the Surface Conditions.
Done
Start
WBC6-79
Microsoft PowerPoint
Water Balance Model ...
Inbox - Microsoft Outlook
Adobe Photoshop
Adobe Acrob


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/surfaceConditions/soils2.asp?landUseID=7348soilID=4
Home
Administration
WATER Balance MODEL
CANADA
SOILS
LAND USE
SURFACE CONDITIONS
SOURCE CONTROLS
VIEW RESULTS
Quick Jump
Return to surface conditons summary.
Return to folder listing
WBM User Guide
Surface Conditions
.1 Entering Surface Conditions
.1.1 Adding Surface Condition Information
.1.2 Creating a User Defined Surface Type
.2 Impervious Surface Properties
.3 Pervious Surface Properties
.3.1 Crop Coefficient
.3.2 Rooting Depth
.3.3 Surface Soil Hydraulic Properties
.3.4 Surface vs Sub-surface Hydraulic Conductivity
.3.5 Soil Moisture Simulations
.4 Tree Canopy Interception
Print the user's guide
Hawthorne Lanes - City Standard
City Lane over Silty Clay Loam (Development Parcel - 700 m²)
Step 1
Step 2
Step 3
Choose a Surface Condition
Apply as a Percentage
[Choose...]
of 'City Lane' over Silty Clay Loam
Apply Condition
Define / Edit a Surface Condition
(D)-Default (R)-Regionally Defined (UD)-User Defined
Surface Conditions
Area
Surface Condition Details
(D)-Grass - (Shoulder)
18% - 126 m²
View Edit Remove Tree Cover
(D)-Impervious Paving
82% - 574 m²
View Edit Remove Tree Cover
(0 %)
This Section is now Complete. Click Next to the Surface Conditons Summary Page.
Done
Start
WBC6-79
Microsoft PowerPoint
Water Balance Model ...
Inbox - Microsoft Outlook
Adobe Photoshop
Adobe Acrob


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/output/result.asp
Home
Administration
WATER Balance MODEL
CANADA
SOILS
LAND USE
SURFACE CONDITIONS
SOURCE CONTROLS
VIEW RESULTS
Quick Jump
Return to Source Controls
Return to Surface Conditions Assignments
Return to folder listing
WBM User Guide
Viewing Results
.1 Climate Change Scenarios
.2 Water Balance Volumes
.2.1 Runoff Volume
.2.2 Infiltration Volume
.3 Average Runoff Rates
.3.1 Duration of Runoff Rates Exceeding Natural MAF
.3.2 Runoff Duration Curves
.4 Source Control Water Levels
Print the user's guide
View Results for Hawthorne Lanes - City Standard
Rainfall
Generate year-at-a-glace rainfall graphs from data available for your scenario climate station. Choose from the following climate options.
Driest Year
25th Percentile
Median
75th Percentile
Wettest year
Yearly Rainfall
1980
1991
1994
1981
1990
Choose a year
1980
Go
Volume
Total surface runoff volume is a key indicator of impacts on aquatic habitat. See how your design compares with the Water Balance Model's 10% runoff target. Select a climate option to generate a stack bar chart.
Historical Record
Choose Date/Duration
1980
1 Year
Go
2020 Climate Projection
2050 Climate Projection
2080 Climate Projection
2020
2050
2080
Runoff Hydrograph
The amount of time that average runoff rate exceeds the level of Mean Annual Flood (MAF) under natural conditions is good indicator of impacts on aquatic habitat. Evaluate your source control design against the model benchmark of 2 litres/second. Select a climate option to generate a plot of average runoff rates from your design.
Done
Start
WBC6-79
Microsoft PowerPoint
Water Balance Model ...
Inbox - Microsoft Outlook
Adobe Photoshop
Adobe Acrob


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/output/graph9CS.aspx
Water Balance Model
Windows Live
globeandmail.com : globeinv...
Waterbucket
Lanarc Consultants Ltd.
Home
Administration
WATER Balance MODEL
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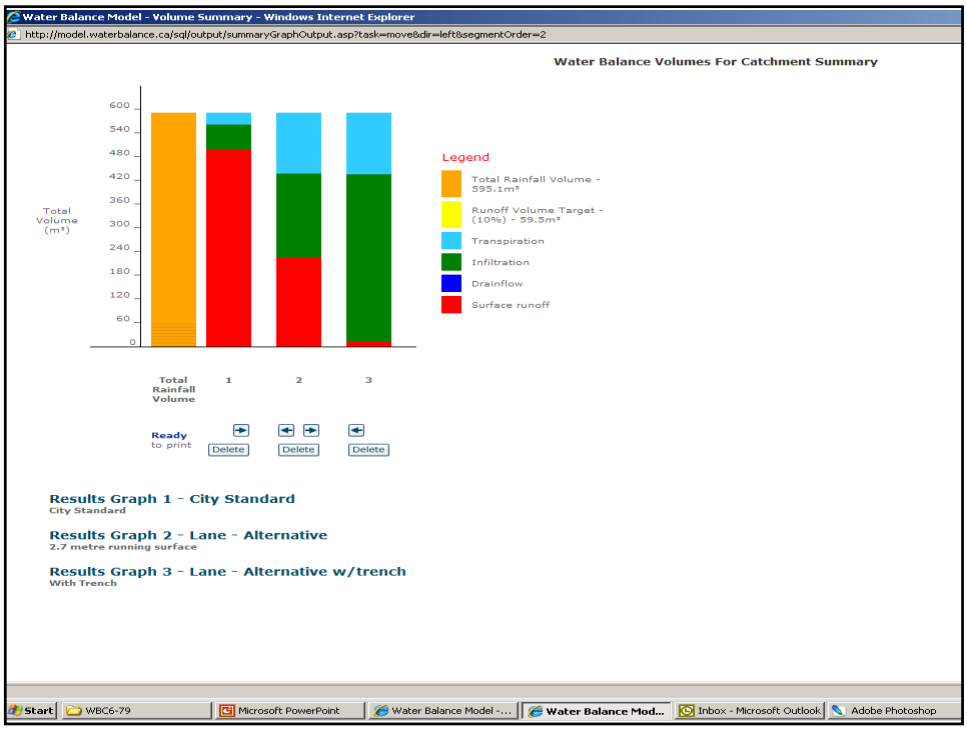
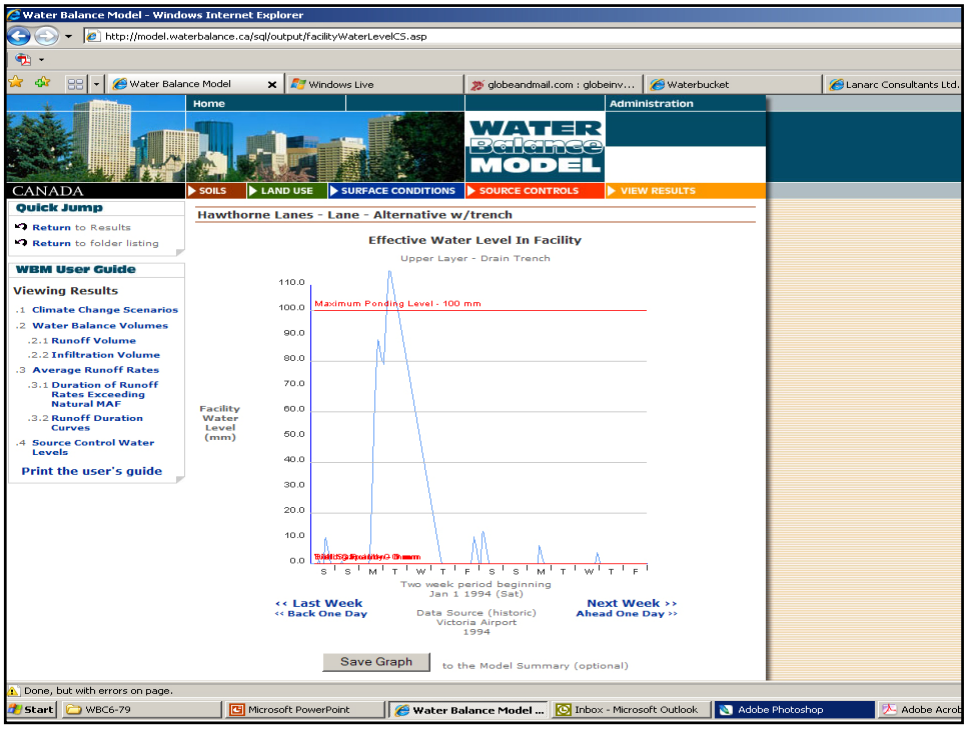
SOILS
LAND USE
SURFACE CONDITIONS
SOURCE CONTROLS
VIEW RESULTS
Quick Jump
Return to Results
Return to folder listing
WBM User Guide
Viewing Results
.1 Climate Change Scenarios
.2 Water Balance Volumes
.2.1 Runoff Volume
.2.2 Infiltration Volume
.3 Average Runoff Rates
.3.1 Duration of Runoff Rates Exceeding Natural MAF
.3.2 Runoff Duration Curves
.4 Source Control Water Levels
Print the user's guide
Hawthorne Lanes - City Standard
Water Balance Volumes For Catchment
Graph for the period Jan 1 1994 to Dec 31 1994
Total Volume (m³)
600
540
480
420
360
300
240
180
120
60
0
Rainfall Volume - 595.1m³
Runoff Volume Target - (10%) - 59.5m³
Evaporation/Transpiration - (4.7%) 28.1m³
Infiltration - (10.6%) 63.3m³
Drainflow - (0%) 0m³
Surface runoff - (84.7%) 504m³
Displaying a runoff volume reduction target of 10 % » Change target
Display monthly volume results
Save graph output to the Model Summary (optional)
Add graph output to the Volume Summary (optional)
Done
Start
WBC6-79
Microsoft PowerPoint
Water Balance Model ...
Inbox - Microsoft Outlook
Adobe Photoshop
Adobe Acrob


Water Balance Model - Volume Summary - Windows Internet Explorer
http://model.waterbalance.ca/sql/output/summaryGraphOutput.asp?task=move&dir=left&segmentOrder=2
Water Balance Volumes For Catchment Summary
Total Volume (m³)
600
540
480
420
360
300
240
180
120
60
0
Legend
Total Rainfall Volume - 595.1m³
Runoff Volume Target - (10%) - 59.5m³
Transpiration
Infiltration
Drainflow
Surface runoff
Total Rainfall Volume
1
2
3
Ready to print
Delete
Delete
Delete
Results Graph 1 - City Standard
City Standard
Results Graph 2 - Lane - Alternative
2.7 metre running surface
Results Graph 3 - Lane - Alternative w/trench
With Trench
Start
WBC6-79
Microsoft PowerPoint
Water Balance Model -...
Water Balance Mod...
Inbox - Microsoft Outlook
Adobe Photoshop


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/output/FacilityWaterLevelCS.asp
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.3.2 Runoff Duration Curves
.4 Source Control Water Levels
Print the user's guide
Hawthorne Lanes - Lane - Alternative w/trench
Effective Water Level In Facility
Upper Layer - Drain Trench
Maximum Ponding Level - 100 mm
Facility Water Level (mm)
Two week period beginning Jan 1 1994 (Sat)
<< Last Week
<< Back One Day
Next Week >>
Ahead One Day >>
Data Source (historic) Victoria Airport 1994
Save Graph
to the Model Summary (optional)
Done, but with errors on page.

WATER Balance MODEL FOR BRITISH COLUMBIA
www.waterbalance.ca
Coming Next Year…..
Integration with QUALHYMO
will provide engineers with "one-stop shopping" for:
Rainwater Storage Routing
Water Quality
Stream Erosion
Drainage Area Flow Routing
Snowmelt Runoff

Workshop Road Map

- Think Beyond the Pond
- Build the Vision, Create the Legacy
- Tour of Water Balance
- **Demonstration of the Model**
- Where To Now?

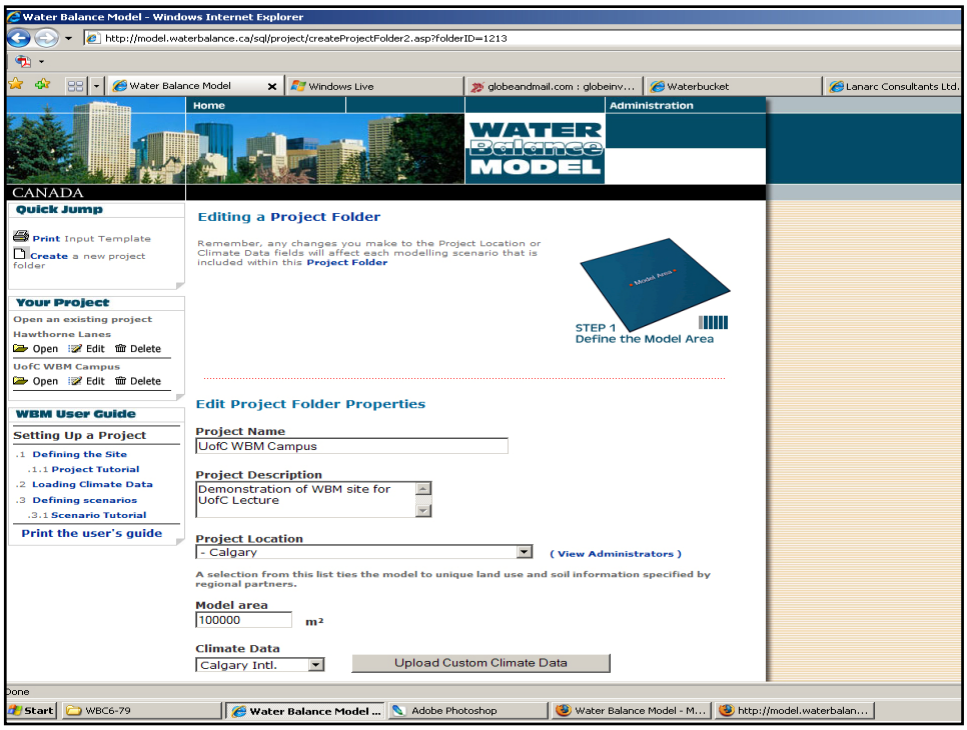
ALIDP

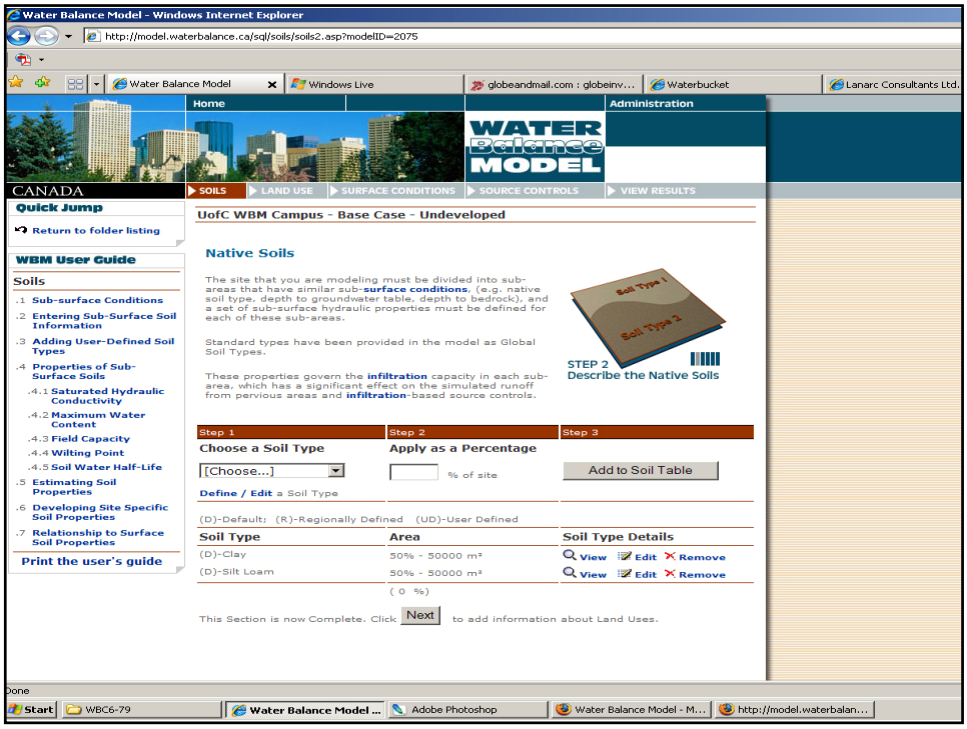
Alberta Low Impact Development Partnership

WaterBalance Model Demonstration

University of Calgary Case Study
Pre-development Scenario

October 18, 2006




Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/soils/soils2.asp?modelID=2075
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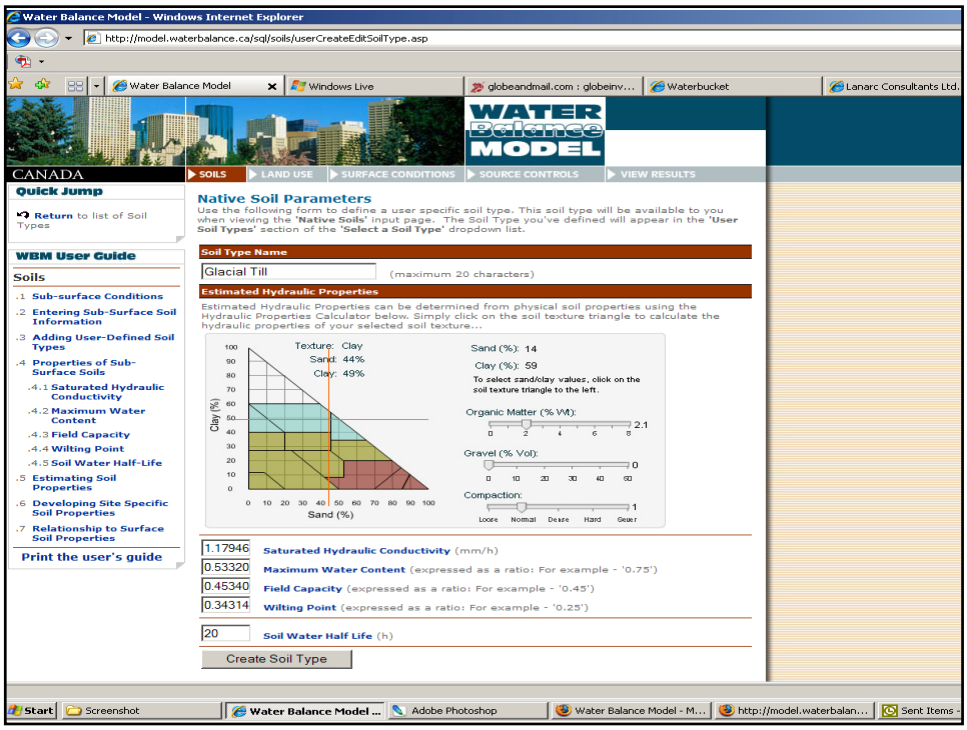
.1 Sub-surface Conditions
.2 Entering Sub-Surface Soil Information
.3 Adding User-Defined Soil Types
.4 Properties of Sub-Surface Soils
.4.1 Saturated Hydraulic Conductivity
.4.2 Maximum Water Content
.4.3 Field Capacity
.4.4 Wilting Point
.4.5 Soil Water Half-Life
.5 Estimating Soil Properties
.6 Developing Site Specific Soil Properties
.7 Relationship to Surface Soil Properties
Print the user's guide
UofC WBM Campus - Base Case - Undeveloped
Native Soils
The site that you are modeling must be divided into sub-areas that have similar sub-surface conditions, (e.g. native soil type, depth to groundwater table, depth to bedrock), and a set of sub-surface hydraulic properties must be defined for each of these sub-areas.
Standard types have been provided in the model as Global Soil Types.
These properties govern the infiltration capacity in each sub-area, which has a significant effect on the simulated runoff from pervious areas and infiltration-based source controls.
Soil Type 1
Soil Type 2
STEP 2
Describe the Native Soils
Step 1
Choose a Soil Type
[Choose...]
Define / Edit a Soil Type
Step 2
Apply as a Percentage
% of site
Step 3
Add to Soil Table
(D)-Default; (R)-Regionally Defined (UD)-User Defined
Soil Type
Area
Soil Type Details
(D)-Clay
50% - 50000 m²
View Edit Remove
(D)-Silt Loam
50% - 50000 m²
View Edit Remove
(0 %)
This Section is now Complete. Click Next to add information about Land Uses.
Done
Start
WBC6-79
Water Balance Model ...
Adobe Photoshop
Water Balance Model - M...
http://model.waterbalan...


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/soils/userCreateEditSoilType.asp
WATER Balance MODEL
CANADA
SOILS
LAND USE
SURFACE CONDITIONS
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Return to list of Soil Types
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.4.2 Maximum Water Content
.4.3 Field Capacity
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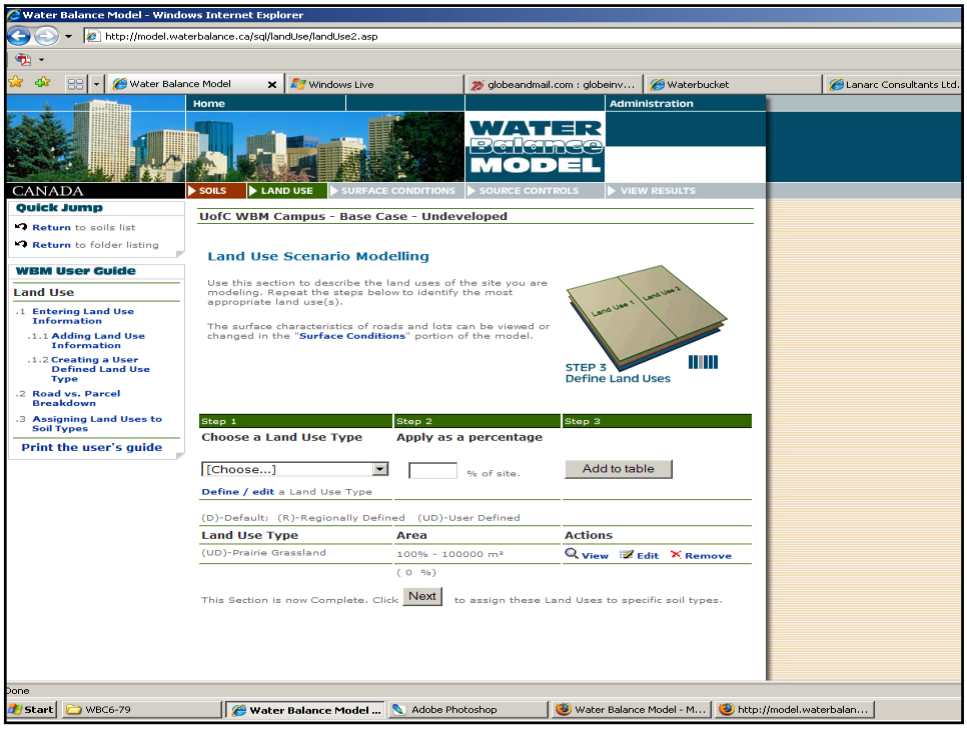
.4.5 Soil Water Half-Life
.5 Estimating Soil Properties
.6 Developing Site Specific Soil Properties
.7 Relationship to Surface Soil Properties
Print the user's guide
Native Soil Parameters
Use the following form to define a user specific soil type. This soil type will be available to you when viewing the 'Native Soils' input page. The Soil Type you've defined will appear in the 'User Soil Types' section of the 'Select a Soil Type' dropdown list.
Soil Type Name
Glacial Till
(maximum 20 characters)
Estimated Hydraulic Properties
Estimated Hydraulic Properties can be determined from physical soil properties using the Hydraulic Properties Calculator below. Simply click on the soil texture triangle to calculate the hydraulic properties of your selected soil texture...
Texture: Clay
Sand: 44%
Clay: 49%
Clay (%)
Sand (%)
Sand (%): 14
Clay (%): 59
To select sand/clay values, click on the soil texture triangle to the left.
Organic Matter (% WI):
2.1
Gravel (% Vol):
0
Compaction:
1
Loose Normal Dense Hard Gravel
1.17946 Saturated Hydraulic Conductivity (mm/h)
0.53320 Maximum Water Content (expressed as a ratio: For example - '0.75')
0.45340 Field Capacity (expressed as a ratio: For example - '0.45')
0.34314 Wilting Point (expressed as a ratio: For example - '0.25')
20 Soil Water Half Life (h)
Create Soil Type
Start
Screenshot
Water Balance Model ...
Adobe Photoshop
Water Balance Model - M...
http://model.waterbalan...
Sent Items


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/landUse/landUse2.asp
Home
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Return to soils list
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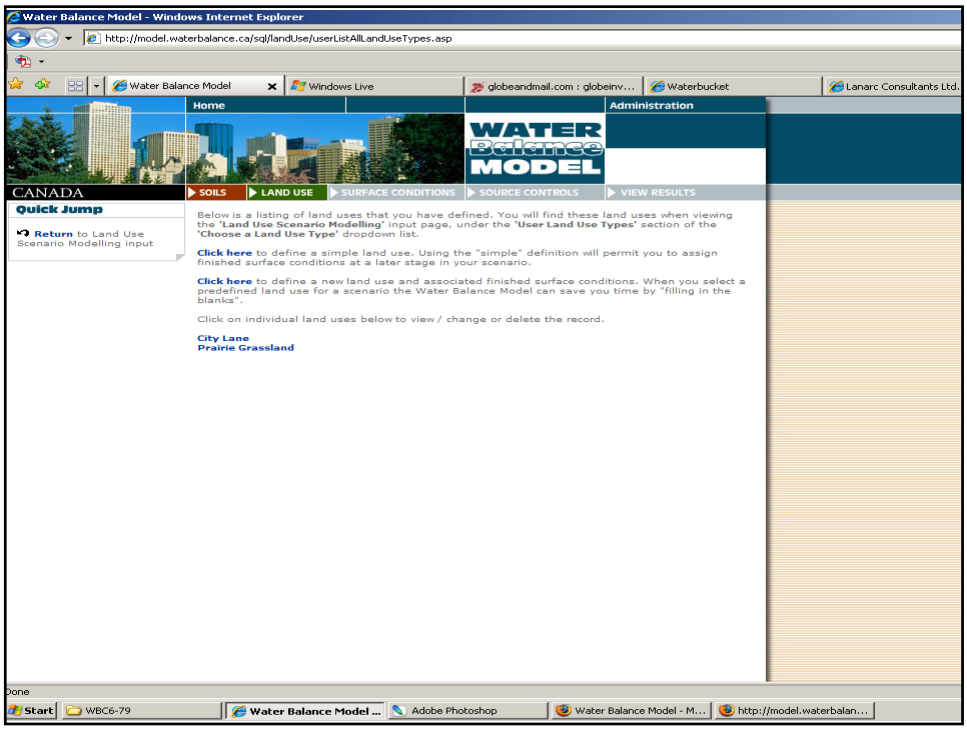
.1.1 Adding Land Use Information
.1.2 Creating a User Defined Land Use Type
.2 Road vs. Parcel Breakdown
.3 Assigning Land Uses to Soil Types
Print the user's guide
UofC WBM Campus - Base Case - Undeveloped
Land Use Scenario Modelling
Use this section to describe the land uses of the site you are modeling. Repeat the steps below to identify the most appropriate land use(s).
The surface characteristics of roads and lots can be viewed or changed in the "Surface Conditions" portion of the model.
STEP 3
Define Land Uses
Step 1
Choose a Land Use Type
Step 2
Apply as a percentage
Step 3
[Choose...]
% of site.
Add to table
Define / edit a Land Use Type
(D)-Default; (R)-Regionally Defined (UD)-User Defined
Land Use Type
Area
Actions
(UD)-Prairie Grassland
100% - 100000 m²
(0 %)
View Edit Remove
This Section is now Complete. Click Next to assign these Land Uses to specific soil types.
Done
Start
WBC6-79
Water Balance Model ...
Adobe Photoshop
Water Balance Model - M...
http://model.waterbalan...


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/landUse/userListAllLandUseTypes.asp
Home
Administration
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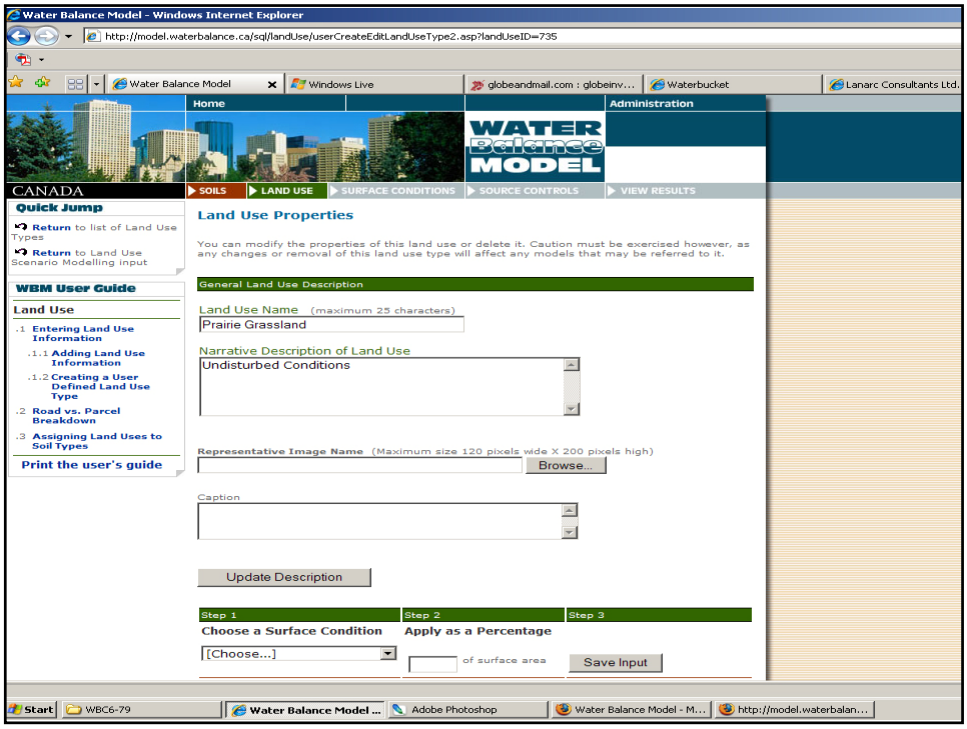
Quick Jump
Return to Land Use Scenario Modelling input
Below is a listing of land uses that you have defined. You will find these land uses when viewing the 'Land Use Scenario Modelling' input page, under the 'User Land Use Types' section of the 'Choose a Land Use Type' dropdown list.
Click here to define a simple land use. Using the "simple" definition will permit you to assign finished surface conditions at a later stage in your scenario.
Click here to define a new land use and associated finished surface conditions. When you select a predefined land use for a scenario the Water Balance Model can save you time by "filling in the blanks".
Click on individual land uses below to view / change or delete the record.
City Lane
Prairie Grassland
Done
Start
WBC6-79
Water Balance Model ...
Adobe Photoshop
Water Balance Model - M...
http://model.waterbalan...


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/landUse/userCreateEditLandUseType2.asp?landUseID=735
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Return to list of Land Use Types
Return to Land Use Scenario Modelling input
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.2 Road vs. Parcel Breakdown
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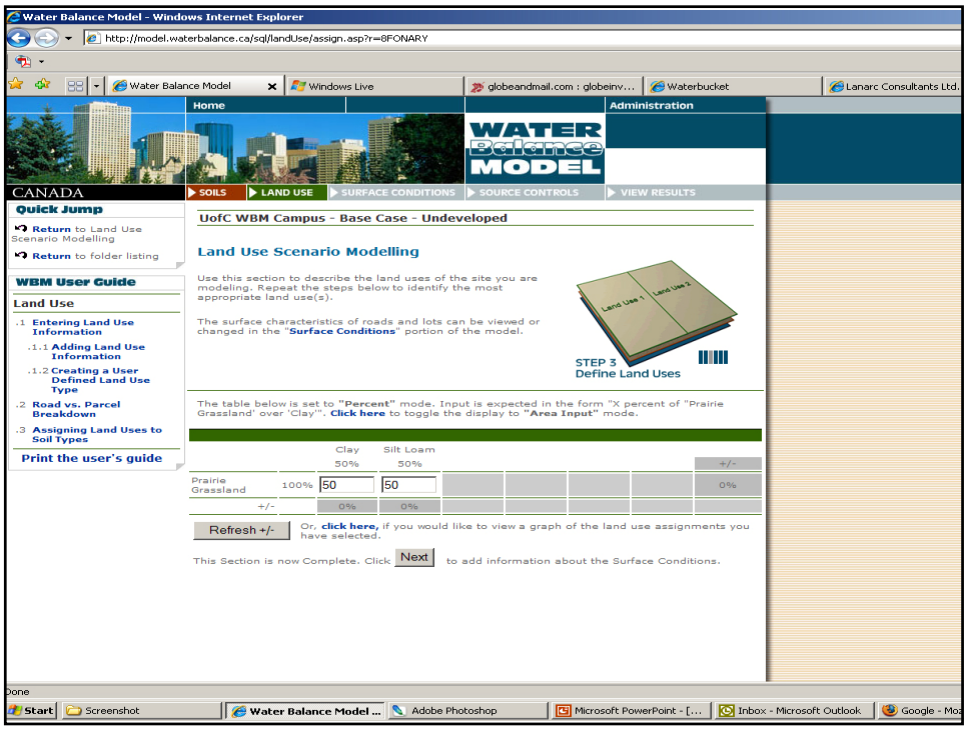
Print the user's guide
Land Use Properties
You can modify the properties of this land use or delete it. Caution must be exercised however, as any changes or removal of this land use type will affect any models that may be referred to it.
General Land Use Description
Land Use Name (maximum 25 characters)
Prairie Grassland
Narrative Description of Land Use
Undisturbed Conditions
Representative Image Name (Maximum size 120 pixels wide X 200 pixels high)
Browse...
Caption
Update Description
Step 1
Choose a Surface Condition
[Choose...]
Step 2
Apply as a Percentage
of surface area
Step 3
Save Input


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/landUse/assign.asp?r=8FONARY
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.3 Assigning Land Uses to Soil Types
Print the user's guide
UofC WBM Campus - Base Case - Undeveloped
Land Use Scenario Modelling
Use this section to describe the land uses of the site you are modeling. Repeat the steps below to identify the most appropriate land use(s).
The surface characteristics of roads and lots can be viewed or changed in the "Surface Conditions" portion of the model.
STEP 3
Define Land Uses
The table below is set to "Percent" mode. Input is expected in the form "X percent of "Prairie Grassland' over 'Clay'". Click here to toggle the display to "Area Input" mode.
Clay 50%
Silt Loam 50%
Prairie Grassland 100%
50
50
Refresh +/-
Or, click here, if you would like to view a graph of the land use assignments you have selected.
This Section is now Complete. Click Next to add information about the Surface Conditions.

Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/surfaceConditions/surfaceConditions1.asp
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Return to Land Use Vs. Soil Types
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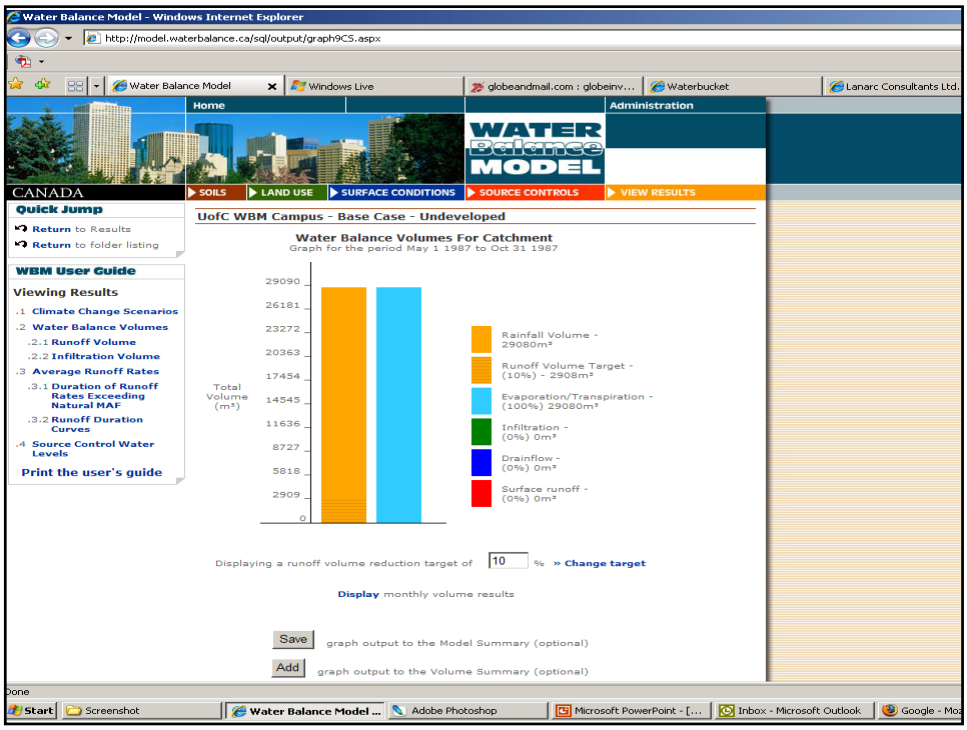
.2 Impervious Surface Properties
.3 Pervious Surface Properties
.3.1 Crop Coefficient
.3.2 Rooting Depth
.3.3 Surface Soil Hydraulic Properties
.3.4 Surface vs Sub-surface Hydraulic Conductivity
.3.5 Soil Moisture Simulations
.4 Tree Canopy Interception
Print the user's guide
UofC WBM Campus - Base Case - Undeveloped
Surface Conditions
Listed below are the land use types you have selected and the native soil types you have assigned.
The distribution of surface types must be defined for the road and lot portions of each sub-area (same land use and soil) within the project site. Each surface type must have similar characteristics.
This is an important step because Surface Conditions govern the model simulations of the hydrologic processes that control surface runoff generation. Surface Conditions can be improved through various source control applications in the "Source Control" portion of the model.
STEP 4
Surface Characteristics
Prairie Grassland 100% of the total site (100000 m²)
Underlying Soil Assignment
Assigned Surface Conditions
Add / Edit Surface Condition
50000 m² of 'Prairie Grassland' is sited on Clay
Development Parcel (Done)
Absorbent Landscape Soil
Add / Edit
50000 m² of 'Prairie Grassland' is sited on Silt Loam
Development Parcel (Done)
Absorbent Landscape Soil
Add / Edit
Click here to reset surface condition assignments to default values (Where, as indicated above, default finished surface conditions exist for the land use.)
This Section is now Complete. Click Next to apply Source Controls.
or bypass the Source Control Module and View Results
Done
Start
Screenshot
Water Balance Model ...
Adobe Photoshop
Microsoft PowerPoint - [...
Inbox - Microsoft Outlook
Google - Mo


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/output/graph9CS.aspx
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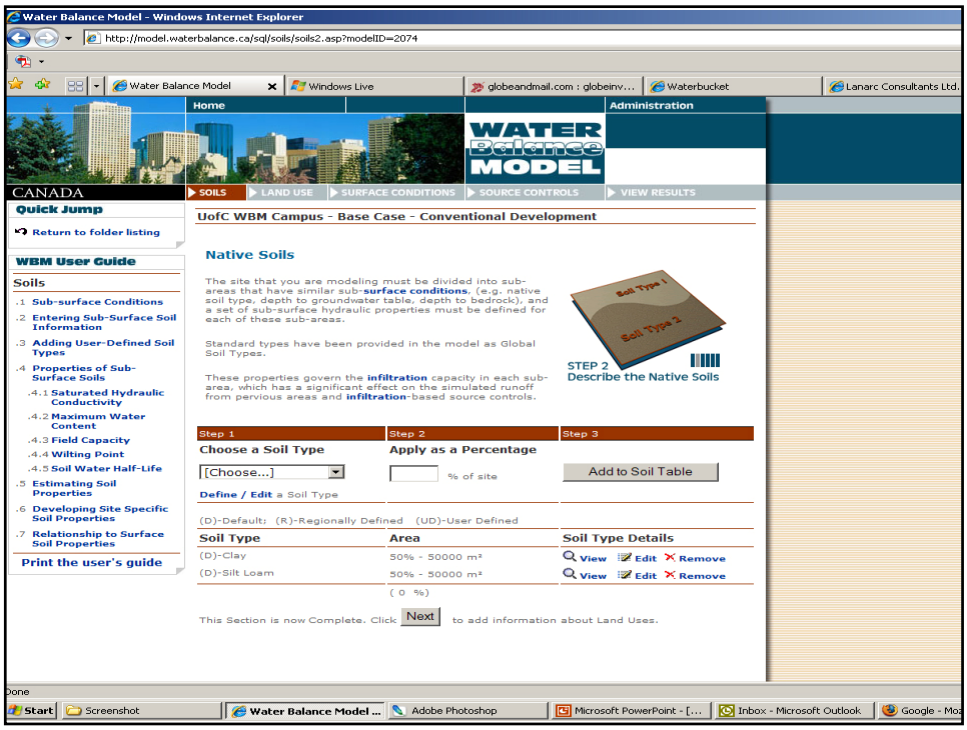
Print the user's guide
UofC WBM Campus - Base Case - Undeveloped
Water Balance Volumes For Catchment
Graph for the period May 1 1987 to Oct 31 1987
Total Volume (m³)
29090
26181
23272
20363
17454
14545
11636
8727
5818
2909
0
Rainfall Volume - 29080m³
Runoff Volume Target - (10%) - 2908m³
Evaporation/Transpiration - (100%) 29080m³
Infiltration - (0%) 0m³
Drainflow - (0%) 0m³
Surface runoff - (0%) 0m³
Displaying a runoff volume reduction target of 10 % » Change target
Display monthly volume results
Save graph output to the Model Summary (optional)
Add graph output to the Volume Summary (optional)
Done
Start
Screenshot
Water Balance Model ...
Adobe Photoshop
Microsoft PowerPoint - [...
Inbox - Microsoft Outlook
Google - Mo

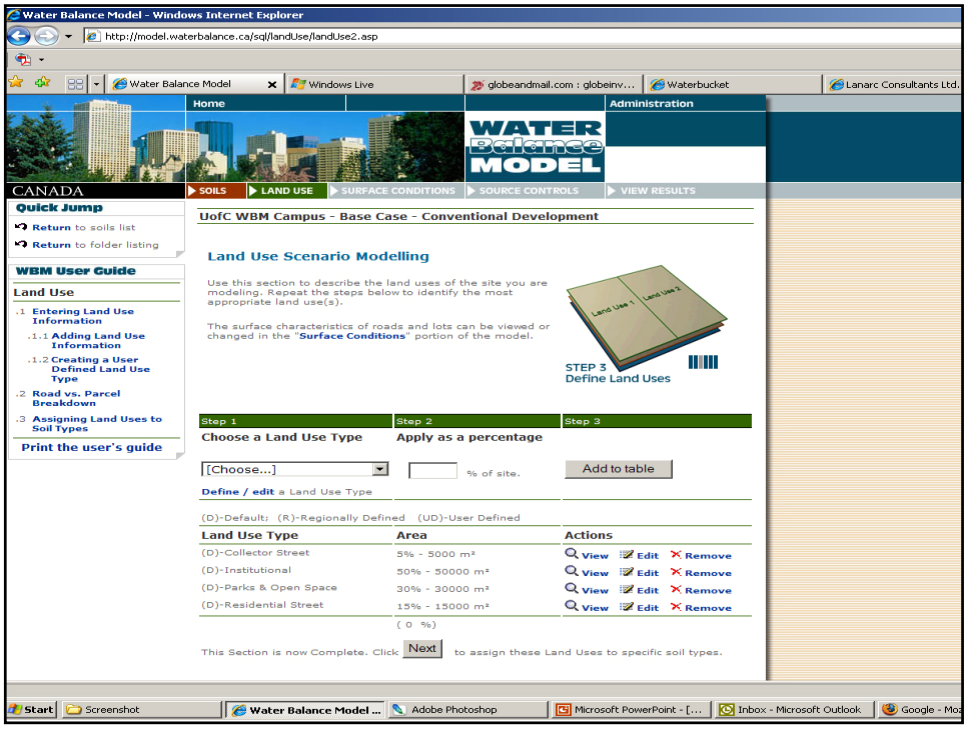
Alberta Low Impact Development Partnership

WaterBalance Model Demonstration

University of Calgary Case Study
Conventional Development Scenario

October 18, 2006




Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/landUse/landUse2.asp
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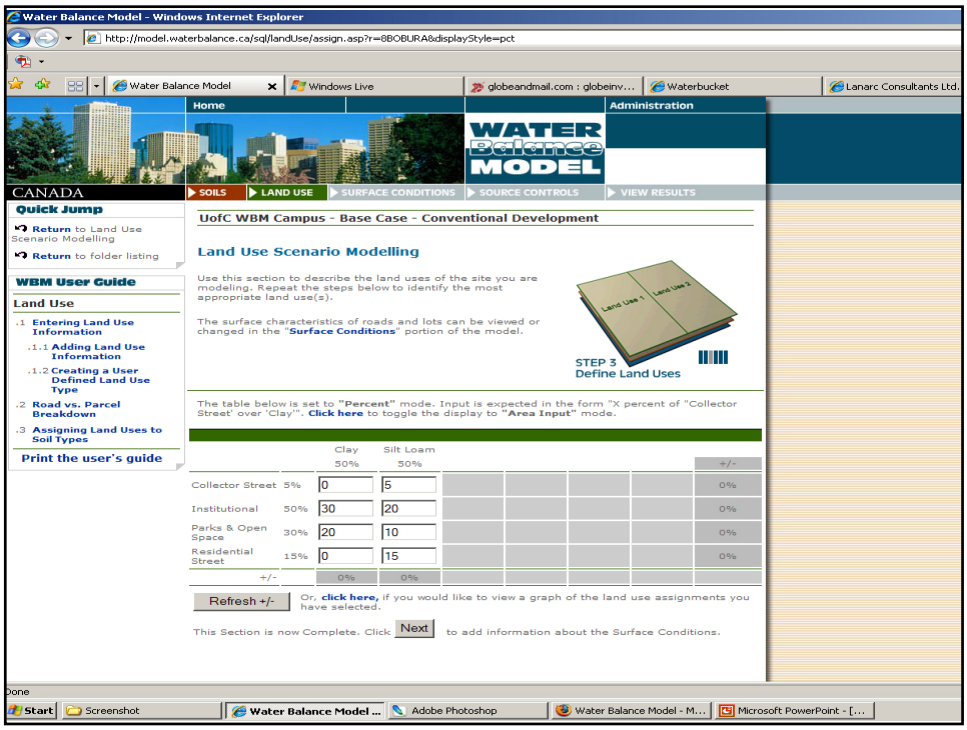
.3 Assigning Land Uses to Soil Types
Print the user's guide
UofC WBM Campus - Base Case - Conventional Development
Land Use Scenario Modelling
Use this section to describe the land uses of the site you are modeling. Repeat the steps below to identify the most appropriate land use(s).
The surface characteristics of roads and lots can be viewed or changed in the "Surface Conditions" portion of the model.
STEP 3
Define Land Uses
Step 1
Choose a Land Use Type
Step 2
Apply as a percentage
Step 3
[Choose...]
% of site.
Add to table
Define / edit a Land Use Type
(D)-Default; (R)-Regionally Defined (UD)-User Defined
Land Use Type
Area
Actions
(D)-Collector Street 5% - 5000 m² View Edit Remove
(D)-Institutional 50% - 50000 m² View Edit Remove
(D)-Parks & Open Space 30% - 30000 m² View Edit Remove
(D)-Residential Street 15% - 15000 m² View Edit Remove
(0 %)
This Section is now Complete. Click Next to assign these Land Uses to specific soil types.


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/landUse/assign.asp?r=8BOBURA&displayStyle=pct
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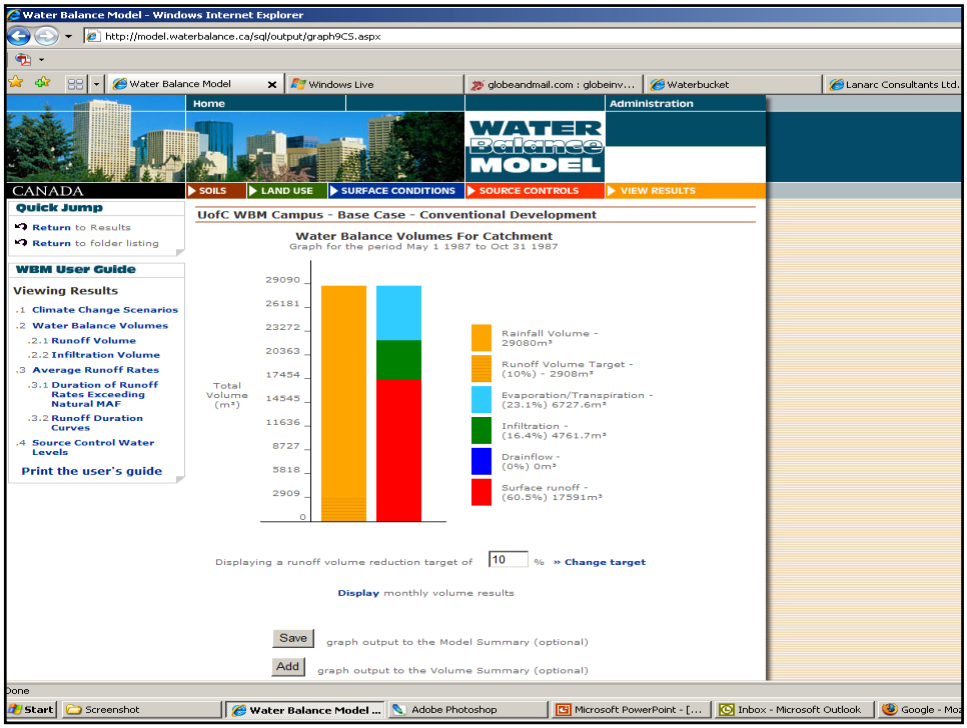
.2 Road vs. Parcel Breakdown
.3 Assigning Land Uses to Soil Types
Print the user's guide
UofC WBM Campus - Base Case - Conventional Development
Land Use Scenario Modelling
Use this section to describe the land uses of the site you are modeling. Repeat the steps below to identify the most appropriate land use(s).
The surface characteristics of roads and lots can be viewed or changed in the "Surface Conditions" portion of the model.
STEP 3
Define Land Uses
The table below is set to "Percent" mode. Input is expected in the form "X percent of "Collector Street' over 'Clay'". Click here to toggle the display to "Area Input" mode.
Clay 50%
Silt Loam 50%
+/-
Collector Street 5% 0 5 0%
Institutional 50% 30 20 0%
Parks & Open Space 30% 20 10 0%
Residential Street 15% 0 15 0%
+/- 0% 0%
Refresh +/-
Or, click here, if you would like to view a graph of the land use assignments you have selected.
This Section is now Complete. Click Next to add information about the Surface Conditions.



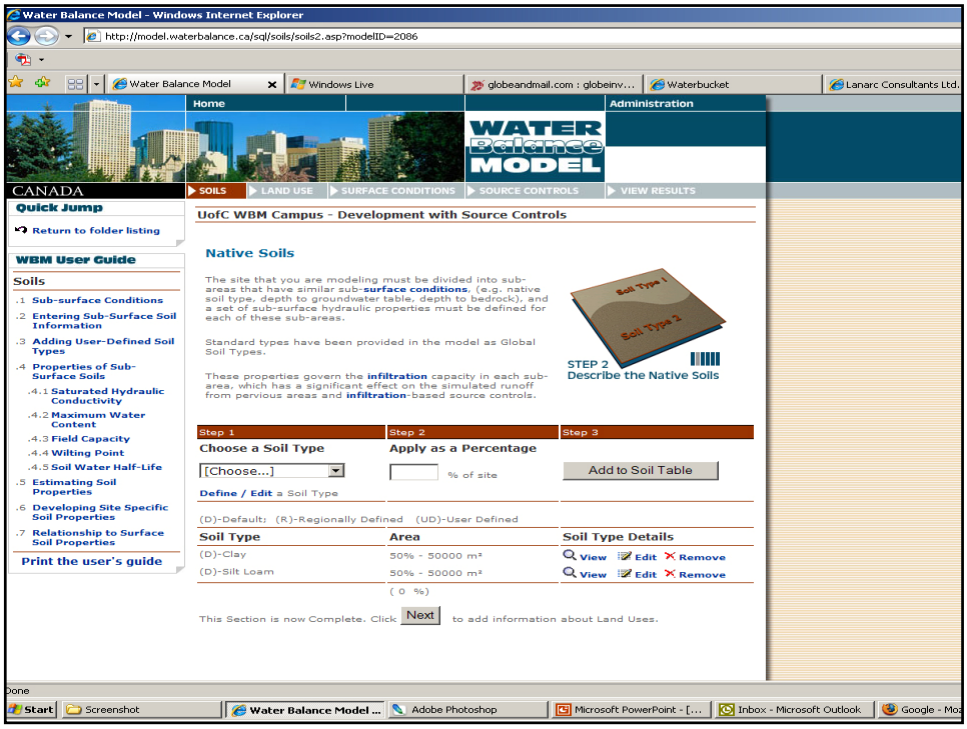
ALIDP

Alberta Low Impact Development Partnership

WaterBalance Model Demonstration

University of Calgary Case Study
LID Scenario

October 18, 2006


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/soils/soils2.asp?modelID=2086
Home
Administration
WATER Balance MODEL
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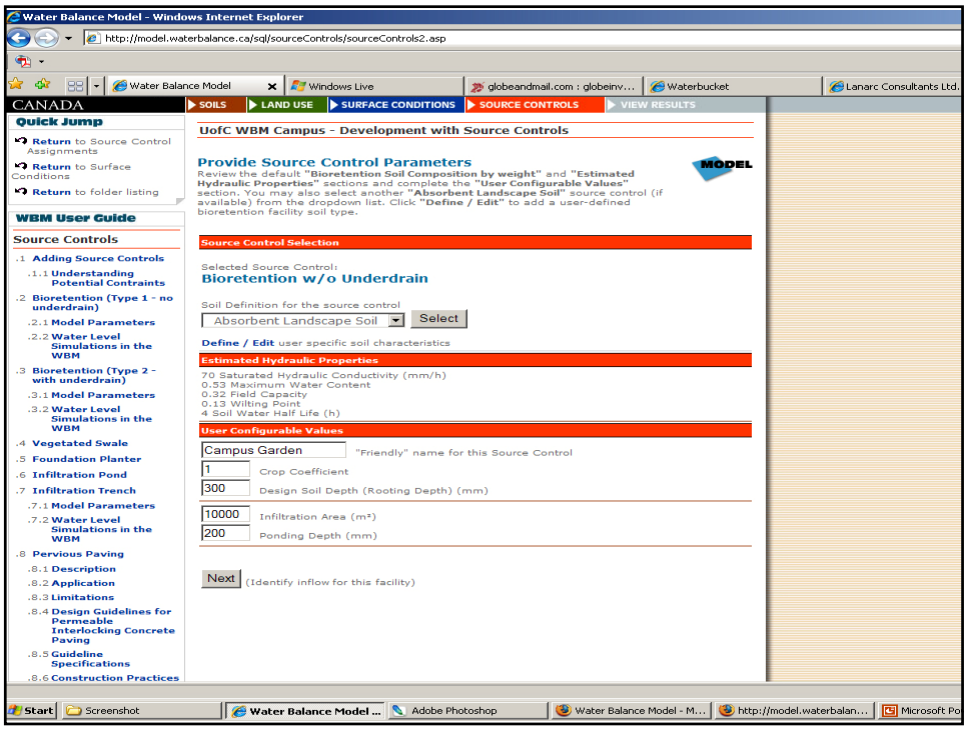
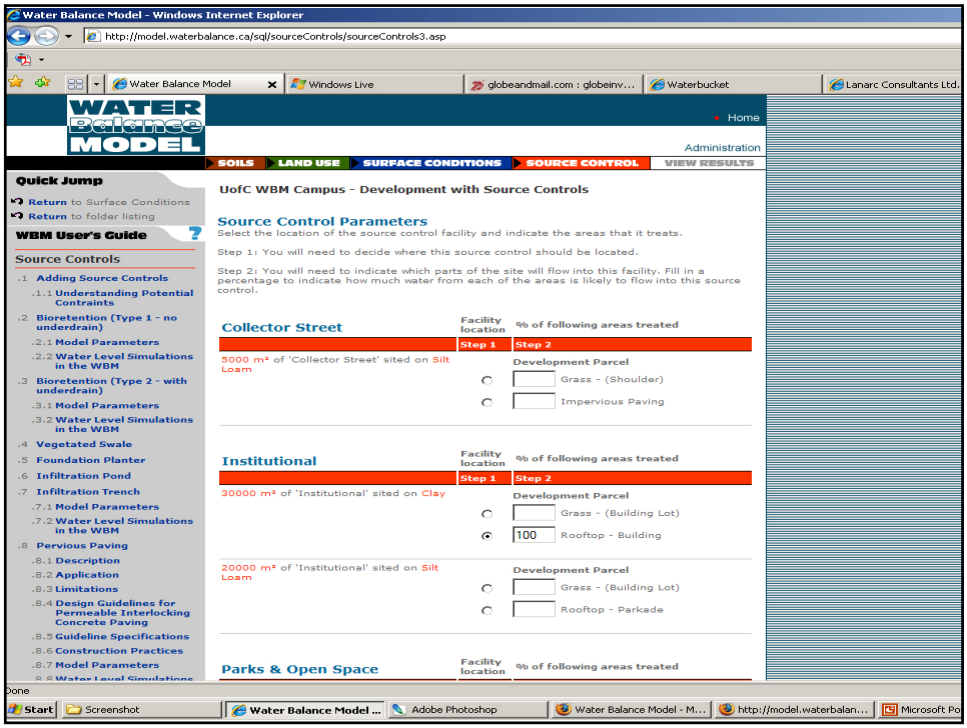
.4.1 Saturated Hydraulic Conductivity
.4.2 Maximum Water Content
.4.3 Field Capacity
.4.4 Wilting Point
.4.5 Soil Water Half-Life
.5 Estimating Soil Properties
.6 Developing Site Specific Soil Properties
.7 Relationship to Surface Soil Properties
Print the user's guide
UofC WBM Campus - Development with Source Controls
Native Soils
The site that you are modeling must be divided into sub-areas that have similar sub-surface conditions, (e.g. native soil type, depth to groundwater table, depth to bedrock), and a set of sub-surface hydraulic properties must be defined for each of these sub-areas.
Standard types have been provided in the model as Global Soil Types.
These properties govern the infiltration capacity in each sub-area, which has a significant effect on the simulated runoff from pervious areas and infiltration-based source controls.
Soil Type 1
Soil Type 2
STEP 2
Describe the Native Soils
Step 1
Choose a Soil Type
[Choose...]
Define / Edit a Soil Type
Step 2
Apply as a Percentage
% of site
Step 3
Add to Soil Table
(D)-Default; (R)-Regionally Defined (UD)-User Defined
Soil Type
Area
Soil Type Details
(D)-Clay
50% - 50000 m²
View Edit Remove
(D)-Silt Loam
50% - 50000 m²
View Edit Remove
(0 %)
This Section is now Complete. Click Next to add information about Land Uses.
Done
Start
Screenshot
Water Balance Model ...
Adobe Photoshop
Microsoft PowerPoint - [...
Inbox - Microsoft Outlook
Google - Mo


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/sourceControls/sourceControls2.asp
CANADA
SOILS
LAND USE
SURFACE CONDITIONS
SOURCE CONTROLS
VIEW RESULTS
Quick Jump
Return to Source Control Assignments
Return to Surface Conditions
Return to folder listing
WBM User Guide
Source Controls
.1 Adding Source Controls
.1.1 Understanding Potential Contraints
.2 Bioretention (Type 1 - no underdrain)
.2.1 Model Parameters
.2.2 Water Level Simulations in the WBM
.3 Bioretention (Type 2 - with underdrain)
.3.1 Model Parameters
.3.2 Water Level Simulations in the WBM
.4 Vegetated Swale
.5 Foundation Planter
.6 Infiltration Pond
.7 Infiltration Trench
.7.1 Model Parameters
.7.2 Water Level Simulations in the WBM
.8 Pervious Paving
.8.1 Description
.8.2 Application
.8.3 Limitations
.8.4 Design Guidelines for Permeable Interlocking Concrete Paving
.8.5 Guideline Specifications
.8.6 Construction Practices
UofC WBM Campus - Development with Source Controls
Provide Source Control Parameters
Review the default "Bioretention Soil Composition by weight" and "Estimated Hydraulic Properties" sections and complete the "User Configurable Values" section. You may also select another "Absorbent Landscape Soil" source control (if available) from the dropdown list. Click "Define / Edit" to add a user-defined bioretention facility soil type.
MODEL
Source Control Selection
Selected Source Control:
Bioretention w/o Underdrain
Soil Definition for the source control
Absorbent Landscape Soil
Select
Define / Edit user specific soil characteristics
Estimated Hydraulic Properties
70 Saturated Hydraulic Conductivity (mm/h)
0.53 Maximum Water Content
0.32 Field Capacity
0.13 Wilting Point
4 Soil Water Half Life (h)
User Configurable Values
Campus Garden
"Friendly" name for this Source Control
1
Crop Coefficient
300
Design Soil Depth (Rooting Depth) (mm)
10000
Infiltration Area (m²)
200
Ponding Depth (mm)
Next
(Identify inflow for this facility)
Start
Screenshot
Water Balance Model ...
Adobe Photoshop
Water Balance Model - M...
http://model.waterbalan...


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/sourceControls/sourceControls3.asp
WATER Balance MODEL
Home
Administration
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LAND USE
SURFACE CONDITIONS
SOURCE CONTROL
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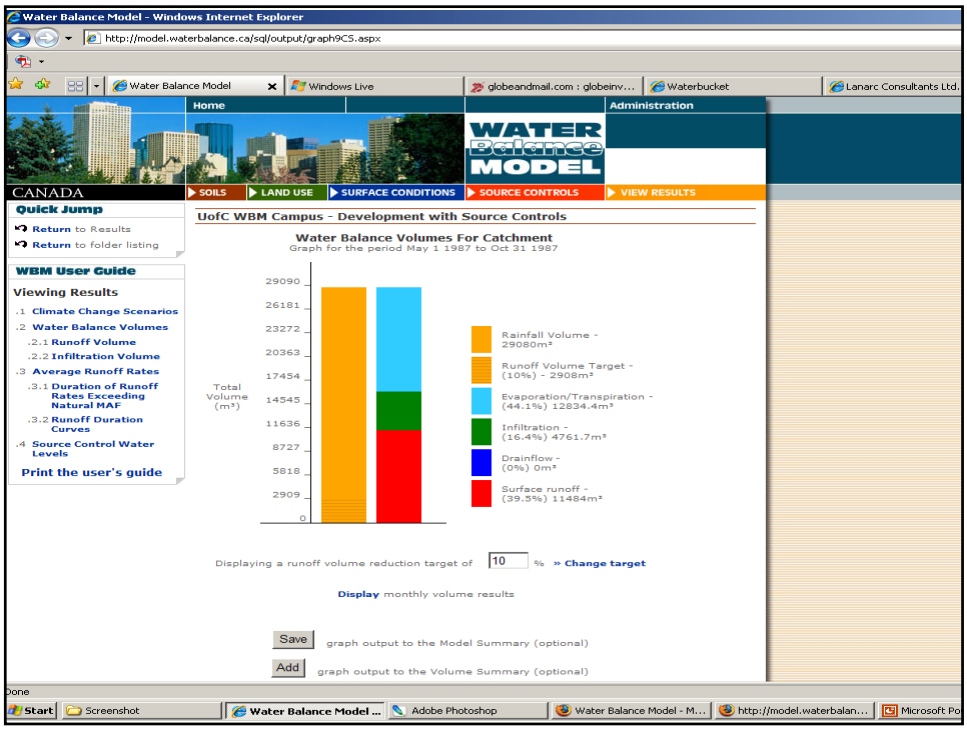
WBM User's Guide
Source Controls
.1 Adding Source Controls
.1.1 Understanding Potential Contraints
.2 Bioretention (Type 1 - no underdrain)
.2.1 Model Parameters
.2.2 Water Level Simulations in the WBM
.3 Bioretention (Type 2 - with underdrain)
.3.1 Model Parameters
.3.2 Water Level Simulations in the WBM
.4 Vegetated Swale
.5 Foundation Planter
.6 Infiltration Pond
.7 Infiltration Trench
.7.1 Model Parameters
.7.2 Water Level Simulations in the WBM
.8 Pervious Paving
.8.1 Description
.8.2 Application
.8.3 Limitations
.8.4 Design Guidelines for Permeable Interlocking Concrete Paving
.8.5 Guideline Specifications
.8.6 Construction Practices
.8.7 Model Parameters
UofC WBM Campus - Development with Source Controls
Source Control Parameters
Select the location of the source control facility and indicate the areas that it treats.
Step 1: You will need to decide where this source control should be located.
Step 2: You will need to indicate which parts of the site will flow into this facility. Fill in a percentage to indicate how much water from each of the areas is likely to flow into this source control.
Collector Street
Facility location
% of following areas treated
Step 1
Step 2
5000 m² of 'Collector Street' sited on Silt Loam
Development Parcel
Grass - (Shoulder)
Impervious Paving
Institutional
30000 m² of 'Institutional' sited on Clay
Grass - (Building Lot)
100
Rooftop - Building
20000 m² of 'Institutional' sited on Silt Loam
Grass - (Building Lot)
Rooftop - Parkade
Parks & Open Space
Done
Start
Screenshot
Water Balance Model ...
Adobe Photoshop
Water Balance Model - M...
http://model.waterbalan...
Microsoft Po


Water Balance Model - Windows Internet Explorer
http://model.waterbalance.ca/sql/output/graph9CS.aspx
Home
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SURFACE CONDITIONS
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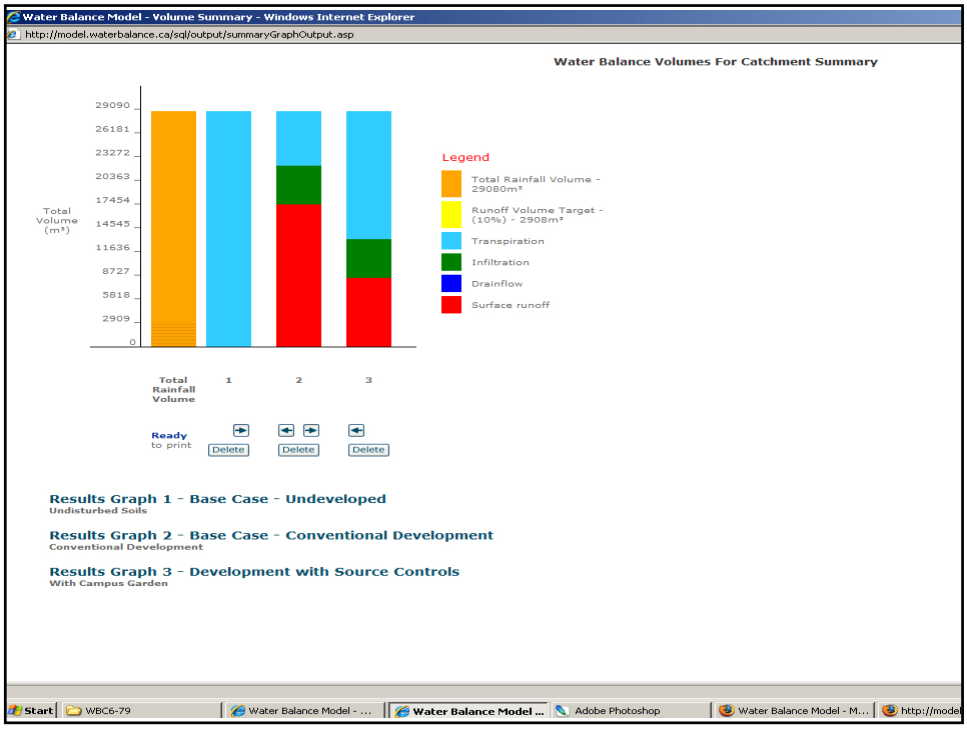
Return to folder listing
WBM User Guide
Viewing Results
.1 Climate Change Scenarios
.2 Water Balance Volumes
.2.1 Runoff Volume
.2.2 Infiltration Volume
.3 Average Runoff Rates
.3.1 Duration of Runoff Rates Exceeding Natural MAF
.3.2 Runoff Duration Curves
.4 Source Control Water Levels
Print the user's guide
UofC WBM Campus - Development with Source Controls
Water Balance Volumes For Catchment
Graph for the period May 1 1987 to Oct 31 1987
Total Volume (m³)
29090
26181
23272
20363
17454
14545
11636
8727
5818
2909
0
Rainfall Volume - 29080m³
Runoff Volume Target - (10%) - 2908m³
Evaporation/Transpiration - (44.1%) 12834.4m³
Infiltration - (16.4%) 4761.7m³
Drainflow - (0%) 0m³
Surface runoff - (39.5%) 11484m³
Displaying a runoff volume reduction target of 10 % » Change target
Display monthly volume results
Save graph output to the Model Summary (optional)
Add graph output to the Volume Summary (optional)
Done
Start
Screenshot
Water Balance Model ...
Adobe Photoshop
Water Balance Model - M...
http://model.waterbalan...
Microsoft Po



Water Balance Analysis

- Water Balance Model does not yet allow for ponds, precipitation harvesting, and capture and re-use of stormwater for irrigation purposes
- Objectives:
  - Provide adequate storage for extreme event
  - Minimize discharge to nearby stream
  - Minimize impacts on existing wetland resources

Water Balance Analysis

Fictional 100 ha subdivision composed of:

- 22% roads
- 52% residential
  (70/30 split single-family vs. multi-family)
- 8% commercial
- 10% municipal reserve
- 5% environmental reserve
  (50/50 split wetland and other ER lands)
- 3% public utility lot (wet pond)

Water Balance Analysis

Roads

- 22 ha
- 80% impervious
- no BMPs

Single-Family Residential

- 36.4 ha
- 45% impervious
- 50% of pervious area composed of absorbent landscaping (300 mm thick, silt-loam)
- 60% of hard areas drain onto absorbent landscaping

Water Balance Analysis

Multi-Family Residential

- 15.6 ha
- 75% impervious
- 50% of hard area covered by green roof
- 90% of green roof and 20% of remaining hard area to capture and re-use system
  (5 m^3/ha/day and 100 m^3/ha storage)

Commercial

- 8 ha
- 80% impervious
- 40% of hard area covered by green roof
- 90% of green roof and 20% of remaining hard area to capture and re-use system
  (7.5 m^3/ha/day and 150 m^3/ha storage)

Water Balance Analysis

Municipal Reserve

- 10 ha
- 90% irrigated from runoff collected in wet pond
  (25 mm each week during summer season)

Environmental Reserve

- 5 ha
- 50% of non-wetland area irrigated from runoff collected in wet pond
- treated runoff from wet pond used to replenish moisture in wetland during dry spells

Use of Stormwater for Irrigation is NOT new

- From *'Green' Irrigation at City Golf Courses and Parks* at City of Calgary website:
  - It's cheaper than using treated drinking water
  - Reduces our impact on our water treatment plants,
  - The energy savings we realize by not treating this water reduces our carbon emissions
  - And we reduce the impact on our stormwater system.
- Quote:

  Work on new parks and sport's field, including projects in Coventry Hills and Citadel, will make use of storm ponds and pump houses for irrigation. "The cost reductions are significant for The City," says Gourdeau. "It will cost only 25 per cent of what is would cost if we were to use potable water to irrigate."
- Greg Shymanski, the City's golf course operations coordinator says,

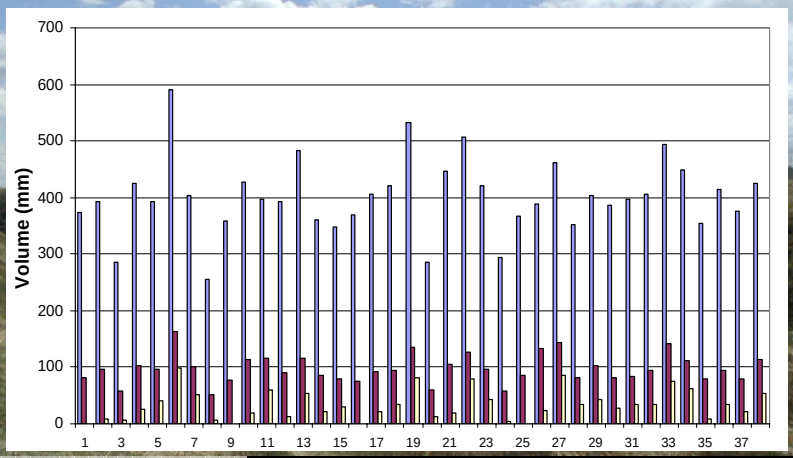
  "Very fundamentally, it's economic. It's much cheaper for The City and lessens the impact on our infrastructure."

Water Balance Analysis

Wet Pond

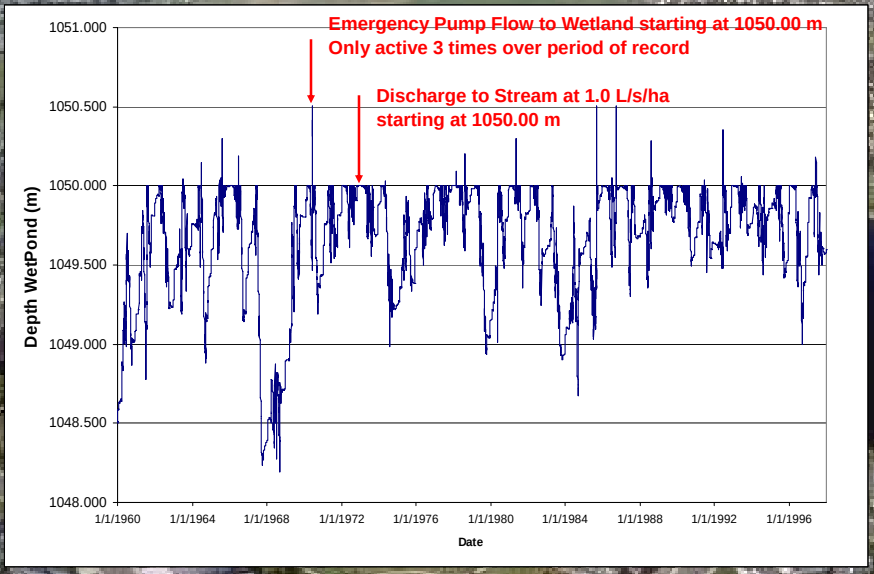
- 3 ha
- permissible discharge at 1 L/s/ha
- emergency pump to wetland
- accumulated water used for irrigation of MR and ER, and replenishment of moisture in wetland

Precipitation vs. Runoff vs. Discharge to Stream

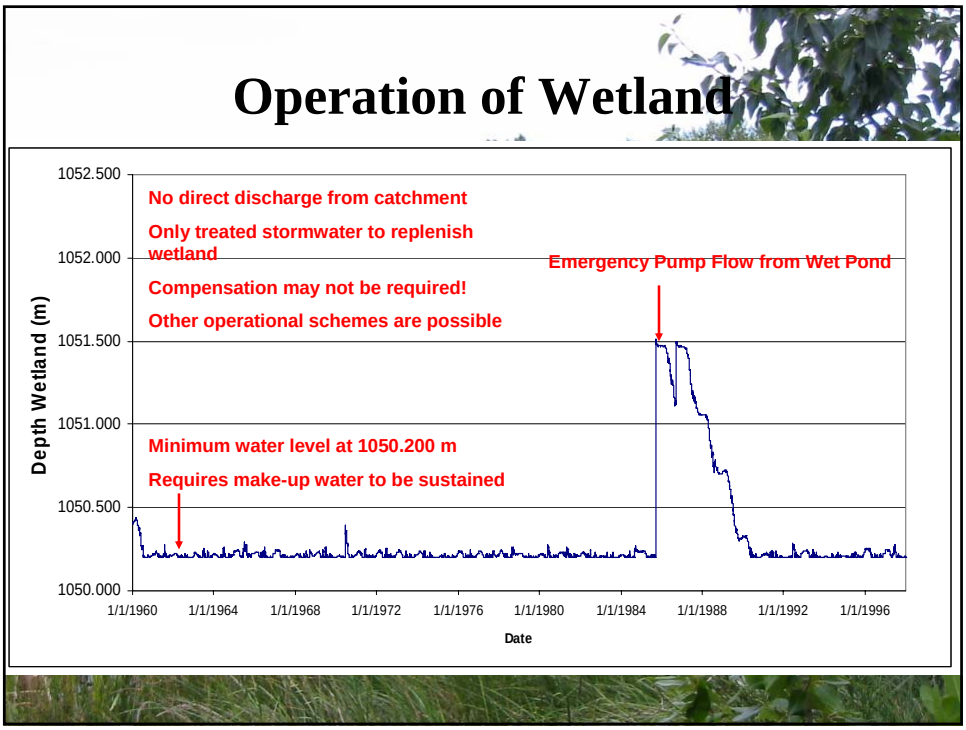


Year starting in 1960	Minimum	Maximum	Average	Median	
Precipitation	256	590	401	398	mm
Runoff	52	164	98	95	mm
	20	28	24	24	%
Discharge to Stream	0	99	34	29	mm
	0	17	8	7	%

Operation of Wet Pond



Operation of Wetland

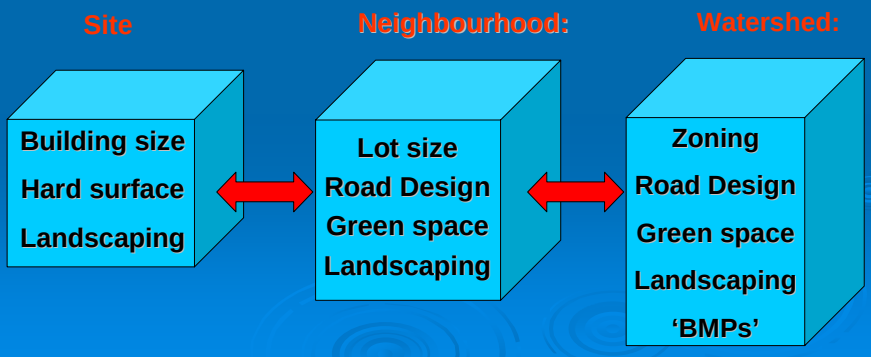


Workshop Road Map

- Think Beyond the Pond
- Build the Vision, Create the Legacy
- Tour of Water Balance Model
- Demonstration of the Model
- Where To Now?

Key Message:

Integrate Actions at Three Scales: Improve Site Practices to Enhance Community Livability



from Stormwater Management to Rainwater Management

From TRADITIONAL to		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	→	Partnerships with Others
Extreme Storm Focus	→	Rainwater Integrated with Land Use
Peak Flow Thinking!	→	Volume-Based Thinking!

So, Why Should You Change the Way You Develop Land?

In Closing:

Because infrastructure design is in a major sea-change….

….create the ‘buzz’, the interest and energy to imagine what the future could look like and then make it happen.