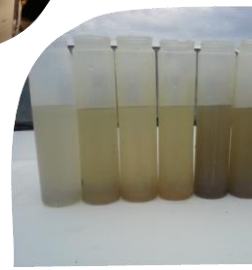
Sustainable Technologies
EVALUATION PROGRAM

Green infrastructure design tools

Presented by: Jenny Hill



STEP Water is a partnership between:

Toronto and Region Conservation for The Living City

CVC CREDIT VALLEY CONSERVATION

Lake Simcoe Region conservation authority

Free tools for you

1. Treatment train tool

   sustainabletechnologies.ca/low-impact-development-treatment-train-tool/

2. Planning and design guide

   wiki.sustainabletechnologies.ca

3. Lifecycle costing tool

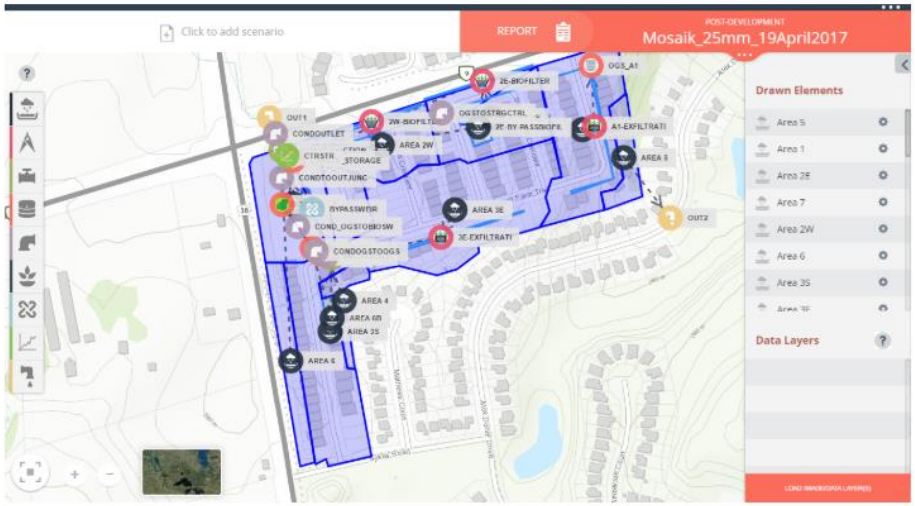
   sustainabletechnologies.ca/low-impact-development-life-cycle-costs/

4. Inspection and maintenance guide

   sustainabletechnologies.ca/low-impact-development-stormwater-practice-inspection-and-maintenance-guide/

Treatment Train Tool

Low Impact Development Treatment Train Tool



The Low Impact Development Treatment Train Tool (LID TTT) has been developed by Lake Simcoe Region Conservation Authority (LSRCA), Credit Valley Conservation (CVC) and Toronto and Region Conservation Authority (TRCA) as a tool to help developers, consultants, municipalities and landowners understand and implement more sustainable stormwater management planning and design practices in their watersheds. The purpose of the tool is to analyze annual and event based runoff volumes and pollutant load removal by the use of Best Management Practices (BMP)'s and Low Impact Development (LID) techniques. The LID TTT provides preliminary water budget analysis (i.e. surface ET, surface runoff, infiltration to soil) and pollutant load removal estimates for pre- and post-development scenarios. The tool is built upon the open source EPA SWMM5 model providing a user-friendly interface for novice modelers and cross-compatibility with SWMM5 for further model development.

LID is a stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff

What's New

» The latest release is *Release Version 1.2.1* (6 April 2018)

Release Notes for LID-TTT Version 1.2.1

To report issues please contact STEP@trca.on.ca

Downloads

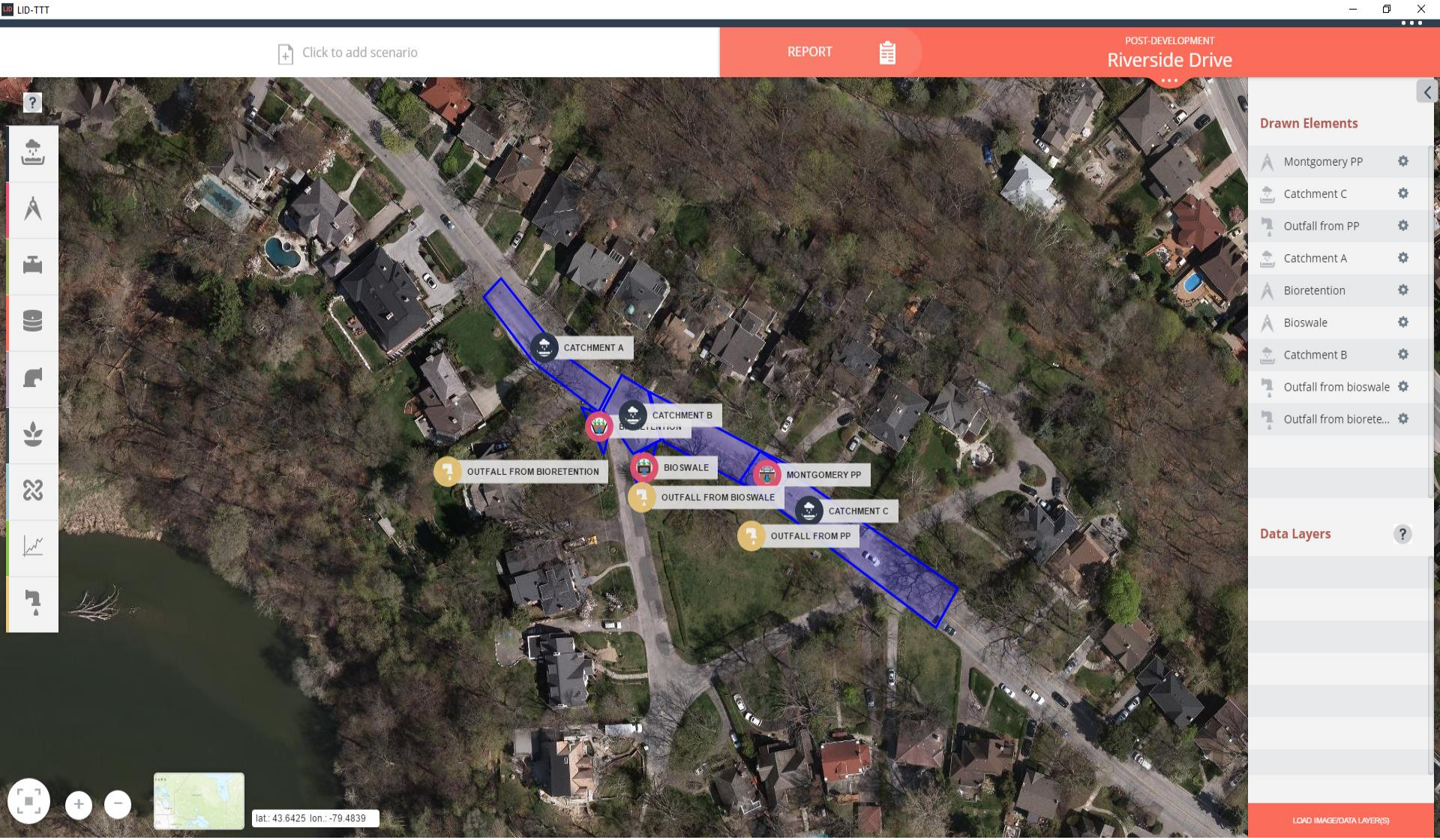
» Example scenarios

» Beta 2.7.4

» Beta 2.7.9

» Release v1.0 (4 Dec 2017)

Download "LID TTT v1.2.1"
LID-TTT-win32-x64.zip – Downloaded 222 times – 106 MB


LID-TTT
Click to add scenario
REPORT
POST-DEVELOPMENT
Riverside Drive
Drawn Elements
Montgomery PP
Catchment C
Outfall from PP
Catchment A
Bioretention
Bioswale
Catchment B
Outfall from bioswale
Outfall from biorete...
Data Layers
LOAD IMAGE/DATA LAYER(S)
CATCHMENT A
CATCHMENT B
OUTFALL FROM BIORETENTION
BIOSWALE
MONTGOMERY PP
OUTFALL FROM BIOSWALE
CATCHMENT C
OUTFALL FROM PP
lat.: 43.6425 lon.: -79.4839

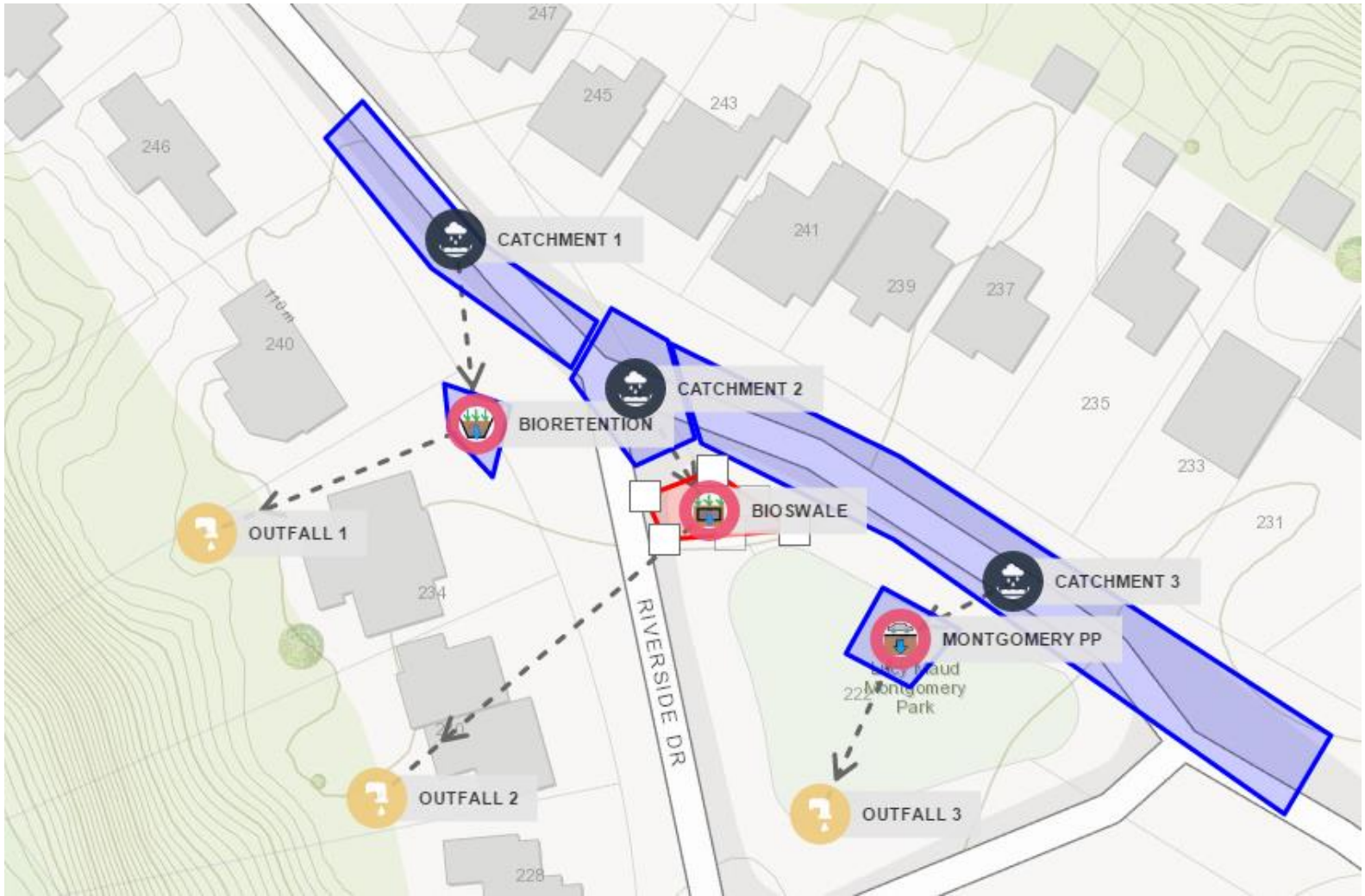
Click ‘REPORT’ to run model and get results

- Rainfall in
- Infiltration
- Evapotranspiration
- Outflow
- Rainfall reduction

▲ Water Balance | Post-Development

Catchment	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
1	0.04 ha	847.60 mm	583.22 mm	235.43 mm	5.39 mm	842.21 mm
		322.09 m^3	221.62 m^3	89.46 m^3	2.05 m^3	99.36 %
2	0.03 ha	847.60 mm	482.34 mm	139.38 mm	223.46 mm	624.14 mm
		220.38 m^3	125.41 m^3	36.24 m^3	58.10 m^3	73.64 %
3	0.12 ha	847.60 mm	314.24 mm	162.00 mm	368.38 mm	479.22 mm
		991.69 m^3	367.67 m^3	189.54 m^3	431.00 m^3	56.54 %
TOTAL	**0.18 ha**	**847.60 mm**	**394.86 mm**	**174.17 mm**	**271.35 mm**	**67.99%**
		1,534.16 m^3	**714.70 m^3**	**315.24 m^3**	**491.15 m^3**	

Three sewer connections…



…or two?


CATCHMENT 1
CATCHMENT 2
BIORETENTION
OUTFALL 1
BIOSWALE
CATCHMENT 3
MONTGOMERY PP
OUTFALL 2
OUTFALL 3
RIVERSIDE DR
Montgomery Park
247
245
243
246
241
239
237
240
235
233
231
234
228

…or just one feature?

Low Impact Development Stormwater Management Planning and Design Guide (2010)

LOW IMPACT DEVELOPMENT STORMWATER MANAGEMENT PLANNING AND DESIGN GUIDE

Version 1.0

2010

CVC
CREDIT VALLEY CONSERVATION

TORONTO AND REGION Conservation
for The Living City

wiki.sustainabletechnologies.ca (2018)

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CITE THIS PAGE
ADD YOUR FEEDBACK
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Main Page

Low Impact Development Stormwater Management Planning and Design Guide

Welcome reviewer! We have been looking forward to your arrival. In anticipation we have prepared a short printable form to help direct your critique of the wiki at this time . Broadly, the themes are split between navigation and content. when it comes to terminology we have attempted to align ourselves with the most commonly applied terms for each BMP found on the internet. Comments will be reviewed in May 2018 (and will be welcome forever thereafter)

This is a new kind of guideline document; intended to improve your experience. Recommendations have been pared down into tight, actionable articles. Expect to find a lot of data rich tables, lists and tools. If you believe the content to be incorrect or out of date, please let us know using 'Help improve this page' and we'll make a rapid response. Minor changes will be made as soon as possible, significant changes may be delayed pending review by a panel of STEP members. Note that the comments you leave will appear in the **VIEW FEEDBACK** link on the left. When you need to reference an article to support your decisions and designs, use the **CITE THIS PAGE** link on the left. The website automatically maintains a public, detailed history of every content change made, see **VIEW HISTORY** at the top. This is a relatively young, living document; conceived in early 2017. You will find that we're missing information, but we are developing rapidly. An important part of this process is to know what you need, so please submit your feedback!

About the guide | Acknowledgements | Photographs | Help and support | Contribute

Why a wiki?

The basics

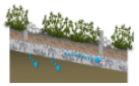
- How to navigate a wiki?
- What about feedback and review?
- How to receive updates?
- What is low impact development?

Browse by interest

Suggested starting places...

- for Engineers
- for Planners
- for Landscape Architects
- for Hydrogeologists
- for Asset Managers
- to wander lonely as a cloud

Quick links



Our top picks of current articles

- Filter media for bioretention
- Modeling a treatment train
- Pretreatment options

Table of contents

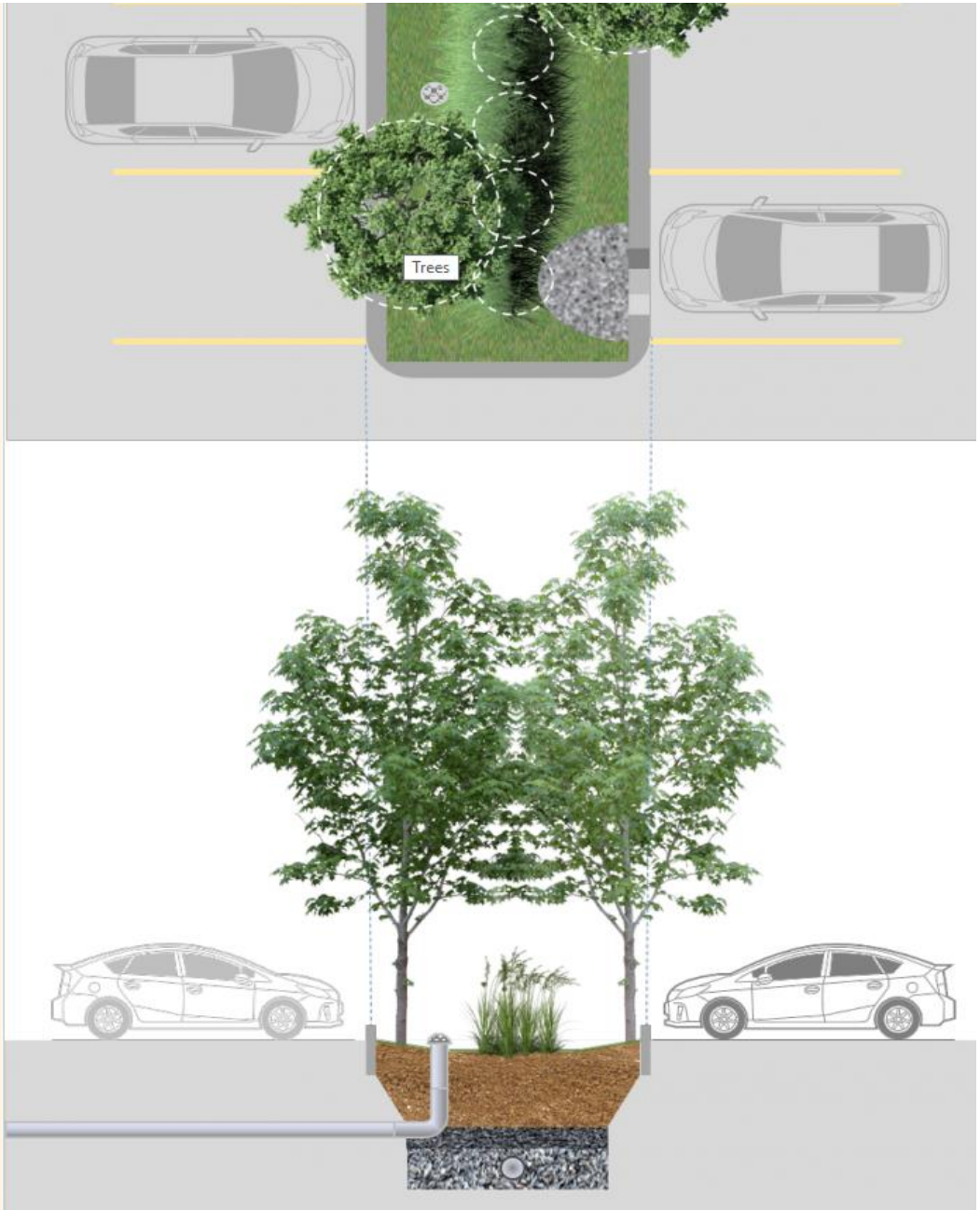
Coming soon...

Works in progress

- Trees are BMPs
- Digital technologies
- Blue roofs
- Sand filters for pretreatment
- Street sweeping: A non-structural BMP

arking lot bioretention sharing underground reservoir with adjacent permeable paving, Edwards gardens, Toronto

The sunken curb holds the edge of the asphalt pavement and lets water freely flow to the bioretention cell beside the 7sigma parking lot in Minneapolis, MN (USA)
Photo credit:BrianAsh



Rainwater harvesting: Sizing and modeling

(Redirected from Rainwater Harvesting: Sizing and Modelling)

Contents [hide]

Simple

The following approximations Five percent of the average annual yield can be estimated

$$Y_{0.05} = A_c \times C_{vol,A} \times R_a \times e \times 0.05$$

Where:

$Y_{0.05}$ is five percent of the average annual yield (L)
A_c is the catchment area (m^2)
$C_{vol,\ A}$ is the annual runoff coefficient for the catchment
R_a is the average annual rainfall depth (mm)
e is the efficiency of the pre-storage filter

- Filter efficiency (e) can be reasonably estimated as 0.9 pending manufacturer's information.
- In a study of three sites in Ontario, STEP found the annual $C_{vol,\ A}$ of the rooftops to be around 0.8 [1]. This figure includes losses to evaporation,

Five percent of the average annual demand can be estimated

$$D_{0.05} = P_d \times n \times 18.25$$

Where:

$D_{0.05}$ is five percent of the average annual demand (L)
P_d is the daily demand per person (L)
n is the number of occupants

Sustainable Technologies EVALUATION PROGRAM

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ADD YOUR FEEDBACK
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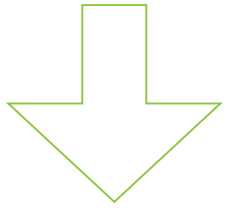
What's this?

Help improve this page

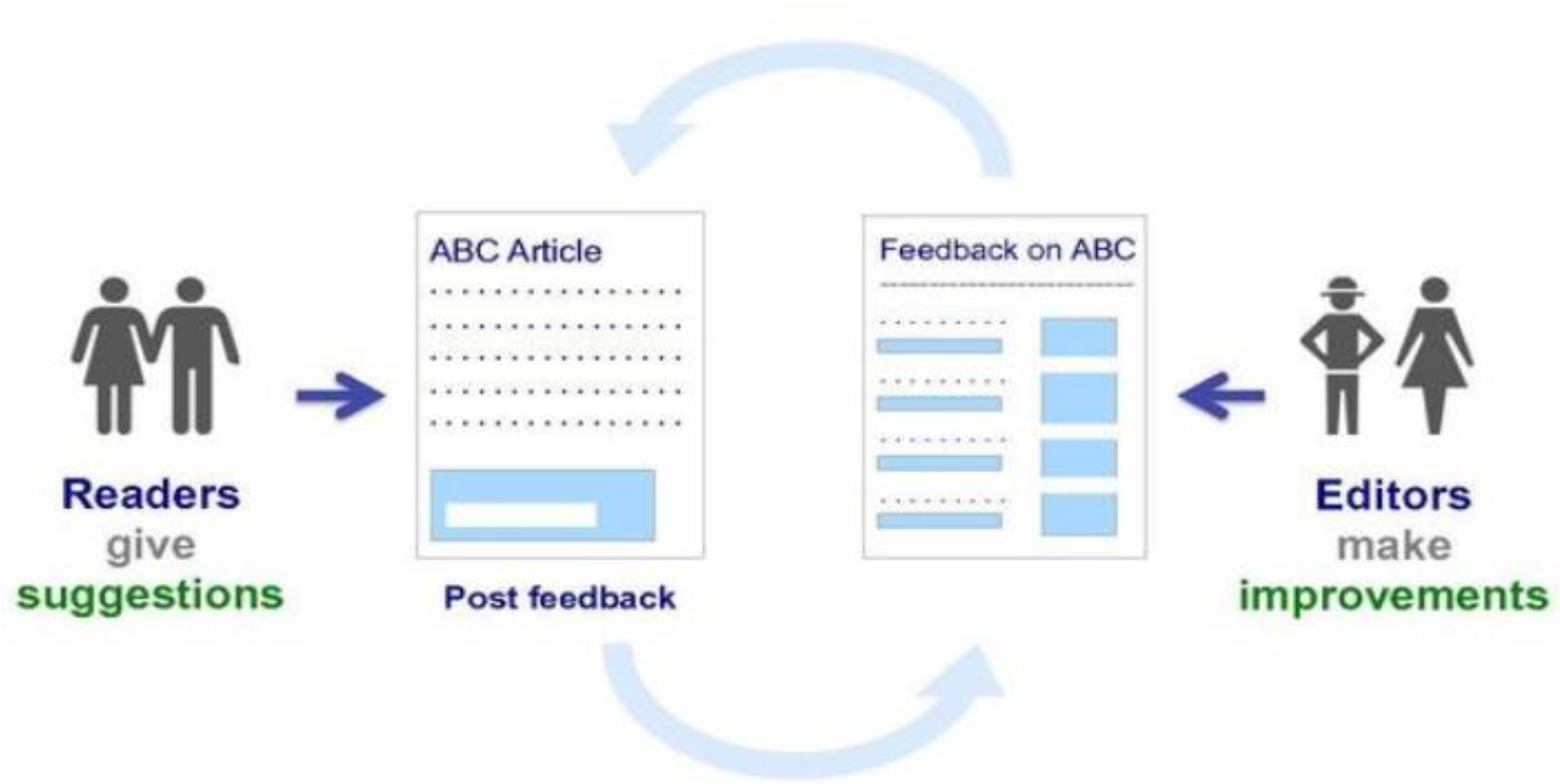
Did you find what you were looking for? Yes No



198.200.124.134 posted [[Special:ArticleFeedbackv5/LID opportunities at municipal facilities#058be50 at municipal facilities 24 April | Details

A general feedback from a french user : I do not know the meaning of the acronym LID,

Feedback flow



Life cycle costing

Low Impact Development Life Cycle Costs

There is increasing interest in the use of Low Impact Development practices to manage urban runoff. However, those considering implementing the practices continue to wonder how their use will affect the bottom line. In this project the capital and life cycle costs of seven Low Impact Development (LID) practices and seventeen design scenarios were evaluated based on a detailed assessment of input costs, maintenance requirements, rehabilitation costs and practice designs relevant to Canadian climates.

The LID practices evaluated include bioretention cells, permeable pavement, infiltration trenches and chambers, enhanced swales, rainwater harvesting and green roofs. Dry swales and perforated pipe systems were considered to be similar to bioretention and infiltration trenches, respectively, and therefore were not evaluated

Downloads

LID Practices Costing Tool Version 2.0 is in development and will be released in 2018.

Assessment of Life Cycle Costs for Low Impact Development Practices
Executive summary | Full report

LID Practices Costing Tool
5.6 MB

Having trouble with the tool? Click here

Please send any comments or feedback on the tool to STEP@trca.on.ca

STEP-LID-Tool_version-1.1.xlsm - Excel

File Home Insert Page Layout Formulas Data Review View LASERFICHE Power Pivot Tell me what you want to do... Sign in Share

Normal Page Break Preview Page Layout Custom Views — Workbook Views
Ruler Formula Bar Gridlines Headings — Show
Zoom 100% Zoom to Selection — Zoom
New Window Arrange All Freeze Panes Split Hide Unhide View Side by Side Synchronous Scrolling Reset Window Position — Window
Switch Windows — Macros

L62

Low Impact Development Costing Tool

Please select an LID practice to open costing sheets

- ☐ Bioretention (BR)
- ☐ Enhanced Grass Swale (EGS)
- ☐ Green Roof (GR)
- ☐ Infiltration Chamber (IC)
- ☐ Infiltration Trench (IT)
- ☐ Permeable Interlocking Concrete Pavers (PICP)
- ☐ Rainwater Harvesting (RWH)

***** Please save this file as an "Excel Macro-Enabled Workbook" (.xlsm)*

***** If the costing sheets do not open, click "Security Warning Options" and "Enable this content"*

LID Selection | Life Cycle Costs

Ready 80%

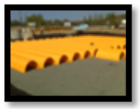
Low Impact Development Costing Tool

Please select an LID practice to open costing sheets

☑ **Bioretention (BR)**

☐ **Enhanced Grass Swale (EGS)**

☐ **Green Roof (GR)**



☐ **Infiltration Chamber (IC)**

☐ **Infiltration Trench (IT)**

☐ **Permeable Interlocking Concrete Pavers (PICP)**

☐ **Rainwater Harvesting (RWH)**

BIORETENTION

USERS: Please enter information into dark coloured cells, DO NOT LEAVE BLANK
*** Medium coloured cells are model defaults and can be changed by the user. All light coloured cells are locked.**

Design

Site & Design Information		
Drainage area (DA)		m²
Native soil infiltration rate		mm/hr
Design type [1]		Unitless
Drainage period	0.048	hours
Ponding depth		m
Safety factor		Unitless
Void ratio		%
Underdrain diameter		m
Filter media depth		m
Mulch depth		m
Pea gravel depth		m
Gravel storage layer depth		m
Total depth [2]		m
Length of bioretention		m
Width of bioretention		m
Water storage volume [3]		m³
Surface area (SA)		m²
Drainage area to surface area ratio (DA:SA)		Unitless
Adjust sizing using the DA:SA ratio?	No	(Y/N)

Notes:
[1] Suggested design type based on native soil infiltration rate
Full Infiltration ≥ 15 mm/hr
Partial Infiltration < 15 mm/hr, requires underdrain
No Infiltration – where there are high water tables, contaminated soils or other constraints to infiltration, requires underdrain and impermeable liner
[2] Total depth can be changed by adjusting the depth of any of the layers
[3] Water volume capacity does not include ponding depth
[4] The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 15:1 to limit the accumulation of fine sediments and thereby prevent clogging

User Notes:

Capital Costs

Costs are 2010 data, apply inflation rate (%)		1.5		
PRE-CONSTRUCTION	**Select**	**Unit**	**Cost**	**emove Cost?**
Test pits		pits	$0.00	No
Infiltration tests		tests	$0.00	No
Stakeout of utilities		visit	$0.00	No
Erosion and sediment controls:				
2" Submersible gas pump		days	$0.00	No
Silt sack in catchbasin		each	$0.00	No
Silt fence around excavation		m	$0.00	No
Add additional costs if necessary			$0.00	
EXCAVATION				
Excavator		m³	$0.00	No
Loading	15	% of excavation cost	$0.00	No
Hauling		hours	$0.00	No
Safety fencing		m	$0.00	No
Pipe to sewer trenching		m	$0.00	No
Add additional costs if necessary			$0.00	
MATERIALS & INSTALLATION				
Impermeable membrane		m²	$0.00	No
Underdrain (200 mm)		m	$0.00	No
Clean out pipes (150 mm)		m	$0.00	No
Overflow pipes (200 mm)		m	$0.00	No
Pipe to sewer (200 mm)		m	$0.00	No
Monitoring pipes (150 mm)		m	$0.00	No
Delivery charges		$	$0.00	No
Fittings (materials & labour)		units	$0.00	No
Manhole adaptor (200 mm)		each	$0.00	No
Stone (50 mm clear)		Cm³	$0.00	No
Pea gravel		m³	$0.00	No
Geotextile		m²	$0.00	No
Filter media (includes delivery)		Lm³	$0.00	No
Backfill excavation		m³	$0.00	No
Curbs & gutter with curb inlets		m	$0.00	No
Vegetation		m²	$0.00	No
Wood mulch		m²	$0.00	No
Stone inlets (50 mm clear)		m³	$0.00	No
Add additional costs if necessary			$0.00	
TOTALS				
Sub-total			$0.00	
Overhead	10	%	$0.00	
Other	0	%	$0.00	
TOTAL			$0.00	

Reset to defaults

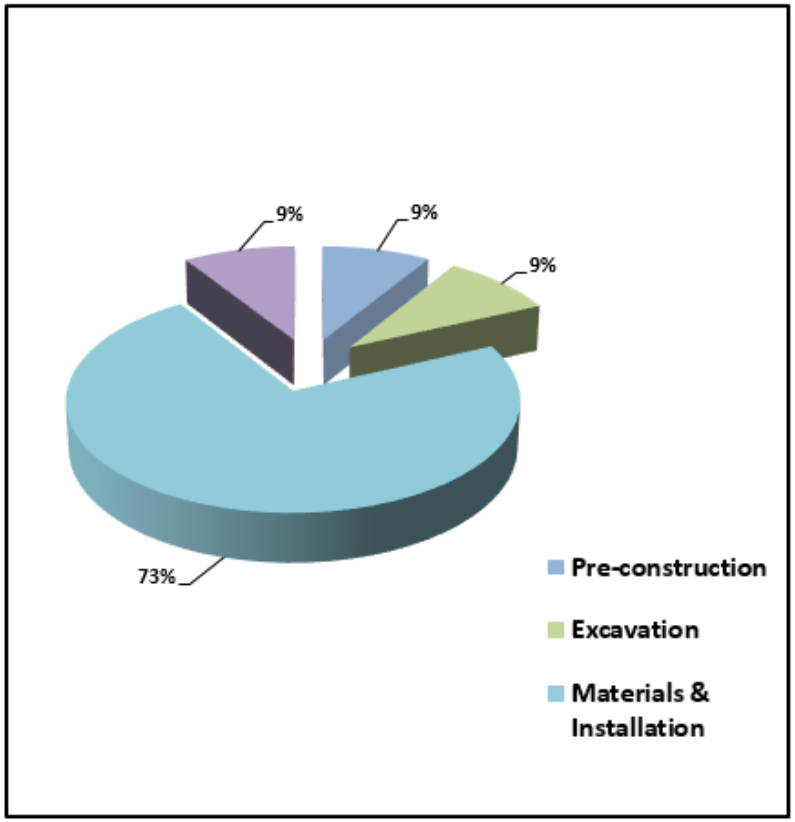
LCC in present value $

Cost Summary

Grand total for this project	
$20,547.50	
Total costs by area	
Pre-construction	$1,804.49
Excavation	$1,923.28
Materials & Installation	$14,951.77
Other	$1,867.95

Retrofit Cost	
Percentage of total cost	16%
Total	$3,287.60

Life Cycle Totals	
50 YEAR EVALUATION PERIOD	
PV of maintenance & rehabilitation	$18,958.58
PV of all costs	$39,506.08
25 YEAR EVALUATION PERIOD	
PV of maintenance & rehabilitation	$10,913.32
PV of all costs	$31,460.82



Inspection and Maintenance

Low Impact Development Stormwater Inspection and Maintenance Guide

Integration of Low Impact Development (LID) best management practices (BMPs) into stormwater management systems is widely advocated to better address all potential impacts of urbanization on the health of receiving waters. A substantial amount of guidance is available on the planning and design of LID BMPs and their construction. However, even with sound design and construction, the function and treatment performance of LID BMPs will only be sustained over the long term if they are adequately inspected and maintained.

Municipalities already face significant challenges in tracking, inspecting and maintaining their own conventional stormwater infrastructure and ensuring practices on private property are adequately maintained. Integrating LID BMPs into stormwater infrastructure programs presents several additional problems, including:

- Lack of experience with inspection and maintenance of LID BMPs;
- Legal arrangements necessary to ensure inspection and maintenance on private property;
- Distributed, decentralized, small-scale practices require more effort to manage them;
- Lack of detailed guidance and templates for program design and implementation.

Downloads

LID Stormwater Inspection and Maintenance Guide 2016

Full Document
33 MB PDF

Table of Contents

Designing an effective LID inspection and maintenance program

Inspection and Testing Framework

BMP Specific Inspection, Testing and Maintenance

- Bioretention and Dry Swales
- Enhanced Swales
- Vegetated Filter Strips and Soil Amendment Areas
- Permeable Pavements
- Underground Infiltration Systems
- Green Roofs
- Rainwater Cisterns

THANK YOU

For more information:

Contact:

Name: Jenny Hill
Email: jenny.hill@trca.on.ca

step@trca.on.ca