



LID Construction

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Disclaimer



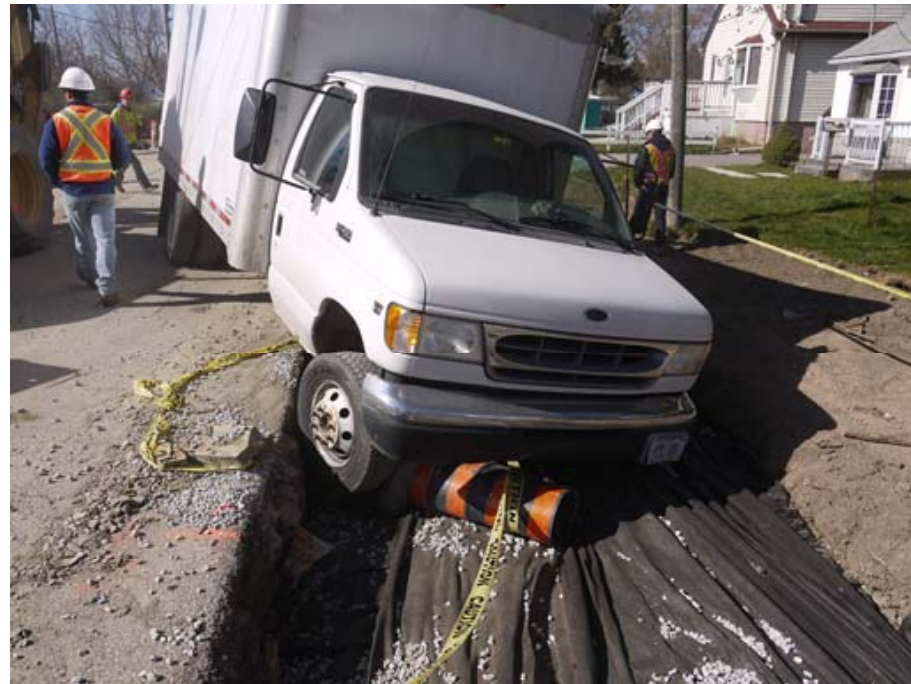


What's the Issue Here?

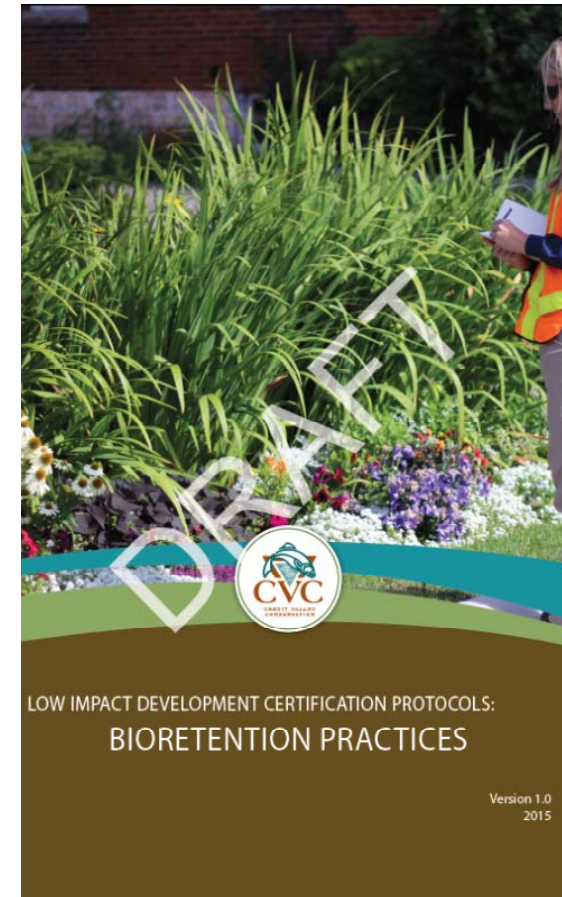
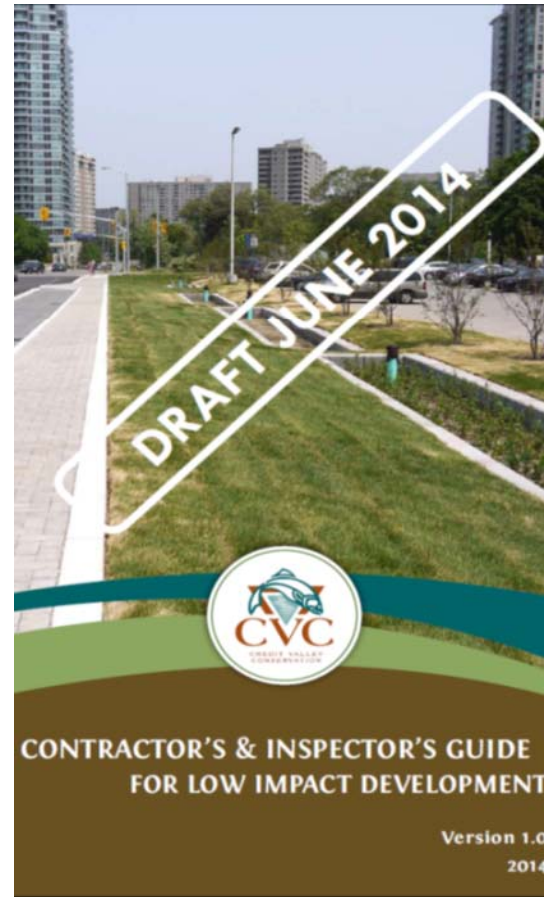
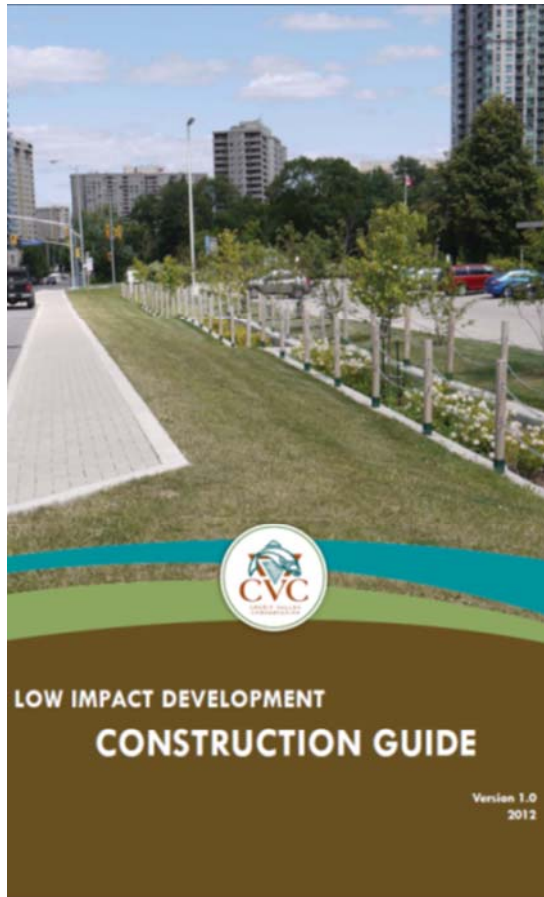


Why do projects face challenges?

- Lack of detail
- Lack of knowledge
- Lack of protection
- Lack of planning
- Lack of communication
- Odd Mishap



How Do You Have Confidence at Project Acceptance?



LID Construction / Inspector / Certification Protocols Guide

All Guides Available @
Bealeader.ca



LOW IMPACT DEVELOPMENT STORMWATER PRACTICE INSPECTION AND MAINTENANCE GUIDE

**DRAFT
JUNE 2015**



The larger package: Special Provisions

- Contractor Training
- Material Testing
- Field Verification
- Material Handling/Storage
- Erosion and Sediment Control
- Tree Protection
- Construction Inspection
- Maintenance and monitoring infrastructure
- Post Construction Maintenance and Operations till Acceptance or Assumption
- Assumption Inspection / Project Acceptance



Detailed Design Drawings

Drawings should be complete

- Detailed Construction Notes should include:
 - sequencing,
 - material specifications,
 - testing requirements,
 - erosion and sediment control,
 - construction notes



Pre-Bid Meeting – Field Verification



- Adjacent land uses
- Drainage Areas (Inflow / Outflow)
- Location of LID Features
- Soil Conditions
- Existing and Planned Infrastructure / Utilities
- Natural Heritage Features
- Constructability Issues
- Access to site & Sequencing
- Property Boundaries (Actual Vs. Drawings)
- Landscape Plans



Avoidance of Future Challenges



Mobilization & Sequencing



Erosion Sediment Control and Material Storage



Mass Grading – Installing, Protecting and Keeping Off Line



Building It – Utility Installation



Building It - Excavation



Building It – Granular Backfill & Infrastructure



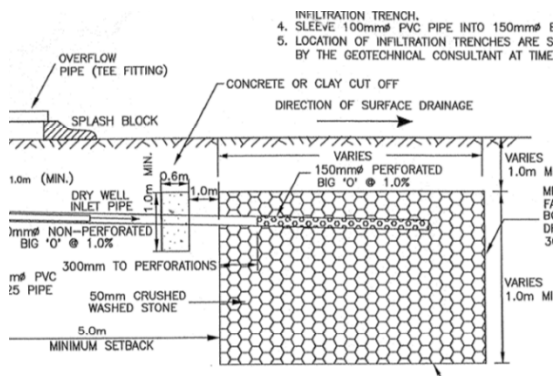
Material Testing & Finish Grading



Building It – Verifying Grades



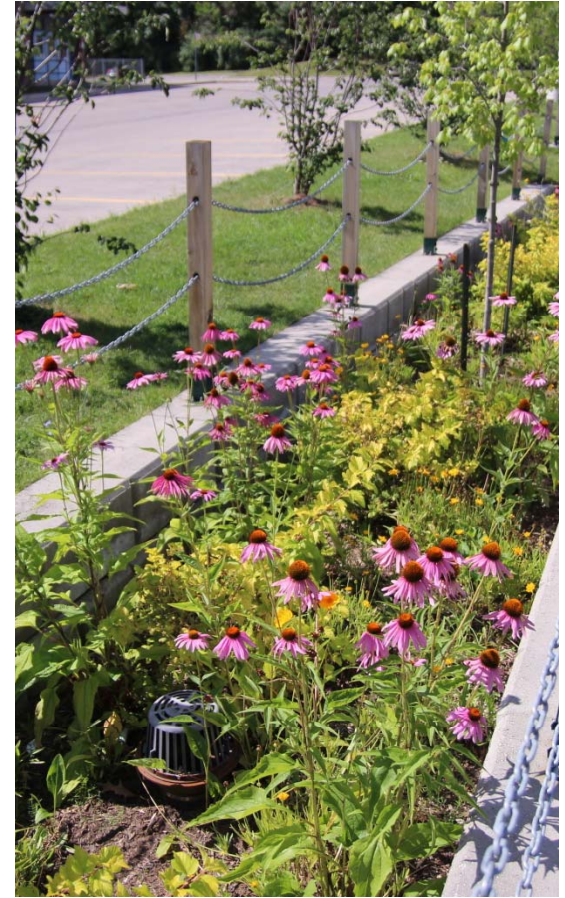
Permeable Pavers



Soakaway Pit



On Going Protection and Overwintering



Plant Establishment



Certification / Final Acceptance

Kyle Vander Linden, Water Resources Specialist

Credit Valley Conservation

Level 1

Visual Inspection

Level 2

Capacity Testing

Level 3

Water Level
Monitoring

Level 4

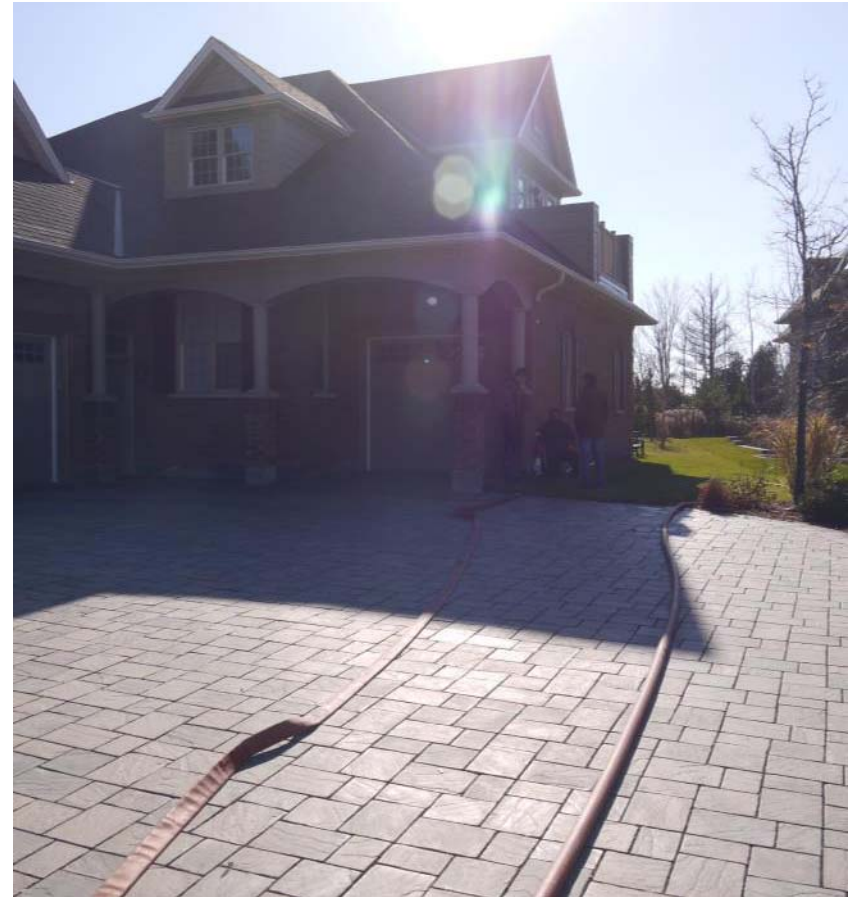
High-Intensity
Monitoring

Certification Levels

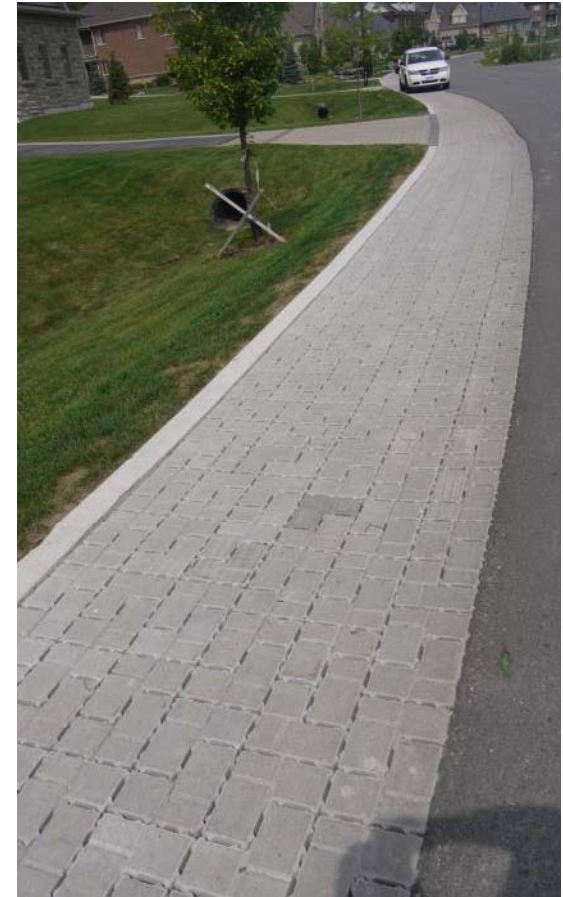
Meadows in the Glenn

- Greenfield Residential Development (95 Lots)
- Single lot estate homes
- Lot level and sub-division level LID features
- SWM ponds used as redundancy
- Certification protocols/testing were not part of the original development agreement

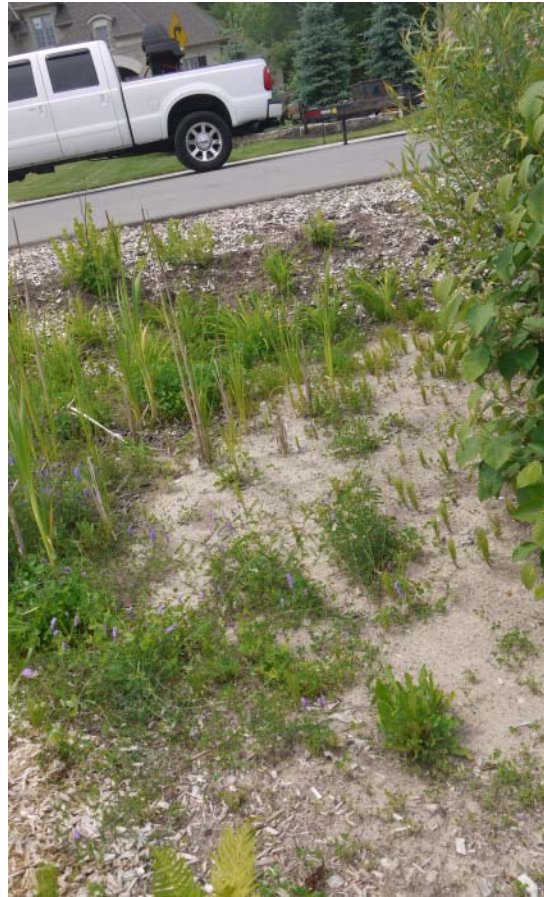




SWM lot level: soakaway pits and permeable paver driveways



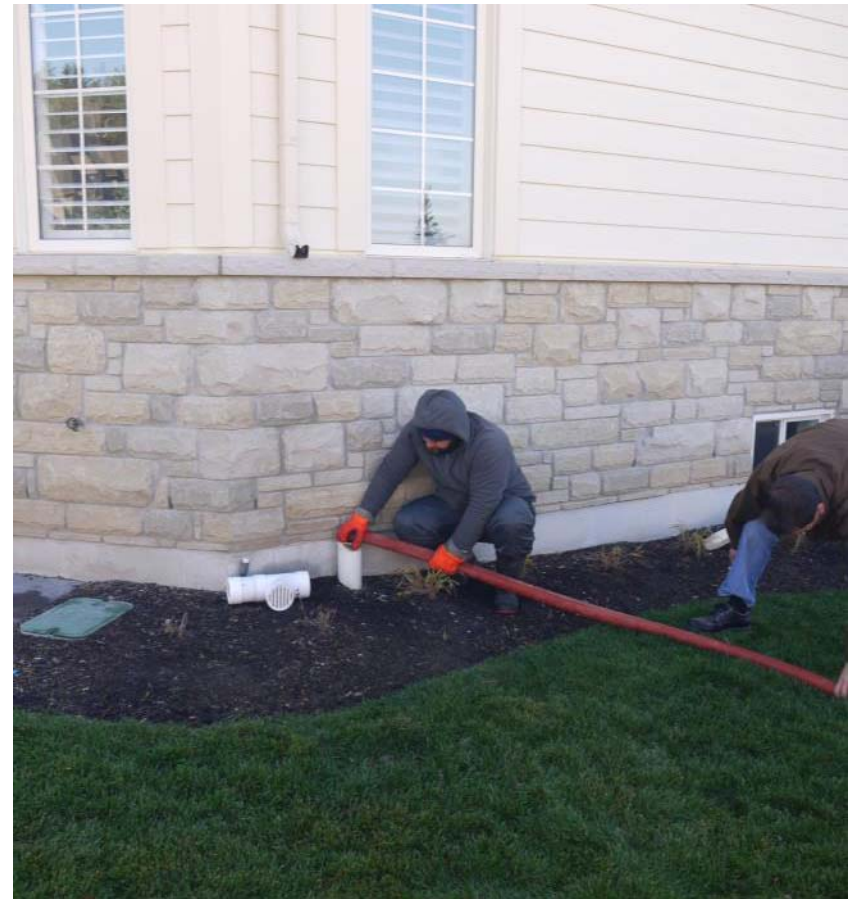
SWM Sub-division: Grass Swale, Bioretention Cell, and Paver Walk Ways



Level 1: Visual Inspection



Level 1: Wet Weather Inspection (Videos)



Level 2: Capacity Testing (Video)

BIOSWALE (Practice #2)				
		Standard	Compliance	Notes
Practice Level: Subdivision-level	2.1.1	Mulch	Passed	
	2.1.2	Slopes	Passed	
Specific Location: North end of subdivision	2.1.3	Stone	Passed	
	2.1.4	Filter Media	Passed	
	2.1.5	Pre-treatment	Passed	Vegetated swales provide pretreatment.
	2.1.6	Setbacks	Passed	
	2.1.7	Geotextile	Passed	
	2.1.8	Underdrain	Passed	200 mm in design
	2.1.9	Drainage Area	TBD	Not reported.
	2.1.10	Vegetation	Passed	
	2.1.11	Inlet	Failed	Visual inspection notes that adjoining grass swale culvert 15 cm lower than invert of inlet creating bypass.
	2.2.1	Elevations	TBD	Unknown - construction complete before time of inspection
2.2.1	Disturbance	Failed	Not specified in construction plans	
2.2.2	Compaction	N/A	Unknown - construction complete before time of inspection	
2.2.3	Subgrade	N/A	Unknown - construction complete before time of inspection	
2.2.4	Soils	N/A	Unknown - construction complete before time of inspection	
2.2.5	Timing	N/A	Unknown - construction complete before time of inspection	
2.2.6	Infiltration Media	N/A	Unknown - construction complete before time of inspection	
2.2.7	Geotextile	N/A	Unknown - construction complete before time of inspection	
2.3.1	Ponding	TBD		
2.3.2	Vegetation	Failed	Site visit report indicates poor vegetation health.	
2.3.3	Sedimentation	Failed	Site visit report indicates evidence of sedimentation.	
2.3.4	As-Built Survey	TBD	To be performed/provided.	
2.3.5	Infiltration Rate	Passed	4 of 4 locations passed a Sep. 12th 2014 test. Additional testing recommended due to sedimentation in 2015	
2.3.6	Maintenance	Failed	Site visit shows sedimentation and poor vegetation health	
Key:				
Design Standards	<i>Recommendations:</i> Address inlet bypass by constructing small berm to direct flows into bioswale inlet.			
Construction Standards	Accumulated sediment should be removed. Vegetative health should be monitored into early summer and			
Performance Standards	vegetation replaced if necessary in early fall. As-built survey and infiltration testing should be performed.			

Assessment Form

<i>Infiltration Basin Size</i>	<i>Infiltrometer Tests</i>
<i>225 – 450 m²</i>	<i>10 Tests + 1 for every 25 m² > 250 m²</i>
<i>450 – 950 m²</i>	<i>20 Tests</i>
<i>> 950 m²</i>	<i>>20 Tests (exact number determined by Contract Administrator)</i>

# of Infiltration Practices	# of Tests Required
95	10 % or minimum of 10 with a maximum of 40 tests
<p>If any test results in failure, an additional 10 test are needed. Maximum failure rate should be < 25 %. If failure is ≥ 25 % then full remediation of practices are recommended.</p>	

How Many Tests?

Home	Criteria	Pass or Fail
1	15,000 L or 15 m ³	Passed
2	15,000 L or 15 m ³	Failed
3	15,000 L or 15 m ³	Passed
4	15,000 L or 15 m ³	Passed
5	15,000 L or 15 m ³	Passed
6	15,000 L or 15 m ³	Passed
7	15,000 L or 15 m ³	Failed
8	15,000 L or 15 m ³	Passed
9	15,000 L or 15 m ³	Passed
10	15,000 L or 15 m ³	Passed

*Test Assumes 100 % Void Space (Clear Stone ~ 40 % Void Space)

**Water truck holds Max 4,000 Gallons or 15,000 L

Test Results Soakway Pits

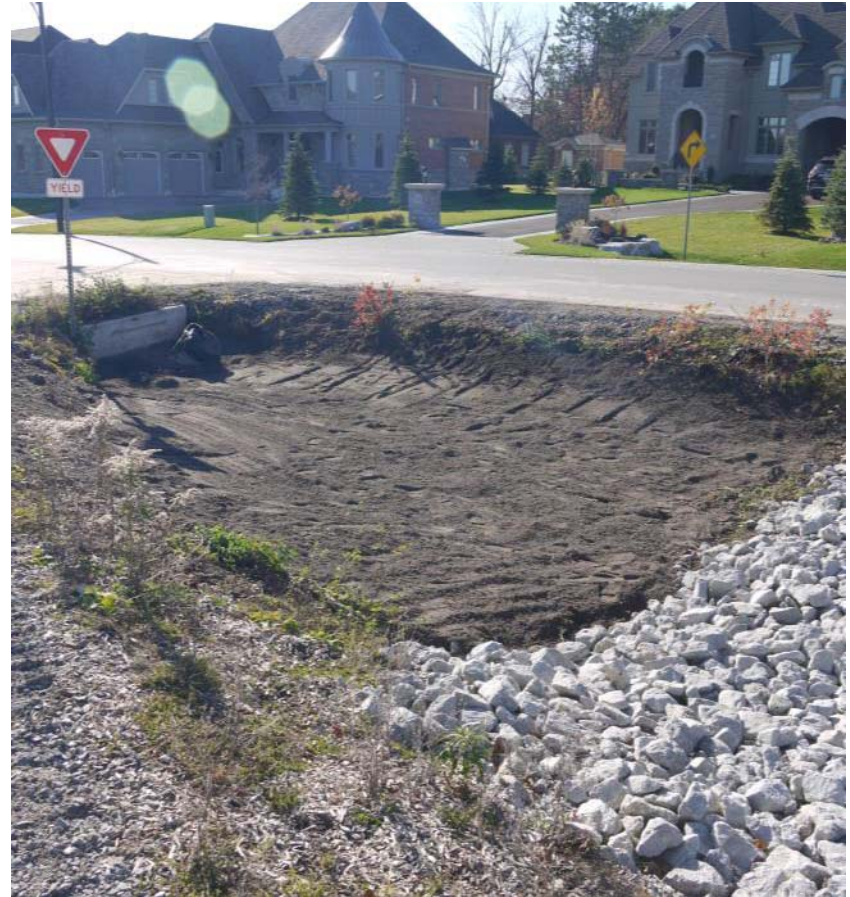


Infiltration Testing Locations

The results are summarized in the table below:

Sample ID	Location of Test	Depth (m)	Soil Type	Hydraulic Conductivity (mm/hr)
Test 1	Upstream Cell (near inlet)	0.23	Sandy Loam	284
Test 2	Upstream Cell	0.17	Sandy Loam	174
Test 3	Upstream Cell	0.21	Sandy Loam	184
Test 4	Middle Cell	0.19	Sandy Loam	154
Test 5	Middle Cell	0.22	Sandy Loam	307
Test 6	Middle Cell	0.22	Sandy Loam	169
Test 7	Downstream Cell	0.20	Sand, Some Silt	54
Test 8	Downstream Cell	0.23	Sandy Loam	154
Test 9	Downstream Cell	0.18	Sand, Some Silt	19
Test 10	Downstream Cell	0.40	Sand, Some Silt	38

Infiltration Testing Results (25 mm/hr Minimum Infiltration Rate)



322 mm/hour

Replacement of Lower Cell Biomedia

Lessons Learned to Date

- Certification Protocols should be part of the development agreement
- They can be linked with the MOECC's ECA
- Minimum standards should be assessed in relation to overall performance of the system
- If LID features are on private property, ensure that you leave time to obtain permission from property owner
- Testing methodology may be restricted to availability of equipment
- Remediation of features may be challenged by developer or property owner if it is costly and/or disruptive
- Level 4 monitoring should be initiated at the beginning of 24 month warranty period so that deficiencies can be address prior to final certification/acceptance