Low Impact Development – A Natural Fit for Road Runoff
Agenda

1. What is Low Impact Development
2. Types of Green Infrastructure for Roads
3. Planning and Design for GI
4. Construction Staging and Erosion/Sediment Control
5. Example Projects + Cross Sections
What is Low Impact Development
LID

• A process/strategy to mitigate the impacts of development
• Includes impervious area reduction or limits, bylaws, and use of green infrastructure
LID

LID is not just green infrastructure; it is a process that includes site planning and development.

LID site design seeks to:

- Minimize land and vegetation disturbance
- Capitalize on the natural hydrology of the site when locating roads, buildings and drainage features
- Reduce the impacts of development by minimizing soil compaction and impervious area
- Reduce or prevent stormwater runoff during small storm events (often for 90% of the typical annual rainfall)
- Provide treatment for stormwater as close to the source as possible
- Incorporate multi-purpose landscapes that treat water as a resource rather than a nuisance.
LID- Limiting Impervious Area

Road widths, sidewalks, allyways and driveways are often fixed to accommodate municipal servicing and emergency.
Green Infrastructure
aka Source Controls or BMP’s

• One of the building blocks commonly recommended to manage stormwater to maintain and improve watershed health

• Limit Effective Impervious Area (EIA) of the development, encourage infiltration and evaportranspiration
Types of Green Infrastructure for Roads
Bioretention

Can take three distinct forms

- Planters
- Bumpouts
- Boulevard
Swales

Can take four distinct forms
• Simple Grassed Swales
• Enhanced Grass Swales
• Wetland Swales
• Bioswales
Subsurface Systems

Can take three distinct forms
- Perforated Pipe (Etobicoke) Systems
- Infiltration Trench / Galleries
- Sewerless Systems
Tree Cells / Planters
Permeable Paving
Planning and Design for GI
Planning for GI

• It is important to integrate the design of green infrastructure (GI) with the entire development process.
• Include LID designers in your design team from the earliest stage of design development to ensure green infrastructure is integrated into the development in the most cost effective way.
• Don’t treat stormwater and green infrastructure as a last minute extras. This will make for a more difficult and expensive design that may require more land, create significant redundancy and require more revisions in the design effort.
Standards and Standard Drawings

- Most municipalities do not have existing design standards or drawings for LID/GI facilities.
- Consult with other departments, especially Operations and Maintenance to ensure new standards fit into existing maintenance programs and activities.
- Consult and coordinate with local utilities.
Site Analysis

- Gather critical data including:
  - Rainfall patterns
  - Existing vegetation cover
  - infiltration constraints
  - soils mapping
  - infiltration tests
- On-site infiltration testing is needed at the elevation of the proposed infiltration facility
Site Analysis

- Drinking water wells / WHPZ
- Pollutant Hot Spots
- Contaminated Soils
- Seasonably High Water Table
- Shallow Bedrock / Karst
Treatment

• All infiltration facilities require treatment prior to infiltration
• Vegetated facilities have soils and vegetation to provide the treatment
• Underground facilities require an upstream treatment method
• This can be achieved using a hydrodynamic separator or catchbasin insert
Designing for Winter

- Most LID/GI facilities still work in winter
- The large pore spaces prevent frost heave and provides for more air exchange for quick thawing
- Warmer melt water will not refreeze on the surface of the facilities
- Some facilities do not do well with salt
Designing for Winter

Constraints and Possible Issues:
• Sanding roads
• Salt application
• Snow removal
• Permeable concretes
• Inlets and outlets
• Proper treatments of GI surfaces
• Frost depth
Construction Staging and Erosion/Sediment Control
Construction Staging

• Schedule the installation of stormwater source controls to avoid problems with disturbance and sedimentation during construction.

• Sub-surface drain rock reservoirs, perforated drains, and overflows should be constructed at the same time as other utilities.
Construction Staging - ESC

- Sub-surface drain-rock reservoir and perforated drains need to be protected during construction
- The use of sacrificial soil layer and poly sheeting should be considered
- If possible, rain garden and infiltration areas should be designated as no-go areas to protected from heavy vehicle traffic, as this compacts the soil.

Photo by KWL
Construction Staging - ESC

- GI locations are not to be used as ESC ponds or routes, as this will destroy the infiltration capabilities.
- GI should be protected and fenced off
Construction Staging and Erosion/Sediment Control

Construction Staging - ESC
Construction Staging - ESC
Field Review and Monitoring

Critical field reviews during construction include:

- Protection of proposed infiltration areas from disturbance, compaction and sedimentation
- Scarification of subgrade
- Filter cloth and rock reservoir installation
- Pipe, drainage utilities, structures, and bedding
- Lab testing of growing medium (if used)
- Growing medium installation and depth
- Plant material at the nursery or prior to planting
- Any irrigation works
- Plant material and surface mulch installation
- Substantial and final performance
- Periodic establishment review
- Review at end of Maintenance or Warranty period
Field Review and Monitoring

The objective of post construction monitoring is to measure the performance of the GI and can consist of:

- Rainfall
- Ground water level
- Flow downstream of the GI

This can be done in many ways:
- Continuous flow, rainfall and water quality monitoring is best, but very expensive. Good for pilot studies and research projects.
- Water quantity can be measured during a dry soil period with a chalk line or a cork in the downstream outlet. This will allow you to see if water flowed during a rainfall event.
- Install Inspection Ports to check drawdown times.
Example Projects
Waterloo Street, London
Waterloo Street Rain Garden Retrofit

- Located in London, Ontario in a heritage neighbourhood (1840)
- City inspired by pending MECP requirements for LID
- Part of Planned Utility Upgrades
- Waterloo Street is sanded in the winter, but Horton is salted
Waterloo Street Rain Garden Retrofit

- Road has wide boulevards making it ideal for LID
- Bioretention (rain gardens) were selected as the preferred LID
- Pilot project with redundant storm sewer
Waterloo Street Rain Garden Retrofit

- Waterloo Road has a large number of mature trees and utility boxes within the boulevard
- Ended up increasing the impervious to pervious (I/P) ratio for some of the LID features
Waterloo Street Rain Garden Retrofit

- Rain gardens will treat surface water run off on Waterloo Street prior to discharge to the Thames River
- Each rain garden will treat and infiltrate up to 25 mm of rainfall per event
- This is approximately the 90th rainfall for London
William Halton Parkway, Oakville
William Halton Parkway Extension

- Interim 2-lane condition
- Ponds planned for ultimate condition
- Interim strategy requires LID within the ROW for 100-year control
- Swales were a natural fit for the project due to number of watercourses along the section and space beside road
William Halton Parkway Extension

- Wetland / enhanced swale hybrid with flow control structures
- Weirs control for slope and volume
- Outlet to watercourses via grassed swale
William Halton Parkway Challenges

- Required more space than available in ROW
- Areas that swales could not go
- Trying to tie in interim infrastructure with ultimate infrastructure
- Road crowned away from swales requiring 100-year leaders
Dixie Road, Region of Peel
Dixie Road

- Sewerless road
- Stormtech chambers with rock underlay used in place of sewers
- Minor flows up to the 10-year are retained, major flows are conveyed by the stormtech system
Dixie Road Challenges

- Pretreatment – every CB requires a CB Shield for WQ
- Poor soils – system foot-print was hard to keep reasonable
- Slopes – usually infiltration needs flat bottoms, but pipes are sloped. Limited system slopes to 1% or less
Yonge Street, York Region
Yonge Street

- Planters and soil cells for trees located in the boulevard on both sides of the street, used to separate bike lane
Yonge Street - Challenges

- Existing utilities (water line)
Dundas Street, Halton Region
Dundas Street

- Stormtech chambers slowly release water via orifice + infiltration
- Full treatment train- CB Shields, Isolator Rows, and OGS units or Jellyfish Filter Units, 90% TSS Removal

Saved Region over $1.2 M
Dundas Street - Challenges

- SAR identified; region required extended treatment
- Designing system to replace ponds
- Original system was box culverts and oversized swm
Road Cross Sections
Fairwinds Neighbourhood Vancouver Island

Minor Collector 50 km/h
Road Cross Section with Drainage Configuration

November 2013
Abbotsford City in the Country Plan

Road Cross Sections

NOTE:
1. WHERE EXISTING O/H POWER PLANT IS AT 1.80m, IT CAN REMAIN AS LONG AS MINIMUM LIGHTING STANDARDS CAN BE ACHIEVED. ORNAMENTAL STREETLIGHT MAY BE REQUIRED AS ALTERNATIVE TO LEASE STREETLIGHTING.

2. SEE CS-D-26 FOR DETAILS BEHIND SIDE INLET

CITY IN THE COUNTRY PLAN LANDS
CROSS INDUSTRIAL ROAD
(_APPPLICABLE TO INFILTRATION RATE GREATER THAN 50 mm/hr)
Abbotsford City in the Country Plan

NOTE:
1. WHERE EXISTING 0/H POWER PLANT IS AT 1.60m, IT CAN REMAIN AS LONG AS MINIMUM LIGHTING STANDARDS CAN BE ACHIEVED. ORNAMENTAL STREETLIGHTS MAY BE REQUIRED AS ALTERNATIVE TO LEASE STREETLIGHTING.
2. SEE CS-D-26 FOR DETAILS BEHIND SIDE INLET

(UNUNIQUE TO INFILTRATION RATE GREATER THAN 50 MIN)

ABBOTSFORD
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Questions?

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And finally, we still need to remember that it is not solely wisely developed or green urban infrastructure, but Human behavior which ultimately determines our sustainability.

Peter Andzans Manager, Community Sustainability, City of Abbotsford