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TRIECA Conference (Thursday March 23, 2017 1:30 – 2 pm)

Development of an LID and Urban Water Balance Modeling Tool

Presenters:

Steve Auger, M.Sc., P.Eng., LSRCA

Chris Davidson, P.Eng., Golder Associates Ltd.



Presentation Outline

- Direction and Evaluating Need
- LID Treatment Train Tool Overview
- Example - User Setup and Results
- Next Steps
- Q & A





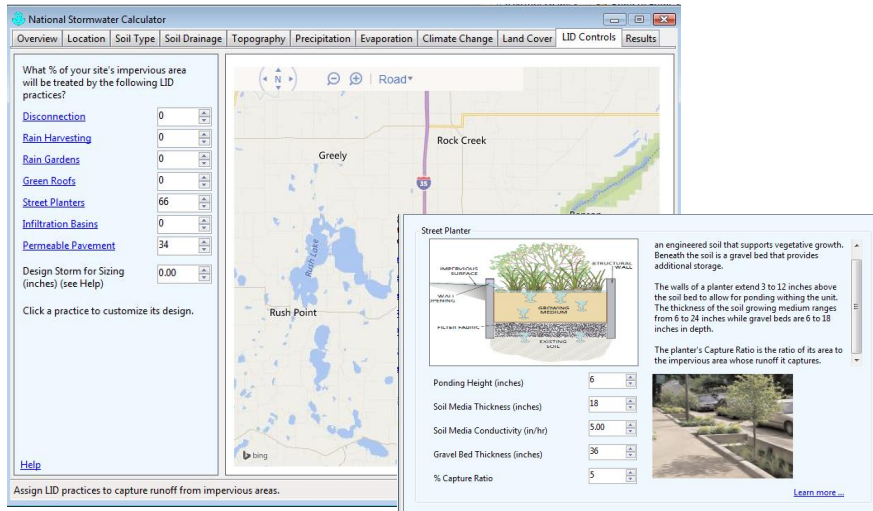
Direction

“Going forward, the Ministry expects that stormwater management plans...will employ LID in order to maintain the natural hydrologic cycle to the greatest extent possible.”

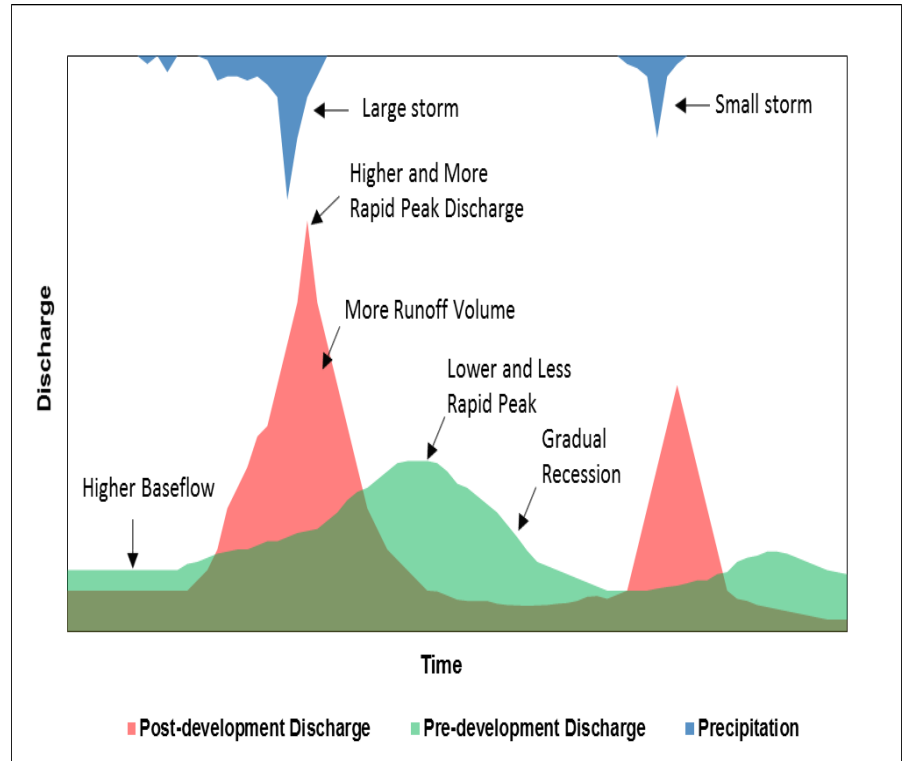
- Interpretation Bulletin from MOECC February 2015

Need For Tool

- Volume control
- Water quality
- Water balance



EPA Stormwater Calculator



adapted from Schueler, 1987



Program Selection

- The BC Water Balance Model
- EPA-SWMM
- EPA National Stormwater Calculator
- HydroTrek
- WinSLAMM
- MIDS GUI Credit Calculator
- GSI-Calc



Program Comparison

	Short Listed Models			
Model Characteristic / Functionality	Water Balance Model	EPA SWMM	HydroTrek	MIDS
Hydrodynamic model type	N/A	One-dimensional	One-dimensional	N/A
Water quantity calculator	Yes	Yes	Yes	Yes
Water quality calculator	No	Yes	No	Yes
Continuous modeling	Yes	Yes	Yes	No
Single event modeling	No	Yes	Yes	No
Dynamic flow routing	No	Yes	No	N/A
Unsteady flow	N/A	Yes	Yes	N/A
Input complexity	Medium	High	Low	Low
# of LIDs represented	Low	Med	Med	Med
Input for LID practice/adaptability	Minimal	Detailed	Minimal	Minimal



Requirements

- Tailored to Ontario Climate & Geology
- Routing for Flows and Volumes
- Estimate Water Budget
- BMPs, End-of-Pipe, and Treatment Train
- User friendly GUI, Open-Source
- Generate Outputs for Local Targets



RFP

LID Treatment Train Tool for Ontario

Purpose:

A conceptual design tool to help developers, consultants, municipalities and landowners implement sustainable storm water management practices.

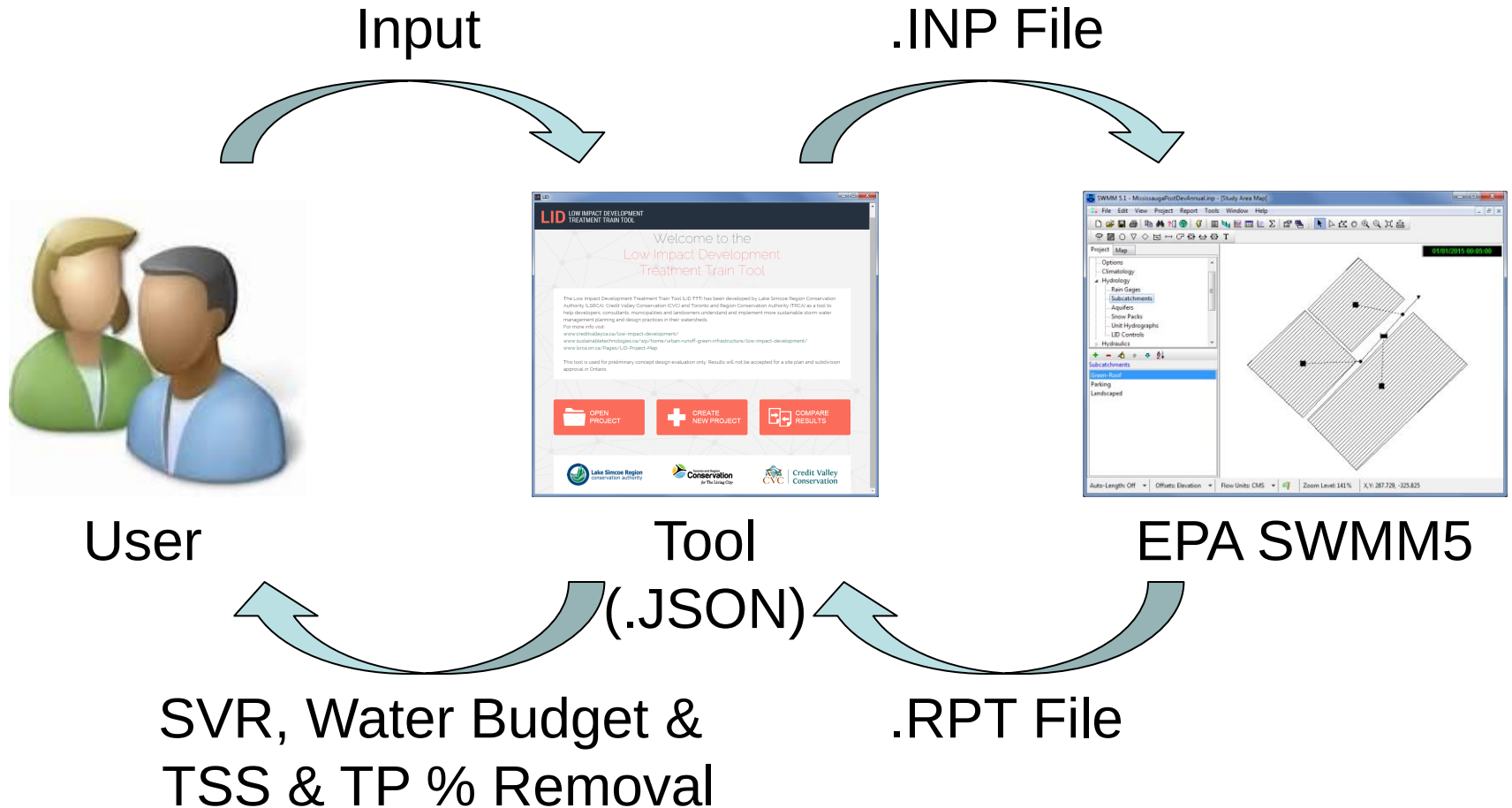
Capabilities:

Quantify runoff volumes reduction, pollutant load removal , and providing a preliminary pre and post development water budget evaluation by implementing Best Management Practices (BMPs) and Low Impact Development techniques.





LID Tool Architecture



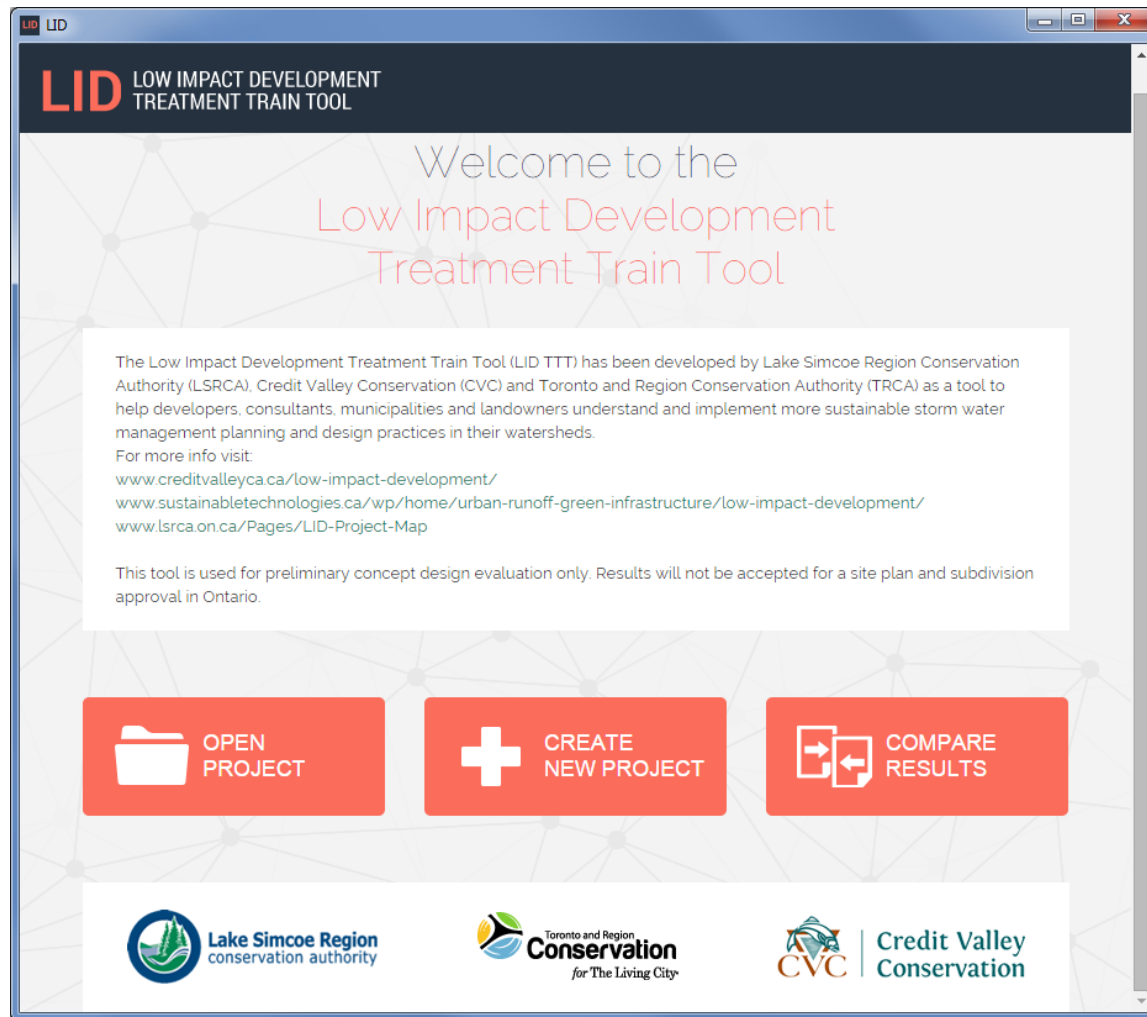


Minimum System Requirements

- Internet Access for Initial Download
 - Windows OS (7, 8,10)
 - 1 GHz and 1-2 GB RAM (32-bit or 64-bit)
 - 200 MB available hard disk space
 - Site Plan and Excel (Optional)
-
- Includes latest version of SWMM5 (5.1.010)
 - No installation required (runs off .exe file)



Project Creation





Project Creation

Scenario

Design
Storm
vs.
Annual
Average

Sitemap

LID LOW IMPACT DEVELOPMENT TREATMENT TRAIN TOOL

Scenario
Pre development

Location
Mississauga

Storm type
Average Annual

Default average annual value for the chosen location is 700

Average Annual
700

Custom Precipitation Time Series
Upload file x

Download Model Average Annual
Download Model Storm Event

Custom Temperature Time Series
Upload file x

Download Model
Load Basemap

Upload image

Minimum recommended image size: 1024px*768px. Extensions allowed: jpg, jpeg, png, gif.

Location

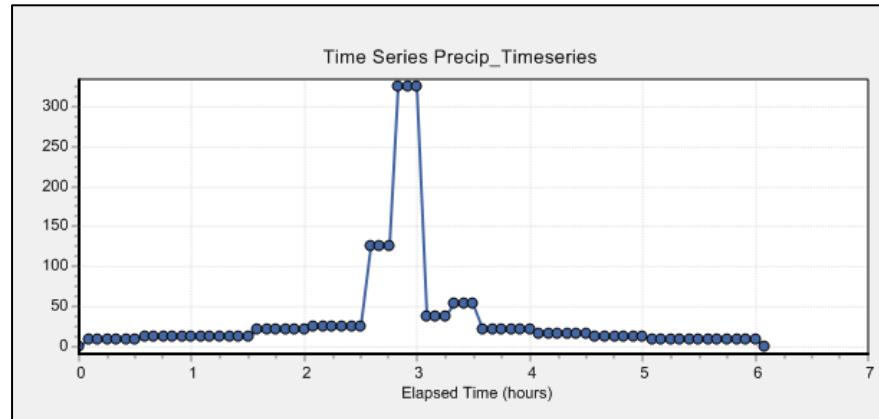
Timeseries

Custom
Timeseries

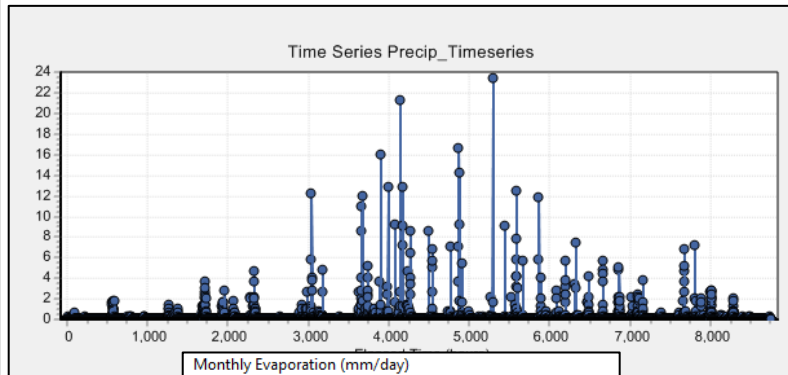


Project Creation

Design Storm

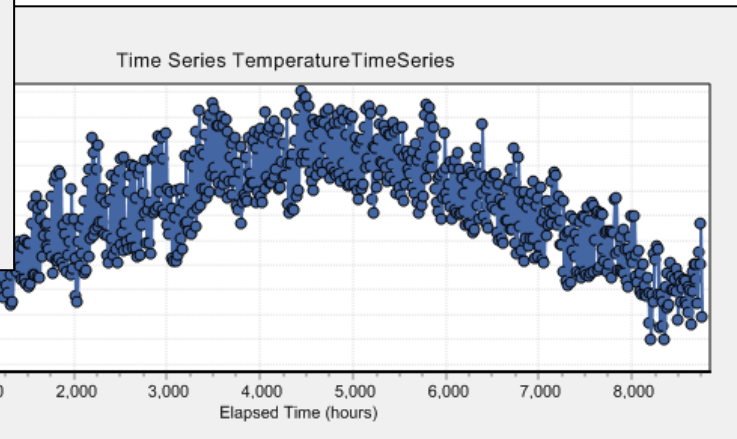


Average Annual



Monthly Evaporation (mm/day)

Jan	Feb	Mar	Apr	May	Jun
0.03	0.04	0.29	1.13	2.45	3.77
Jul	Aug	Sep	Oct	Nov	Dec
4.35	3.84	2.67	1.35	0.47	0.10





Step 1: Pre Development

LD-TTT

PRE-DEVELOPMENT
Universal Exports

REPORT

Click or drag to add scenario

101 FOREST

102 FIELD

103 OUTFALL

Drawn Elements

101 Forest	Incomplete
103 Outfall	
102 Field	Incomplete

Table of contents

Drop image file

Drop shape file

Leaflet | Powered by Esri | Developed by Interfase, City of Brampton, Region of Peel, Province of Ontario, Ontario Base Map, Ontario MNR, Esri, HERE, Garmin, Intermap, INCR

Step 1: Pre-Development

PRE-DEVELOPMENT
Universal Exports

REPORT

Click or drag to add scenario

EDIT CATCHMENT

DELETE CONFIRM

OPEN SPACE/PARKLAND (%)
0

OPEN SPACE/PARKLAND (HA)
0

FOREST (%)
100

FOREST (HA)
1.37

WETLAND (%)
0

WETLAND (HA)
0

TOTAL AREA %
100

TOTAL AREA (HA)
1.37

Drawn Elements

- 101 Forest
- 103 Outfall
- 102 Field *Incomplete*

Table of contents

Drop image file Drop shape file

Leaflet | Powered by Esri | Developed by Interfase, City of Brampton, Region of Peel, Province of Ontario

Click or drag to add scenario

EDIT CATCHMENT

DELETE CONFIRM

CATCHMENT WIDTH (M)
100

CATCHMENT SLOPE (%)
1

MANNING'S N FOR IMPERVIOUS AREAS
0.01

MANNING'S N FOR PERVIOUS AREAS
0.1

DEPRESSION STORAGE FOR IMPERVIOUS AREAS (MM)
2

DEPRESSION STORAGE FOR PERVIOUS AREAS (MM)
2.54

WEIGHTED CURVE NUMBER
58

Drawn Elements

- 101 Forest
- 103 Outfall
- 102 Field *Incomplete*

Table of contents

Drop image file Drop shape file



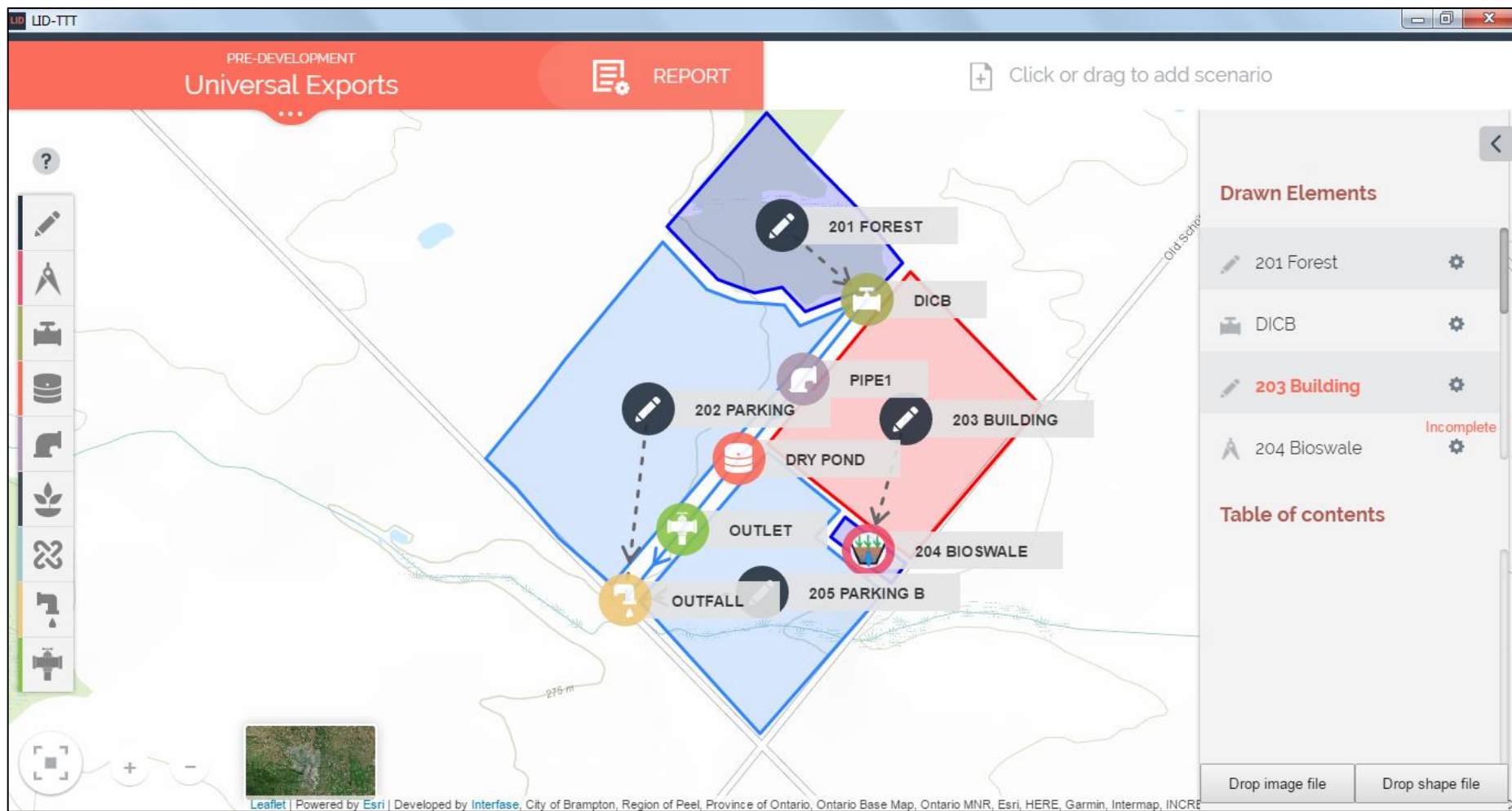
Default Event Mean Concentrations

Land Cover	TSS (mg/L)	TP (mg/L)
Paved surface	84	0.16
Roof	8	0.05
Landscaped Area	70	0.20
Row Crop	100	0.20
Open Space/Parkland	29	0.20
Forest	55	0.20
Wetland	38.5	0.10

Preliminary values



Step 2: Post-Development



Step 2: Post-Development

The screenshot displays a water infrastructure design software interface. The main map area shows a network of pipes, ponds, and outlets. Key features include:

- 202 PARKING**: A grey rectangular area.
- PIPE1**: A pipe segment with a valve icon.
- DRY POND**: A red circular feature with a white cross icon.
- OUTLET**: A green circular feature with a white cross icon.
- 205 PARKING B**: A grey rectangular area.
- FALL**: A dashed line indicating a slope.

Two configuration panels are visible:

- EDIT STORAGE**:
 - Buttons: **DELETE**, **CONFIRM**
 - STORAGE TYPE: **Dry Detention Ponds**
 - ZONE: **1**
 - BOTTOM ELEVATION (M): **100**
 - MAXIMUM DEPTH (M): **3**
 - INITIAL WATER DEPTH (M): **0**
 - LINED/UNLINED: **Lined**
- EDIT CONDUIT**:
 - Buttons: **DELETE**, **CONFIRM**
 - DICB: **DICB**
 - DOWNSTREAM NODE: **Dry-Pond**
 - LENGTH (M): **281**
 - MANNING'S ROUGHNESS: **0.013**
 - UPSTREAM INVERT (M): **102**
 - DOWNSTREAM INVERT (M): **101**

The map also shows other features like **201 FOREST**, **204**, and **204**. The interface includes a toolbar on the right with icons for various tools.

Step 3: Iterative LID Design

The screenshot displays the LID Design software interface, which is used for iterative Low Impact Development (LID) design. The interface is divided into three main sections:

- Map View (Left):** A map showing the project area with various LID features labeled: PIPE1, DRY POND, 203 BUILDING, 204 BIOSWALE, and 205 PARKING B. The map includes a scale bar and a north arrow.
- LID Schematic (Middle):** A cross-sectional diagram of an LID feature. It shows a surface layer with a berm, a storage layer, and a drain layer. Labels include: Surface Berm Height, Soil Thickness, Surface, Soil, Storage, Drain (Optional), and Drain Offset Height.
- Settings Panel (Right):** A panel for editing the LID feature. It includes a title bar (EDIT LID) with DELETE and CONFIRM buttons. The panel is divided into sections for Surface and Storage. The Surface section includes fields for BERM HEIGHT (MM) (50), SURFACE ROUGHNESS (MANNING'S N) (0.1), and SURFACE SLOPE (%) (1). The Storage section includes fields for THICKNESS (MM) (300), VOID RATIO (0.5), SEEPAGE RATE (MM/HR) (10), CLOGGING FACTOR (0), and DRAW/DOWN TIME (30). There is also a section for Drain.

At the bottom of the map view, there is a small text box that reads: "Data by Interfase, City of Brampton, Region of Peel, Province of Ontario, Ontario Base Map, Ontario MNR".



Step 3 (Cont.): Removal Efficiencies

LID	TSS Removal Efficiency %	TP Removal Efficiency %	Icon
Bioretention	75	25	
Green Roof	0	-45	
Infiltration / Exfiltration Systems	75	60	
Permeable Pavement	75	60	
Vegetated Filter Strips / Buffer Strips	30	20	
Enhanced Swale	40	25	

Storage	TSS Removal Efficiency %	TP Removal Efficiency %	Icon
Constructed Wetland	80	60	
Wet Retention Ponds	80	60	
Dry Detention Ponds	60	20	

Junction	TSS Removal Efficiency %	TP Removal Efficiency %	Icon
Specialized Phosphorus Media Filter	75	70	
Sand or Media Filter	75	40	
Oil Grit Separator	50	0	



Tool Results – Runoff Volume Control Target

LID LOW IMPACT DEVELOPMENT TREATMENT TRAIN TOOL	
Design Storm Performance Goal Requirement	
Runoff Volume Control Target (mm)	25
Stormwater Volume Reduction Target (m ³)	3,550
Stormwater Volume Reduction Provided (m ³)	2,065
Stormwater Volume Reduction Met (Y/N)?	No



Tool Results – Water Budget Comparison

LID LID

LID LOW IMPACT DEVELOPMENT
TREATMENT TRAIN TOOL

Water Budget (mm): Comparison

Site	Rainfall	Evapo- transpiration	Infiltration	Runoff
Pre-development	753.2	543.1	140.2	41.3
Post-development	753.2	288.3	155.8	277.3
Difference	0	-254.8	+15.6	+236.0
% Difference	0	-47%	+11%	+571%



Tool Results – Post Dev. TSS Loading

Feature (Removal%)	LID Type	% Removal	Incomming			Peak Outflow (m³/s)	Outgoing		
			Total Flow (m³)	Concentration (mg/L)	Total Load (kg)		Total Flow (m³)	Concentration (mg/L)	Total Load (mg/L)
201 Forest			-	-	-	0.010	130	55	7
DICB			130	55	7	0.006	130	55	7
Pipe1			130	55	7	0.006	130	55	7
203 Building			-	-	-	0.160	17,060	8	136
204 Bioswale (75%)	Bioswale	75%	18,568	10	182	0.040	650	2	2
202 Parking A			-	-	-	0.220	22,990	81	1,867
Dry Pond (60%)	Dry Detention Pond	60%	23,770	79	1,876	0.030	20,768	32	655
Outlet 1			20,768	32	655	0.030	20,768	32	655
205 Parking B			-	-	-	0.180	18,440	81	1,497
Outfall_1			39,380	55	2,153	0.187	-	-	-



Tool Results – Post Dev. TP Loading

Feature (Removal%)	LID Type	% Removal	Incomming			Peak Outflow (m³/s)	Outgoing		
			Total Flow (m³)	Concentration (mg/L)	Total Load (kg)		Total Flow (m³)	Concentration (mg/L)	Total Load (mg/L)
201 Forest			-	-	-	0.010	130	0.20	0.03
DICB			130	0.20	0.03	0.006	130	0.20	0.03
Pipe1			130	0.20	0.03	0.006	130	0.20	0.03
203 Building			-	-	-	0.160	17,060	0.05	0.85
204 Bioswale (25%)	Bioswale	25%	18,568	0.05	0.93	0.040	650	0.04	0.02
202 Parking A			-	-	-	0.220	22,990	0.15	3.49
Dry Pond (20%)	Dry Detention Pond	20%	23,770	0.15	3.54	0.030	20,768	0.12	2.48
Outlet 1			20,768	0.12	2.48	0.030	20,768	0.12	2.48
205 Parking B			-	-	-	0.180	18,440	0.15	2.80
Outfall_1			39,380	0.13	5.28	0.187	-	-	-

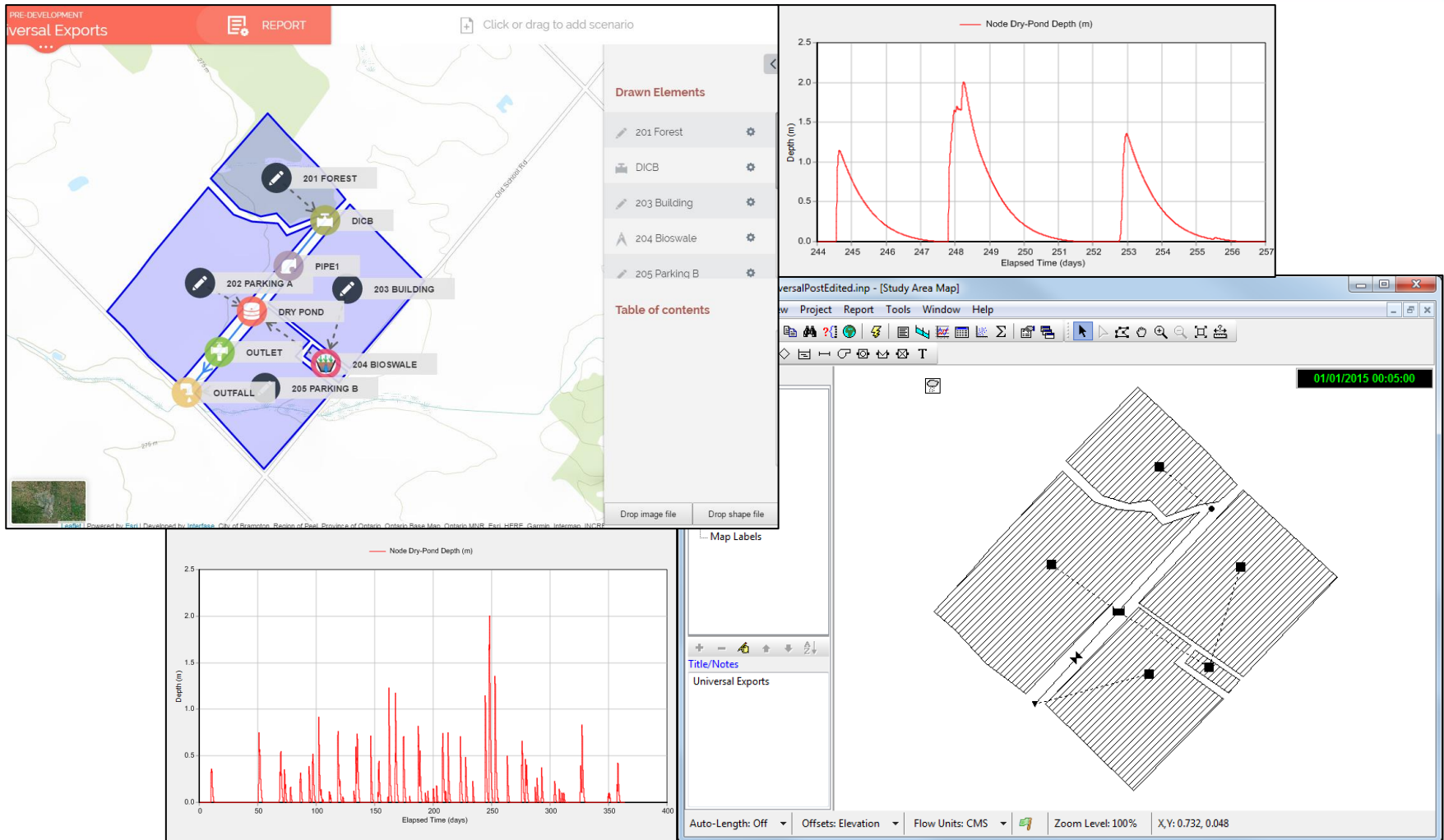


BMP	Drawdown Time (hrs)	Effective VP Ratio	Flow			TSS			TP		
			Flow In (m3)	Flow Out (m3)	Actual % Reduction	Load In (kg)	Load Out (kg)	Actual % Reduction	Load In (kg)	Load Out (kg)	Actual % Reduction
Bioswale	30	12.3	18,568	650	96%	182	2	99%	0.93	0.02	97%
Dry-Pond	-	-	23,770	20,768	13%	1,876	655	65%	3.54	2.48	30%





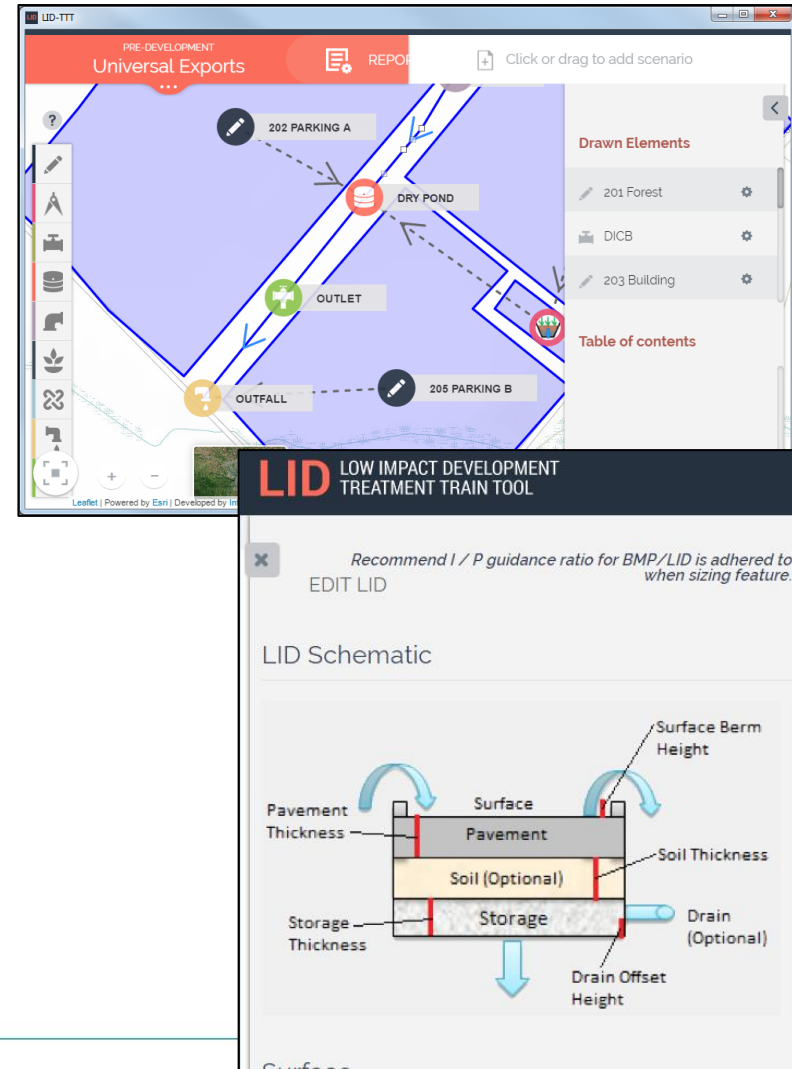
Tool in SWMM5





Next Steps Planned

- Version 1.0 Scheduled for completion at end of April
- Training Workshops:
 - Lake Simcoe Watershed June, 2017
 - Toronto and Region Watershed September, 2017
 - Credit Valley Watershed October or November 2017
- STEP – Technical Support





Acknowledgements

GTA Conservation Authority Project Team:

- Yuestas David, Wilfred Ho, Tim van Seters (TRCA)
- Amanjot Singh, Sakshi Saini (CVC)

Golder Associates Team:

- Melanie Kennedy, Kevin MacKenzie, Bob Murdoch, Massimo Draggan, Ruggero Bonora

Other Contributors:

- Rob Baldwin, Ken Cheney, Peng Du, Tom Hogenbirk, Ben Longstaff, Phil Thase, Mike Walters (LSRCA)
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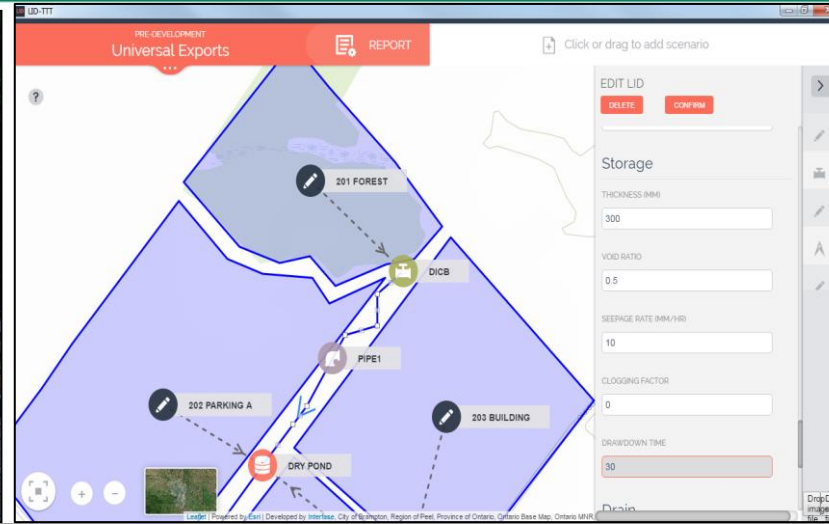
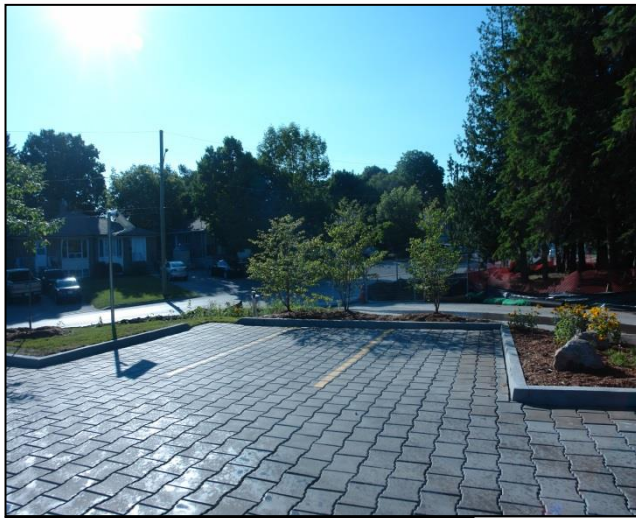


Partial Funding Provided
by Province of Ontario





Thank You - Questions ?



LID	TSS Removal Efficiency %	TP Removal Efficiency %	Icon	INCOMING				OUTGOING		
				Total Flow (m3)	Concentration (mg/L)	Total Load (kg)	Peak Outflow (m3/s)	Total Flow (m3)	Concentration (mg/L)	Total Load (kg)
Bioretention	75	25		-	-	-	0.010	130	55	7
Green Roof	0	-45		130	55	7	0.006	130	55	7
Infiltration / Exfiltration Systems	75	60		130	55	7	0.006	130	55	7
Permeable Pavement	75	60		-	-	-	0.160	17,080	8	138
Vegetated Filter Strips / Buffer Strips	30	20		18,568	10	182	0.040	650	2	2
Enhanced Swale	40	25		-	-	-	0.220	22,990	81	1,867



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