

# TRIECA CONFERENCE



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# Effective LID Retrofit Guidance for Various Landuses and Municipality Sizes

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**Water Resources Specialist**

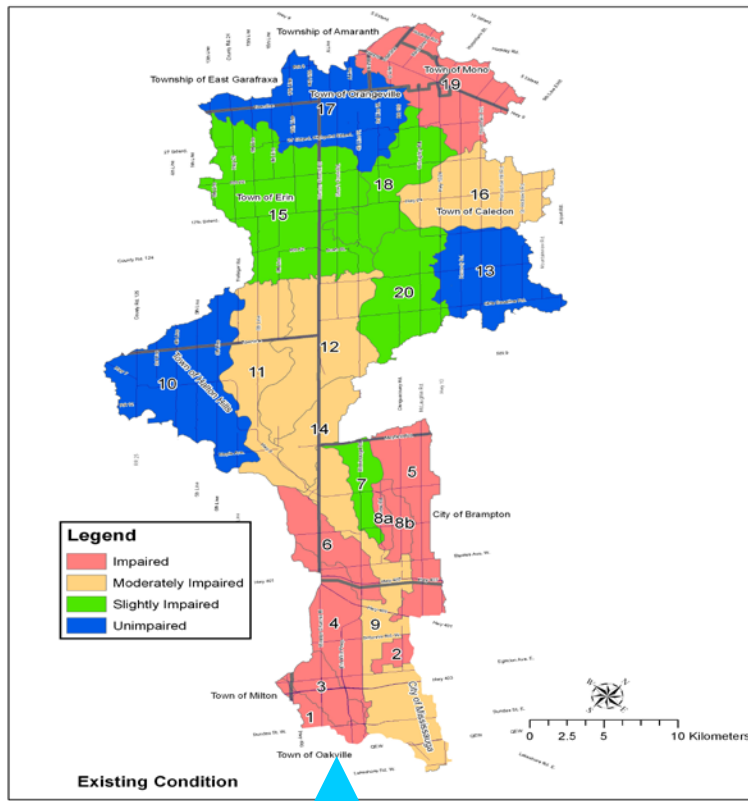
**Credit Valley Conservation Authority**

# Outline

- Challenges we all face
- The need to retrofit
- Land uses, guides and supplementary tools
- Layout, branding, consistency
- Building the (business) case
- Writing style, and example of ROW Guide
- More info and keep in touch

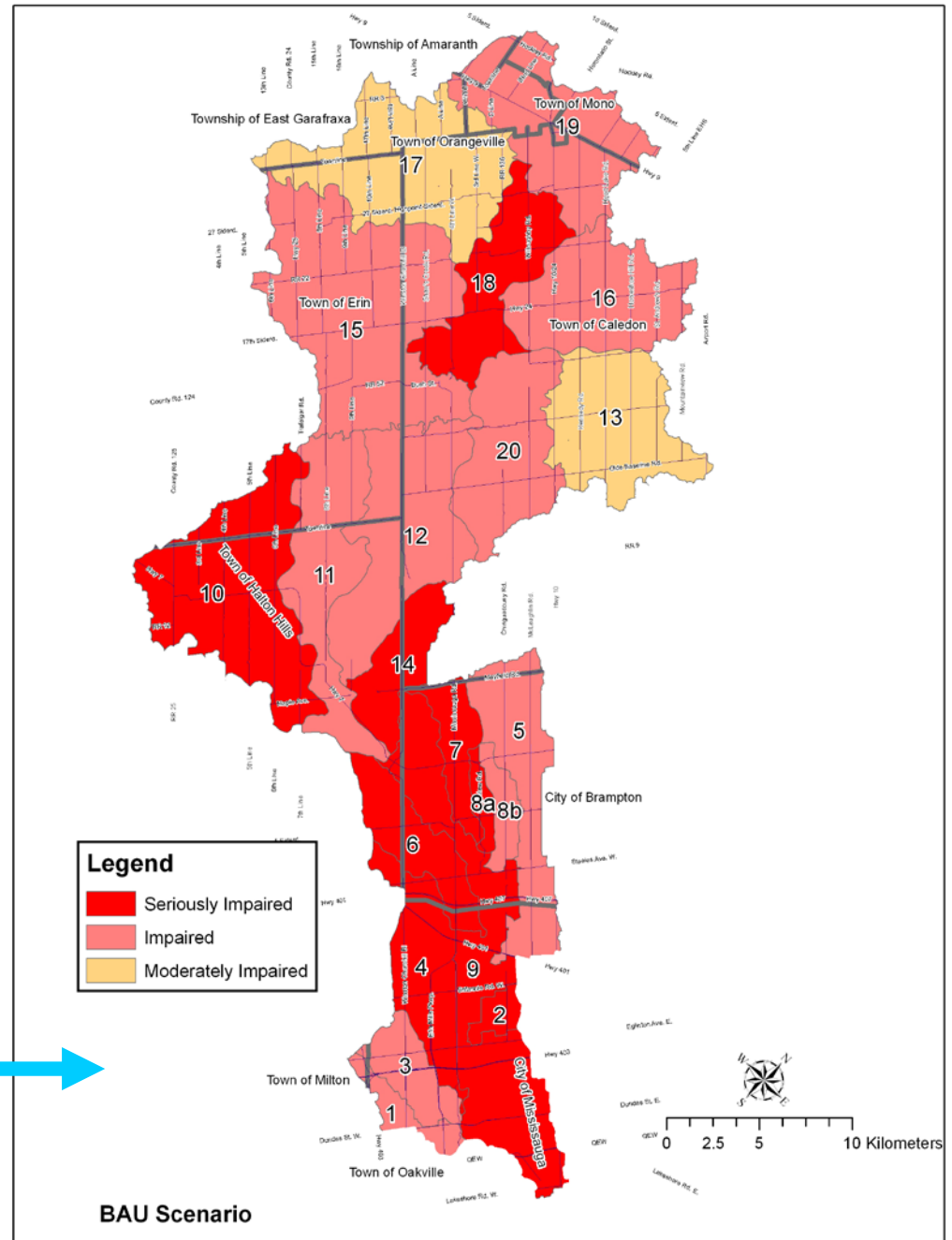
## Challenges we all face

- Since 1995 a state of emergency almost every year in Ontario
- Water related insurance claims now #1 property damage in Canada at \$1.7 billion per year
- Extreme events occurring more frequently, at significant cost to municipalities, businesses and homeowners
- Many municipalities built before modern stormwater management practices were implemented – how do we retrofit these for quantity and quality control?

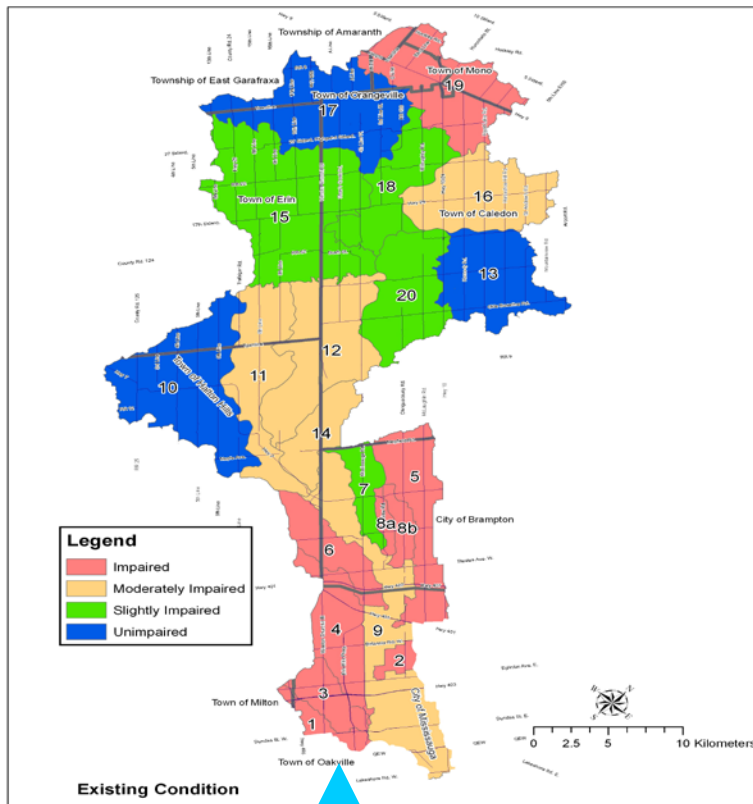


**EXISTING CONDITIONS  
(15% URBANIZATION)**

**BUSINESS AS USUAL  
MANAGEMENT ALTERNATIVE  
(25% URBANIZATION)**

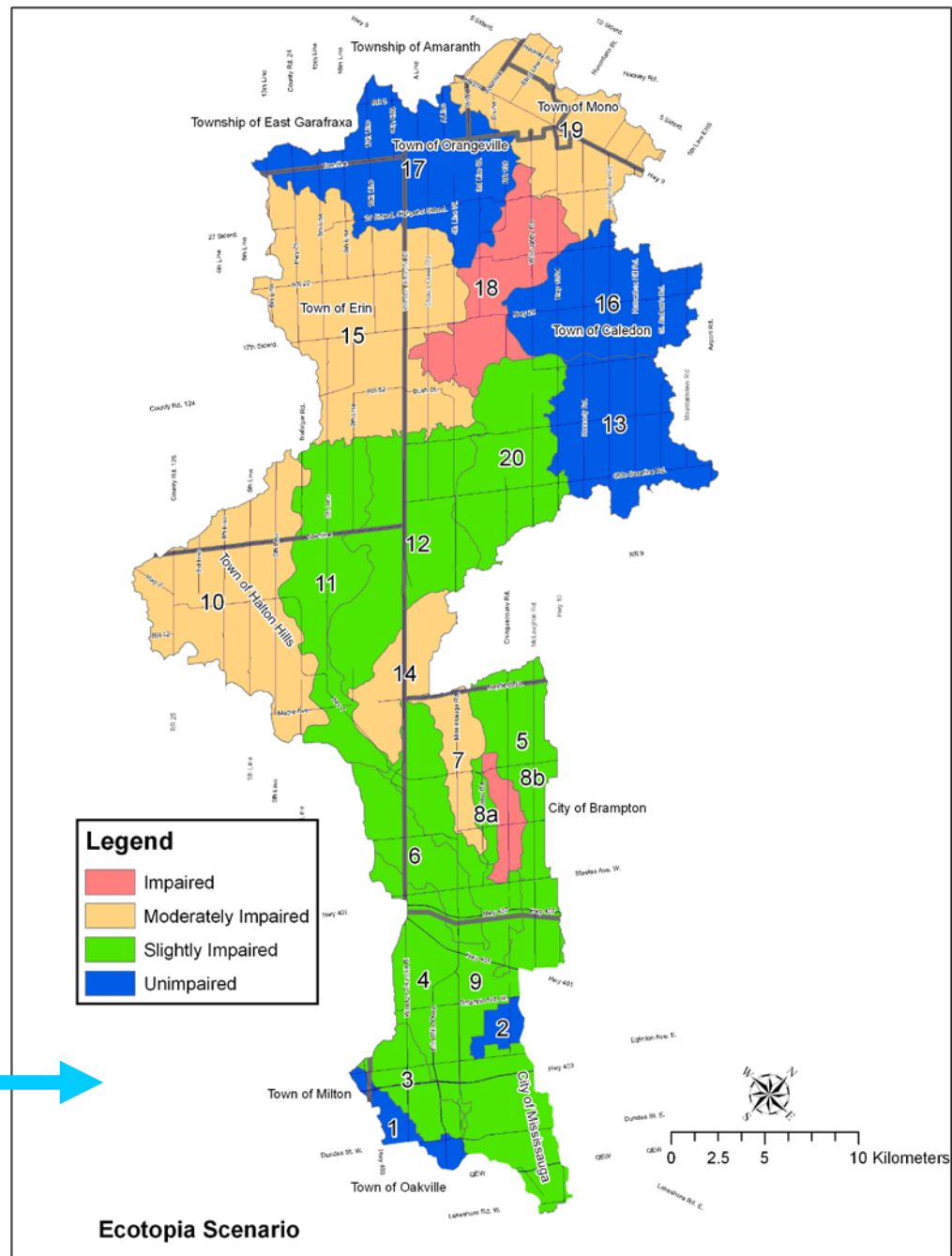


**BAU Scenario**



EXISTING CONDITIONS (15%  
URBANIZATION)

PREFERRED MANAGEMENT  
ALTERNATIVE (25%  
URBANIZATION)



# The need to retrofit

- To address challenges, critical to adopt Low Impact Development (LID) for new development and existing urban areas
- How? **Grey to Green Retrofit Guide** series:
  - 5 guides, tailored to specific stakeholders
  - Small, medium & large municipalities, businesses, managers of public lands
  - Provide clear guidance on how to implement LID retrofits
  - Share experiences and lessons learned from leaders who have implemented LID (Case Studies)
  - Build an effective business case to explain **why** stakeholders need to retrofit their property to incorporate LID



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# Grey to Green Retrofit Guidance Documents

## Grey to Green Municipal Retrofits:

Guide to Optimizing Infrastructure Assets and Reducing Risk  
Through Low Impact Development

A How-To Guide

## Grey to Green Business & Multi-Residential Retrofits:

Optimizing your Bottom-line Through Low Impact Development

Businesses, Universities, Colleges and Condominiums

## Green Road Retrofits:

Optimize Assets Through

Road Right-of-Way

## Public Lands Retrofits:

Parks, Schools and Places of Worship  
Government

Public Lands

## Green Residential Retrofits:

How to adopt Low Impact Development on their Properties

Residential



## Showcasing Water Innovation

- Project supported in part through Showcasing Water Innovation (SWI)
- Complements Ontario's Water Opportunities Act by fostering innovation
- \$17 million available over three years for communities across Ontario
- Creates opportunities for economic development and protecting water resources through partnerships and innovation
- Strengthens water efficiency and sustainable water planning for municipalities
- Awarded Feb 2012- Completion 2014
- Total Project 3.8 M- MOE 1 M, Partners 900K, CVC remainder.



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# How we're overcoming Gaps – Collaboration with over 40 Partners



MINISTRY OF THE  
**ENVIRONMENT**



Environment  
Canada

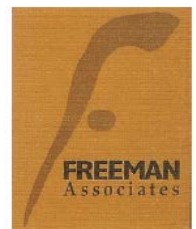
Environnement  
Canada



HALTON HILLS

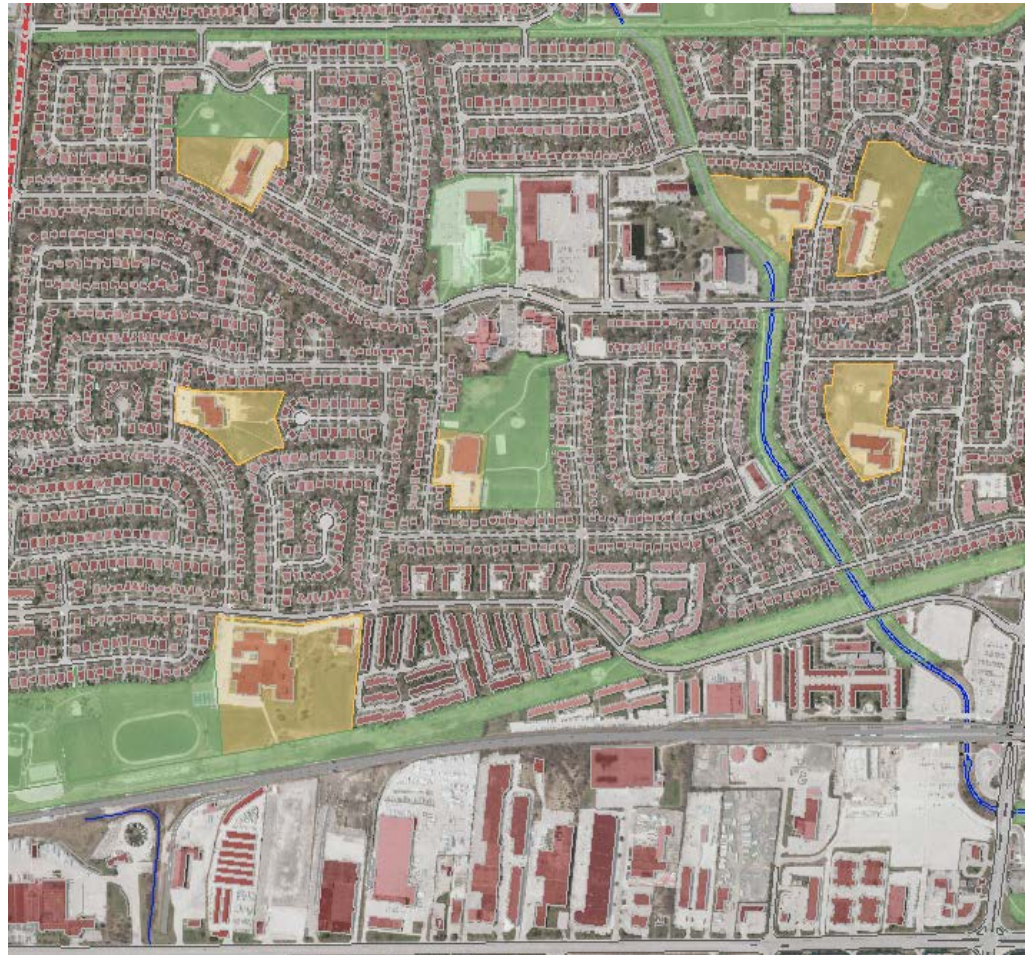


POLIS Project on Ecological Governance



# Stormwater Management Retrofit Guide

- Answers the question ***where do I begin?***
- Small, medium & large municipalities



# Stormwater Management Retrofit Guide

- Provide guidance consistent with the Ministry of the Environment Water Opportunities Act & Ministry of Infrastructure Asset Management
- Provides tools to assist with identifying the best area(s) and land use type(s) to focus LID retrofit activities.
- Help municipalities define levels of service for stormwater management



# Land use types



**Business & Multi-  
residential**



**Residential  
Lands**



**Road ROW**



**Public Lands**

## Shared content

- Business Case for key audiences
- LID Options appropriate for land use type
- Public consultation/project team requirements
- Screening options (LCC approach, maximize benefits, manage risk, level of service, in a sustainable and environmentally manner)
- Design & aesthetics
- Construction & Contract Administration
- Operations



# Case Studies



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## Elm Drive

Location: Mississauga  
Constructed: May 2011

Case Study



## Road Right-of-Way Retrofit

### Project Objectives, Design and Performance

- Road retrofit comprised of six bioretention planters and permeable pavement that treats and infiltrates road runoff on adjacent school property.
- Retrofit aimed at improving stormwater management within the Cookville Creek watershed by providing enhanced erosion control, quantity control, and water balance.
- Ongoing performance assessment had found that LID practices are exceeding all design expectations, providing 99% total suspended solids removal and reducing peak flows for 2-year events by 70-100%.

### Overcoming Barriers and Lessons Learned

- To provide additional clarity and reduce the potential for error, drawings should include a profile view of the storm services through the bioretention cells, and detailed dimensions of any non-standard items.
- Warranty provisions need to be more specific with respect to LID features (i.e. plant watering and weeding) and need to be adhered to by all parties.
- Aesthetics are key - original landscaping had to be supplemented with additional plantings, including trees, to improve aesthetics and add seasonal variety to cells.

### Practices Implemented



### Barriers & Issues Encountered



## Credit Valley Conservation Head Office

Location: Mississauga  
Constructed: 2011

Case Study



## Public Lands

### Project Objectives, Design and Performance

- Building addition that incorporates a variety of low impact development (LID) features including permeable pavement, grass swales and rainwater harvesting.
- Permeable parking lot reduced impervious area by 610 m<sup>2</sup> and reduced construction costs by \$90,000 compared to traditional asphalt lots.
- CVC is evaluating the operations and maintenance needs of the various LID features as well as their stormwater management performance and water savings.
- The rainwater harvesting system is reducing water use in the building addition by approximately 25%.

### Overcoming Barriers and Lessons Learned

- The need to tighten project budget meant that a retaining ship was used for the permeable pavement parking lot rather than a concrete curb.
- CVC utilized concrete curbs for an expansion of constructed at a later date. The performance of these concrete curbs are being evaluated against the retaining ships.
- During commissioning, issues were encountered with the rainwater harvesting system that prevented it from properly switching from rainwater supply to municipal supply in times when the tank was dry.
- The rainwater harvesting system was modified post-construction to incorporate a low-level control system that automatically "tops-up" the tank with municipal water when the tank is low.

### Practices Implemented



### Barriers and Issues Encountered



**NEW**

# Case Studies



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## IMAX Parking Lot Retrofit

Location: Mississauga  
Constructed: 2013

Case Study



### Business and Multi-Residential

#### Project Objectives, Design and Performance

- Design and construct a better functioning parking lot that upgraded stormwater management infrastructure with modern low impact development (LID) features.
- Benefit from project partnerships to enable a variety of innovative stormwater management techniques to be integrated into the IMAX parking lot including permeable pavers, Juleyford® Fiber, bio-swales and Suctiwell® Media.
- Conduct infrastructure performance assessment to directly address knowledge gaps impacting the wide-scale adoption of LID technologies in Ontario.

#### Overcoming Barriers and Lessons Learned

- Challenging soil conditions were encountered on site requiring a conservative design that provides sufficient drainage infrastructure and structural support.
- Coordination and a transparent design process between CVC, product supplier, the design team and academic experts ensured the successful integration of performance assessment infrastructure into the IMAX parking lot.
- Contractor and IMAX staff worked together to ensure that IMAX could conduct business as usual during the construction phase.
- To ensure that construction is performed properly and proceeds on time, be sure to have an individual experienced in LID construction and design as a great asset on the job-site. They act as a resource and liaison between the contractor, client and other stakeholders.

#### Practices Implemented



#### Barriers and Issues Encountered



**NEW**



## Clairfields, Westminster Woods and Pine Ridge Subdivisions

Location: Guelph  
Constructed: May 2011

Case Study



### Residential Lands

#### Project Objectives, Design and Performance

- Three subdivisions located in the south end of Guelph that utilize large-scale infiltration practices called "greenways".
- Use of on-site infiltration practices driven by ideal soil conditions and inability to connect to municipal storm sewer system.
- Greenways provide recreational amenity for residents through trail network, parks and playgrounds.

#### Overcoming Barriers and Lessons Learned

- During planning, concerns regarding cold weather performance required extensive geotechnical investigation.
- Multi-year monitoring has shown that subdivision-scale infiltration can operate successfully year-round.

#### Practices Implemented



#### Barriers & Issues Encountered

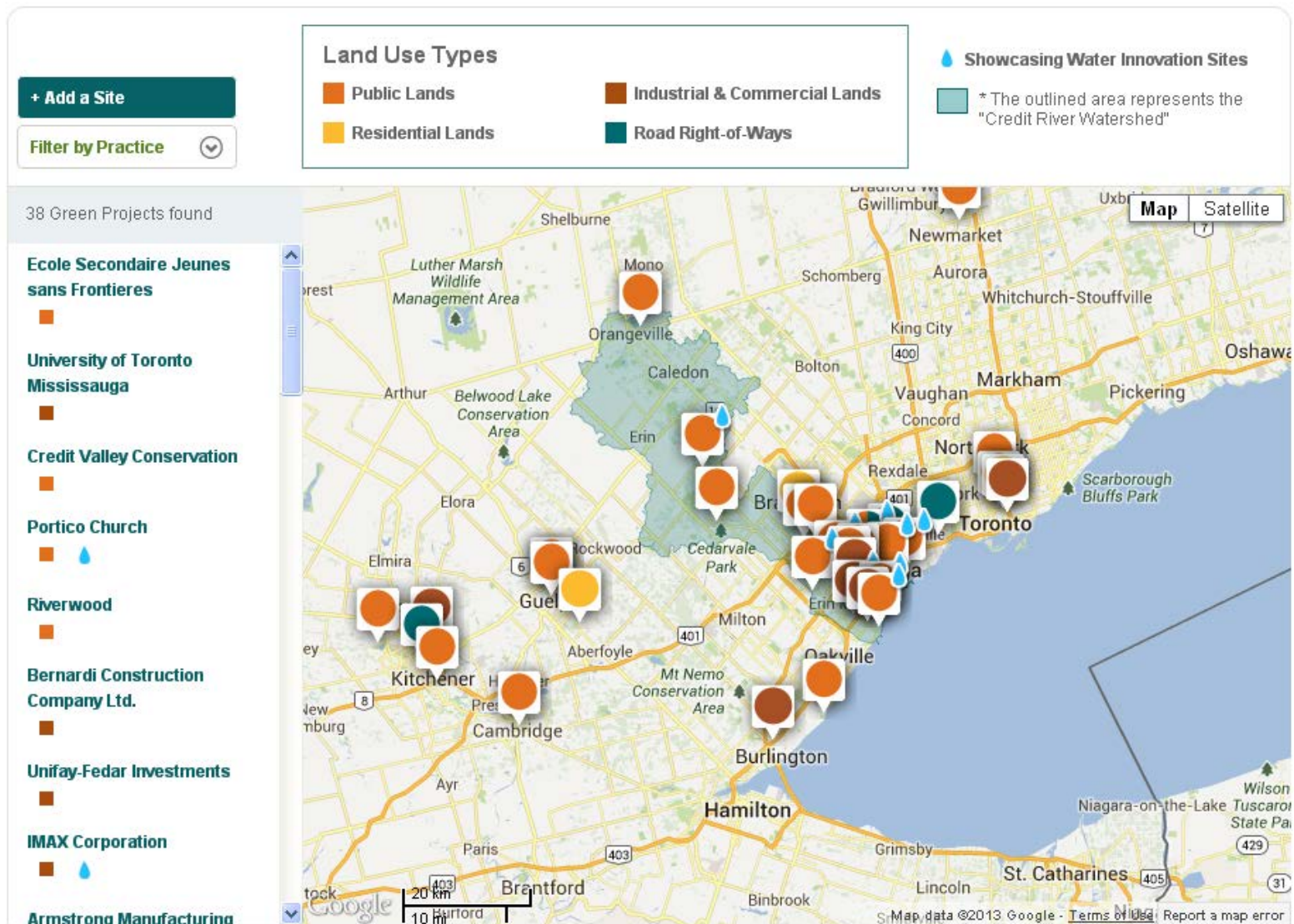




# LID Map



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# Technical Reports & Other Documents

- Also extending branding and style lessons learned to:
  - Technical reports
  - Fact sheets
  - Annual updates
  - Sub-watershed studies

## Welcome to the 2012 Credit Valley Conservation Water Report

Credit Valley Conservation (CVC) is dedicated to protecting, restoring and managing the water resources of the Credit River Watershed. Working hand in hand with our partners, members and donors, we are making significant progress towards a more sustainable future for our watershed.



The CVC vision is to "ensure abundant, safe, clean water for environmentally, socially and economically healthy communities within the Credit River Watershed". In the last five years we have engaged partners and stakeholders around this vision and are working to address issues that matter most to the health of our watershed.

Guided by our strategic plan, we have demonstrated leadership in watershed protection and restoration through our Low Impact Development (LID) demonstration sites and "Making it Work" conferences and training workshops. We are in schools and on the streets, providing hands-on opportunities for all age groups to recognize the value of LID. We are in our rivers and in the lab, establishing Water Quality Monitoring and flood mitigation strategies to safeguard our communities against risk. We are working with municipalities to provide cost-effective stormwater solutions, and helping businesses showcase their sustainability commitments through leading edge site design.

The impact of our work has been acknowledged by a Showcasing Water Innovation grant, opening an exciting new chapter for our organization. Through provincial funding of \$1 million and private-public funding from 17 partners of \$900,000, CVC is committed to developing our storm water program and establishing Ontario as a water leader.

More than ever, strong partnerships are needed in the Credit River Watershed. The increase in extreme weather events has underscored the damaging and costly impacts of climate change. With population and urban intensification also growing in the watershed, action must be taken to build resilient communities in the face of changing environmental, demographic and economic conditions.

We will continue to expand our program delivery, particularly in the areas of water quality and flood risk management, and look for ways to develop our partnerships with businesses and communities across the jurisdiction.

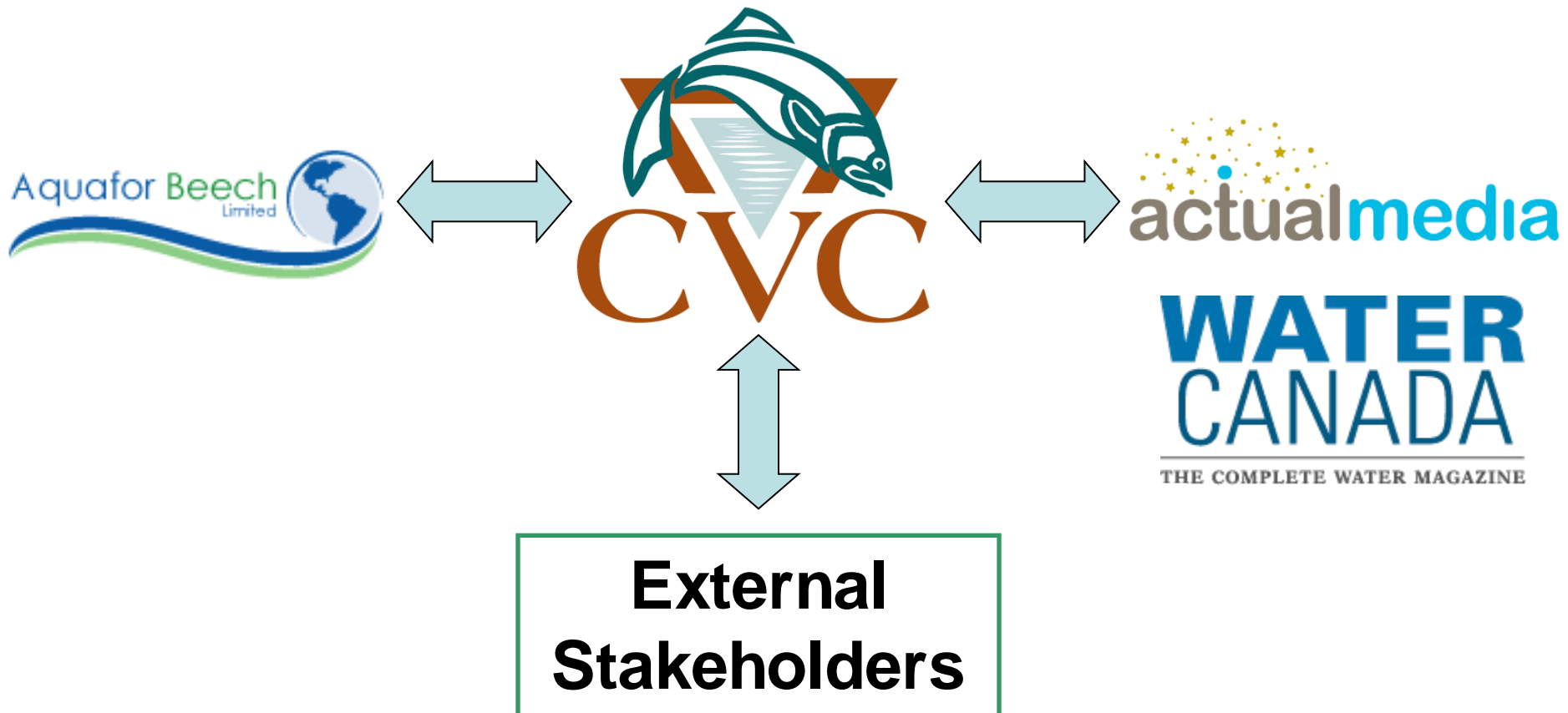
On behalf of all of us at Credit Valley Conservation, I thank you for sharing in our progress.

Patricia Mullin, Chair of Credit Valley Conservation,  
City of Mississauga Councillor

**Writing**

**PM/Review**

**Editing**



# Being Consistent - CVC House Style Guide

Be consistent! Develop a House Style Guide and keep it updated as you work

## GENERAL RULES

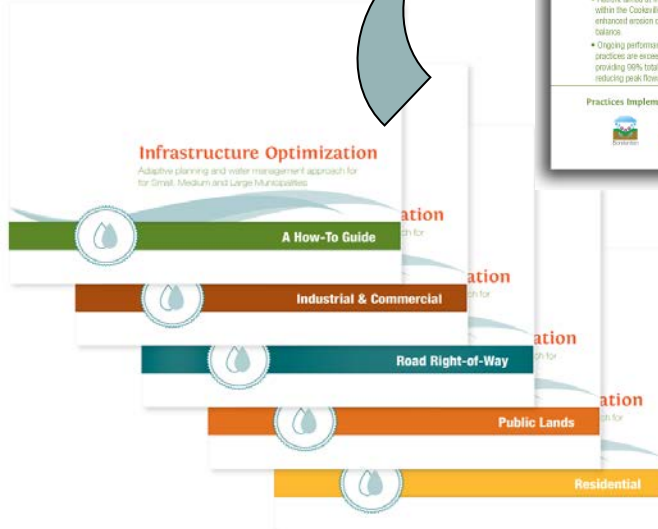
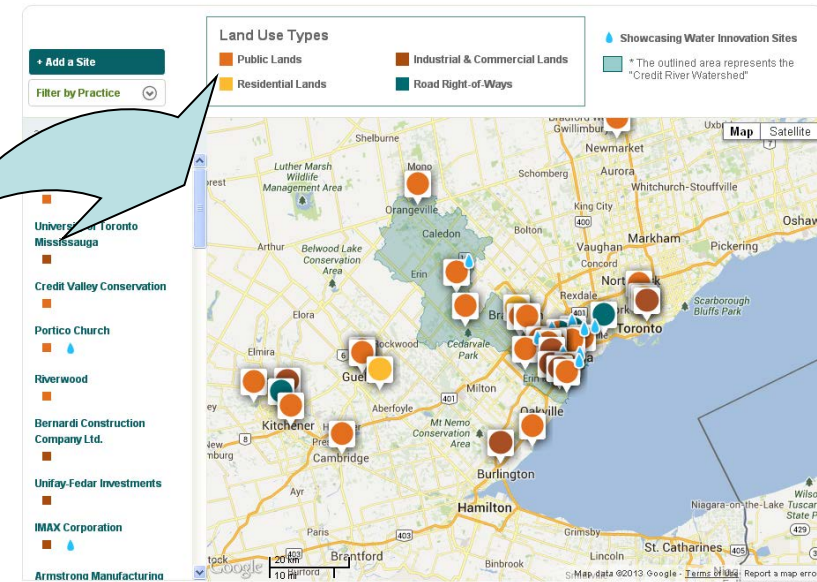
- Quotation marks should be used only when quoting a person, never for emphasis on a statement or word.
  - Example: big picture, not “big picture”
- Do not use italics, bold, or underline for emphasis.
- Passed acts are always italicized.
- low impact development, not:
  - Low Impact Development / Low impact development / low-impact development
- **Consistency applies to everything...**





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# Applying Consistency



## Build the (Business) Case



- Need to communicate to the reader WHY they should do the things you are providing guidance for
- Do not be abstract – don't just spout facts and figures
- Know your audience & speak to the reader
- If they care, they will follow through and implement what you recommend

# Know Your Audience

- What is the audience you are trying to reach?
- Think about:
  - What do they care about?
  - What level of technical detail will they want?
  - How much time will they spend reading the document?
- Some of the different groups:
  - General public, High-level decision makers, Practitioners, Funders



## Speak to the Reader (the Audience)

- Don't be afraid to engage the reader by using terms like “you” and “your” on occasion!! i.e.,
  - Owners/tender developers must be aware of their design situation...

### **Replace with:**

- When you are developing a tender, you must be aware of...



## Reader Should Identify Themselves

- Include content/examples the reader will identify with – “that’s me”
- Associate with styles/colours/images
- Repeat throughout to draw the reader’s attention
- Icons used for Public Lands guide:



**Parks**



**Municipal  
Facilities**



**Schools**



**Places of  
Worship**

# Active Voice vs Passive Voice



- Which is catchier? Which is easier to read?
- Passive voice is often associated with long, dry academic papers.
- Switching from passive to active throughout the document helps with pace
- While you do have technical information to communicate, the sentences do not have to be burdensome.

# Active Voice vs Passive Voice



- Passive: “In a majority of situations, it is typically considered a best approach to use an underdrain in LID practices placed in clay soils”

Replace with:

Active: “When retrofitting LID practices on clay soils, use an underdrain”

## Economy of Language – i.e., Be Direct

- Similar to active voice
- Be more direct with what you are trying to convey
- We often try to couch our recommendations in multiple qualifiers. This tends to “bury the lede” – obscure the very point we’re trying to convey
- How do we apply this?
  - If you need to qualify something, don’t bury the piece of information you’re trying to convey within the qualifier(s)
  - If there are qualifiers, add them after the advice, ideally within the next sentence (to reduce the number of long run-on sentences.

## Plain Language

- Clear compelling writing
- Logical organization
- Easy-to read format (sentence/paragraph structure/length)
- Get to the root of it
- Not “dumbed down”
- Avoid jargon/acronyms
- Provide memorable messages

# Engage your Stakeholders



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# **Theory to Practice:**

## **Road ROW Guide & Public Lands Guide**



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## Grey to Green Public Lands Retrofits:

Optimizing Parks, Public Buildings, Schools and Places of Worship  
through Low Impact Development



**Public Lands**



## Audience

- Managers of Public lands:
  - Municipal facilities, Parks, Schools, Places of worship
- Property owners/managers, Councillors, School board trustees, Directors
- Facilities, Environment, Health & Safety, Community Services
- Lower level of technical detail



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## Welcome to the Grey to Green Public Land Retrofit Guide

### LID

*low impact development is a green infrastructure approach to stormwater management that uses simple, distributed and cost-effective landscaped features and other techniques to infiltrate, store, evaporate and detain rainfall where it falls.*



#### Who should read this guide?

The Grey to Green Public Lands Retrofit Guide supports properties managed by municipalities as well others that, while privately owned, are considered by many to be part of the public realm in our communities. Read this guide if you are responsible for one of the following public lands:

- Municipal facilities
- Parks
- Schools
- Places of worship

#### Why should I read this guide?

LID practices provide several benefits to the community: they can reduce risk of flooding, create beautiful green spaces, provide water quality improvements and help you meet your organization's sustainability targets. Establishing an LID practice on your site demonstrates your commitment to improve your community and your local environment.

This guide provides you with the information, guidance, case studies and tools you need to do the following:

- Understand why you should implement an LID retrofit on your property
- Know what LID options are available and how to select the right option for your property
- Implement an LID retrofit, including both small- and large-scale projects
- Operate and maintain your new LID practice over its lifecycle

#### How should I read this guide?

This guide includes information, guidance, case studies and tools that are general and apply to all types of public lands as well as content applicable specifically to your public land type. To help draw attention to the information that is important to you, this guide uses the following colour-coded icons:



**Parks**



**Municipal  
Facilities**



**Schools**



**Places of  
Worship**

#### Where should I go for more information?

For more information on the design, construction and lifecycle activities of LID features, case studies of public lands that have implemented LID on their property please visit Credit Valley Conservation's (CVC) Be a Leader website at

**bealeader.ca**

# Business Case

- Be a leader in sustainability
- Minimize your risk
  - Climate change risk
  - Flood risk
- Protect your public lands
- Other benefits:
  - Create healthy communities
  - Save operations & maintenance costs
- Public lands site-specific business cases



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## *How can you be a leader in your community?*

*The City of Ottawa has targeted LEED (Leadership in Energy and Environmental Design) Silver certification for all new construction and renovations over 500 square meters<sup>1</sup>. LID retrofits demonstrate your leadership in green infrastructure and can help you qualify for LEED credits.*

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# LID Options

This chapter provides an overview of the LID options that are best suited for Public Lands. Given the wide variety of options, selecting the ones that will best meet your needs may seem daunting. To help you identify the best option(s) for your road retrofit project, the following information is provided for each LID option:

- A brief description
- Photograph(s) of the practice implemented within a public lands setting
- A Suitability & Considerations table that provides supplementary information

With this information you should have a better idea of the LID options that meet your needs. Further guidance on screening LID practices is provided in Chapters 3-6.

## Bioretention

- Parking lot bioretention
- Bioretention in landscaped areas



page 18

## Swales

- Enhanced grass swales
- Bioswales



page 20

## Perforated pipe



page 24

## Prefabricated modules

- Precast tree planters
- Soil support systems
- Phosphorus removal media
- Proprietary stormwater treatment devices



page 25

## Landscape alternatives

- Tree clusters
- No-mow zones
- Xeriscaping
- Micro-grading
- Soil amendments



page 28

## Permeable pavement

- Pervious concrete
- Porous asphalt
- Permeable pavers



page 21

## Soakaways and infiltration chambers



page 23

## Rainwater harvesting



page 30

## Green roofs



page 31

## Pollution prevention (P2)

- Spill containment
- Material waste storage
- Protection and designation of buffer and drainage areas



page 32

For further information on the LID options, see the LID Design Guide at [bealeader.ca](http://bealeader.ca)

# Screening the Options

- LID opportunities:
  - Active use
  - Passive use
  - Pedestrian walkway
  - Internal driveway
  - Parking lot
  - Driveway
- LID suitability table
- Aerial photo with opportunities
- Print out aerial photo and follow along



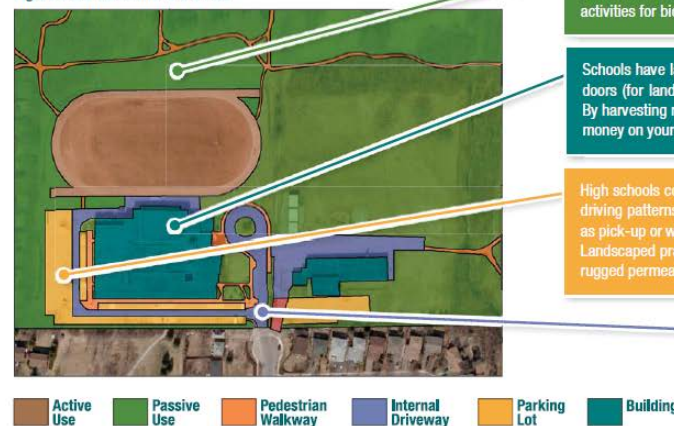
## Schools

Table 5.3.1 LID options for parks

Source area	Permeable pavement	Bioretention	Enhanced grass swales / bioswales	Green roofs	Soakaways / Infiltration chambers	Perforated pipe system	Rainwater harvesting	Landscape alternatives	Prefabricated modules	Pollution prevention
Active use area	●	●	●	○	●	○	○	○	○	○
Passive use area	○	●	○	○	●	●	○	●	●	○
Pedestrian walkway	●	●	●	○	●	○	○	○	○	○
Internal driveway	●	●	●	○	●	●	○	○	○	○
Parking lot	●	●	●	○	●	●	○	○	●	○
Building	○	○	○	●	●	○	●	○	○	○

● common option ○ possible option ○ unlikely

Figure 5.3.6: Landforms of a school



When considering installing an LID practice that requires more frequent maintenance routines, do not place them far from the school. Custodial staff can easily forget to perform maintenance activities for bioretention practices far from the building during the critical summer months.

Schools have large roof areas and use lots of water both indoors (for toilet flushing) and outdoors (for landscape irrigation). This makes schools ideal for rainwater harvesting systems. By harvesting rainwater, you will improve stormwater management on your property and save money on your water bill.

High schools commonly have lots reserved for students and those reserved for teachers; with driving patterns varying significantly between the two. Some school parking lots can be used as pick-up or waiting areas for school buses. Consider all uses before a parking lot LID retrofit. Landscaped practices like bioretention may be better for teacher and staff lots, whereas more rugged permeable pavers are better for student lots.

Consider how the site is currently being used by students, staff and teachers before choosing a LID practice. If students (or staff and teachers) use a particular area for an activity, such as smoking, then putting permeable pavers isn't recommended (the cigarette butts can get stuck between the pavers).



# Case Studies



## Municipal Facilities

### Case Study: Credit Valley Conservation Head Office

#### LID Features:

- Permeable pavers
- Rainwater harvesting
- Enhanced grass swale



Credit Valley Conservation's head office incorporates a variety of LID features to better manage stormwater on its property and reduce its potable water use.

#### How it works:

Stormwater runoff from an asphalt roadway is directed to an **enhanced grass swale**. The swale helps to slow down the flow of water and improve its quality by removing larger sediment and debris.

The building uses a **rainwater harvesting** system to collect rainwater from the roof and re-use it for toilet flushing

For more information, check out the Credit Valley Conservation Head Office Case Study in Appendix C.

and outdoor irrigation. Rainwater is stored in a large tank located in the basement of the building.



Instead of a typical asphalt parking lot, staff at CVC park on a **permeable pavers**. There are small gaps between the pavers that allow rainwater to pass through to an underground gravel storage reservoir.



Source – all photos: CVC

Prefabricated modular infiltration chambers are gaining acceptance for their easy integration with parking lot functions. These subsurface systems are typically installed over a coarse granular reservoir to provide storage and allow infiltration into native soils. Infiltration chambers under conventional asphalt system work well on sites where parking demand and other site uses do not allow space for a stormwater feature.

Permeable pavement can also be integrated in large municipal parking lots. Pervious concrete, permeable interlocking concrete pavers, and porous asphalt can detain stormwater and increase infiltration.

There are also excellent opportunities to integrate rainwater harvesting systems in many municipal facilities. Rainwater harvesting systems have two requirements: an area for catchment of relatively clean runoff, and a nearby demand for water usage. Municipal facilities often have large rooftop areas that produce relatively clean runoff. Installing a cistern either internal to the building or buried adjacent to the building can provide a sustainable source of water for site irrigation needs, including landscaped areas and recreational fields, as well as indoor use for flushing toilets and urinals.

- Mini case studies throughout document
- Full case studies in Appendix
- Link guide content to real-world applications
- Use plain language
- Colours/styles
- Visual interest
- Photos

## 7.0 Implementing LID Retrofits



Grey to Green Public Lands Retrofits

## 9.0 Sharing your Success and Next Steps



Grey to Green Public Lands Retrofits

107

## 8.0 Lifecycle Activities





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DRAFT

## Grey to Green Road Retrofits:

Optimizing your Infrastructure Assets Through  
Low Impact Development



Road Right-of-Way



## Audience

- Municipalities:
  - Councillors, commissioners, directors
  - Frontline staff: Water resources engineers
- Consultants, contractors
- Level of technical detail increases in later chapters
- Much greater technical detail in later chapters than Public Lands guide



# Road Right of Way Guide

- Chapter 1 - The Business Case for Grey to Green Road Retrofits
- Chapter 2 – LID Options for Road ROWs
- Chapter 3 – Building the Project Team & Consulting the Public
- Chapter 4 – Screening the LID Options
- Chapter 5 – Pre-design
- Chapter 6 – Detailed Design
- Chapter 7 – Approvals
- Chapter 8 – Tender and Contract Documents
- Chapter 9 – Construction Supervision and Administration
- Chapter 10 – Lifecycle Activities
- Chapter 11 –Next Steps & Additional Resources

**Technical  
Detail**



# Business Case

## 1.0 The Business Case for Grey to Green Road Retrofits



The Dixie Road underpass in Mississauga, Ontario, was one of many infrastructure assets damaged following the July 8, 2013 storm event. (Source: Fred Loek, Mississauga News)

- Speak the language of commissioners, roads staff
- Consistent with Ministry of Infrastructure's Building Together: Guide for Municipal Asset Management Plans
- Provides overview of all relevant direct and indirect costs & benefits associated with LID

# LID Options for Road ROWs – Permeable Pavement

## Permeable Pavement

### Permeable Pavers

Permeable pavers have expanded joints that are 5-10% of the paved surface area and filled with a porous aggregate material. As with porous asphalt and pervious concrete, a crushed stone aggregate bedding supports the pavers and provides storage for stormwater retention, infiltration, and treatment.

An advantage of pavers is the improved aesthetics made possible by varying colour and pattern. Among other uses, they can help differentiate parking lanes from the travel portion of the roadway and highlight pedestrian crossings.

When considering retrofitting with permeable pavement, it is important to examine current use of the prospective site. For instance, use of pavers in a designated or informal smoking area can result in reduced aesthetics from cigarette butts accumulating in paver joints. In this instance, it's good to have a plan for regular cleaning and maintenance.

Suitability	
● High density	
● Medium density	
● Low density	
○ Low Suitability ● Moderate ● High	
Municipal Staff & Financial Considerations	
○ Community engagement	
○ Inter-departmental co-ordination	
○ Design team	
● Capital cost	
○ Operation & maintenance costs	
○ Low Effort/Cost ● Moderate ● High	
Design Considerations	
● Geotechnical testing complexity	
● Infiltration testing complexity	
○ Planning complexity	
○ Design complexity	
○ Low Effort ● Moderate ● High	
Benefits	
○ Flood risk reduction (water quantity)*	
○ Pollutant removal (water quality)	
○ Groundwater recharge (water balance)*	
● Stream channel erosion control	
○ Amenity & aesthetic value	
○ Traffic calming	
○ Urban tree canopy	
○ High profile with community & media	
○ Low Benefits ● Moderate ● High	

\*Performance will vary based upon site characteristics and design of LID practice.

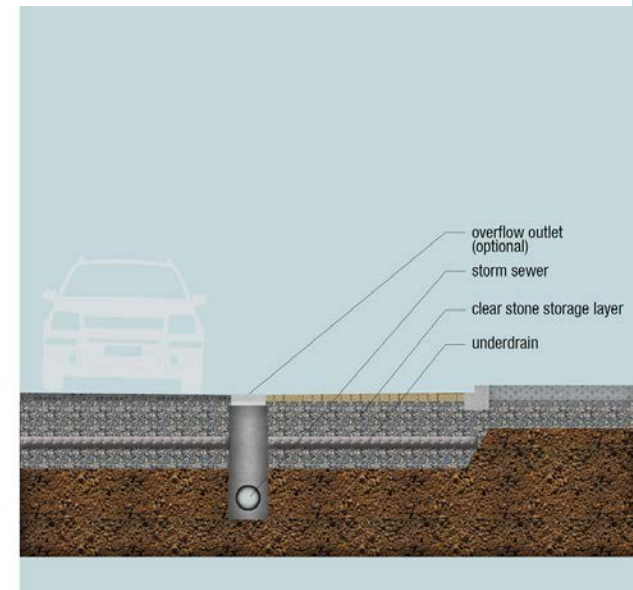
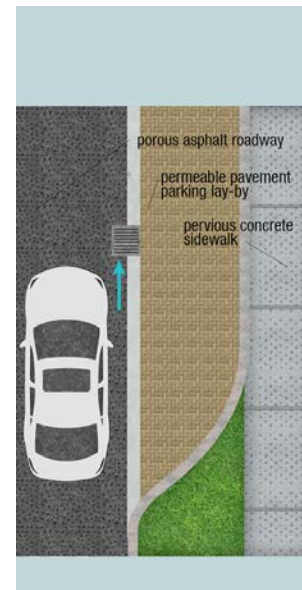
### Examples



**Figure 2.4.4:** Permeable pavers can be used to create visual interest within the ROW. On Elm Drive, located in Mississauga, permeable pavers with different shapes and colours were used for parking lay-bys and the sidewalk. (Source: CVC)



**Figure 2.4.5:** Permeable pavers can be used in a curb-to-curb application, as shown in this example from Warrenville, IL. Using pavers within the road or along the parking lanes helps with traffic calming. (Source: ICPI)



Use two-page spreads to convey information more concisely – i.e., information, LEFT, graphic RIGHT

# Screening the LID Options

- Screening a major focus of the guide
- Background review, field reconnaissance
- Screening varies based on:
  - Type of road construction:
    - Resurfacing
    - Reconstruction
    - Road improvement
    - Roadway reduction
  - Six road types, including:
    - Local residential road
    - Industrial collector road
    - Major arterial road



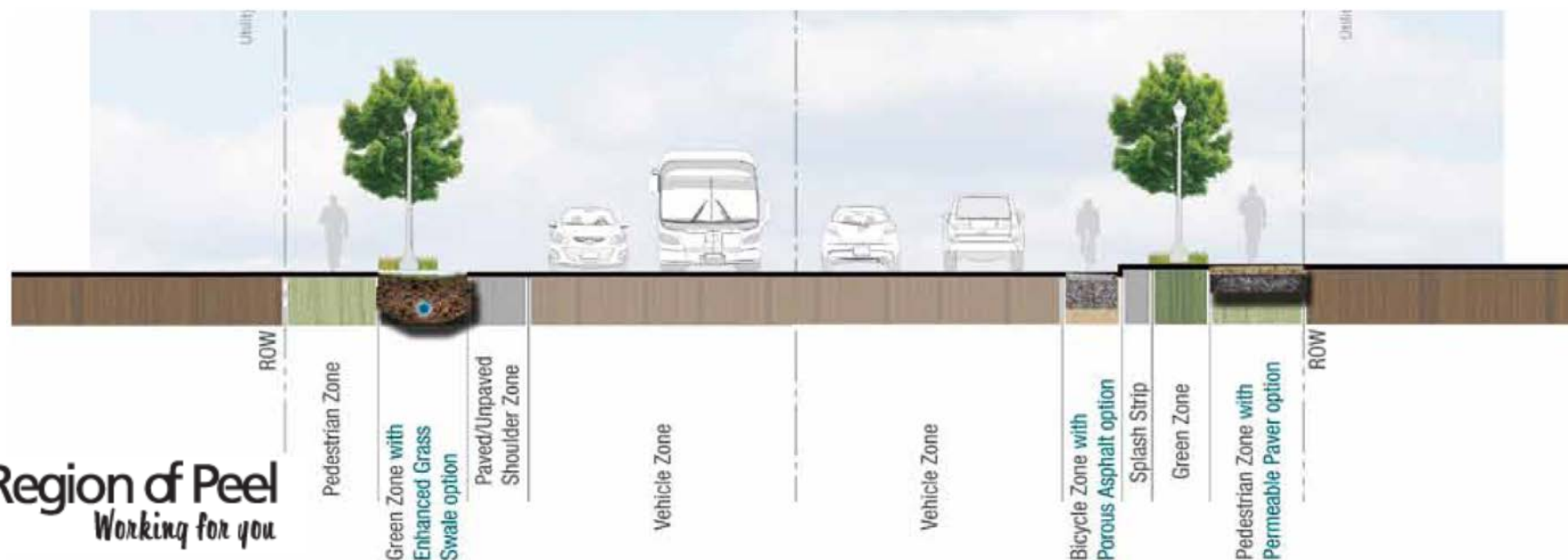


# Screening – Residential collector road

**Table 4.3.5:** LID options for the residential collector road

ROW Construction Type	Bioretention Planter	Curb Extension	Boulevard Bioretention	Bioswale	Enhanced Grass Swales	Perforated Pipe	Permeable Pavement (sidewalk)	Prefabricated Modules
Rural Resurfacing	○	○	●	●	●	○	○	○
Rural Reconstruction	○	○	●	●	●	○	○	○
Rural to Urban Reconstruction	○	○	●	●	○	●	●	○
Urban Resurfacing	○	○	●	○	○	○	●	○
Urban Reconstruction	○	○	●	○	○	●	●	○
Urban Reduction	○	○	●	○	○	●	○	○

○ Unlikely Option    ○ Possible Option    ● Common Option





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# Pre-design & Detailed Design

- Pre-design:
  - Utility locates, geotechnical investigation, topographic survey
- Detailed design process:
  - **Step 1:** Review design guidelines and requirements
  - **Step 2:** Catchment area development
  - **Step 3:** Hydrologic and hydraulic assessments
  - **Step 4:** Design optimization
  - **Step 5:** Design drawing and brief development







**Figure 9.2.9:** At the Lakeview Project a gas line was found to span the bioswale trench. Moving the gas line was not an option. An adaptive approach using avoidance was determined to be the best course of action.

(Source: Aquafor Beech)



**Figure 9.2.10:** The above photo shows how the perforated pipe was installed around the exposed gas line at the Lakeview Project. A notch was cut in the perforated pipe and fit into place below the gas line. (Source: Aquafor Beech)



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## Construction Supervision & Administration

- Stresses importance of construction to ensuring proper performance
- Product QA/QC – Bioretention media!
- Strategies for dealing with utilities
- Erosion and sediment control
- For more info on LID construction:
  - CVC LID Construction Guide is available at [bealeader.ca](http://bealeader.ca)

# Draft Guides Available

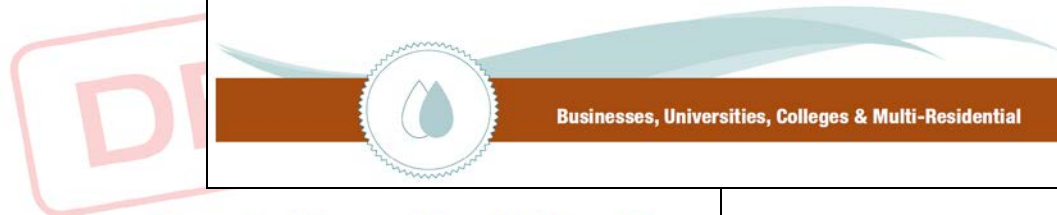
## Grey to Green Public Lands Retrofits:

Optimizing Parks, Public Buildings, Schools and Places of Worship through Low Impact Development



## Grey to Green Business & Multi-Residential Retrofits:

Optimizing your Bottom-line Through Low Impact Development



## Grey to Green Road Retrofits:

Optimizing your Infrastructure Assets Through Low Impact Development



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# Coming soon, thanks & keep in touch!

[bealeader.ca/LIDCaseStudies](http://bealeader.ca/LIDCaseStudies)

## Draft April

### Grey to Green Residential Retrofits:

Engaging Residents to adopt Low Impact Development on their Properties



Residential

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## Draft June

### Grey to Green Municipal Retrofits:

Guide to Optimizing Infrastructure Assets and Reducing Risk  
Through Low Impact Development



A How-To Guide