

# SANDFORD FLEMING FORUM

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## Flood Risk



UNIVERSITY OF TORONTO  
FACULTY OF APPLIED SCIENCE & ENGINEERING



**Credit Valley  
Conservation**  
inspired by nature

**Smart Blue Roof Systems:  
An Innovative Approach for  
Flood and Drought Resilience and Adaptation**

**Sandford Fleming Forum  
May 9<sup>th</sup>, 2019**

**Presented by Bernadeta Surowiec**



# Land Limitations

- Urban areas have limited land availability
  - Difficult to implement land-based stormwater practices  
ie. stormwater ponds, bioretention and vegetative swales
- Building-integrated stormwater management solutions more viable in certain dense urban areas
  - Blue roofs, green roofs, rainwater harvesting etc.



# Next Level Stormwater Management



Industrial



Commercial



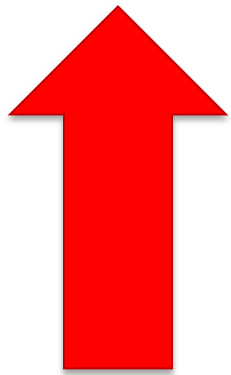
Institutional



Parking lots



Rooftops



**IMPERVIOUSNESS**





# Retrofitting Urban Areas with End of Pipe SWM Facilities



- 1. Capital costs (construction, land acquisition etc.)
  - 2. Ongoing O&M costs (dredging, thermal mitigation etc.)
- ↳ **costs falling on municipalities**

**AN INTEGRATED APPROACH IS NECESSARY**

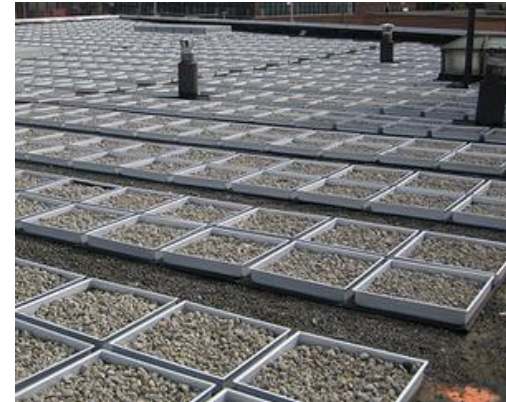
# The Evolution of Rooftop Stormwater Management



Conventional Flat Roof



Green Roof

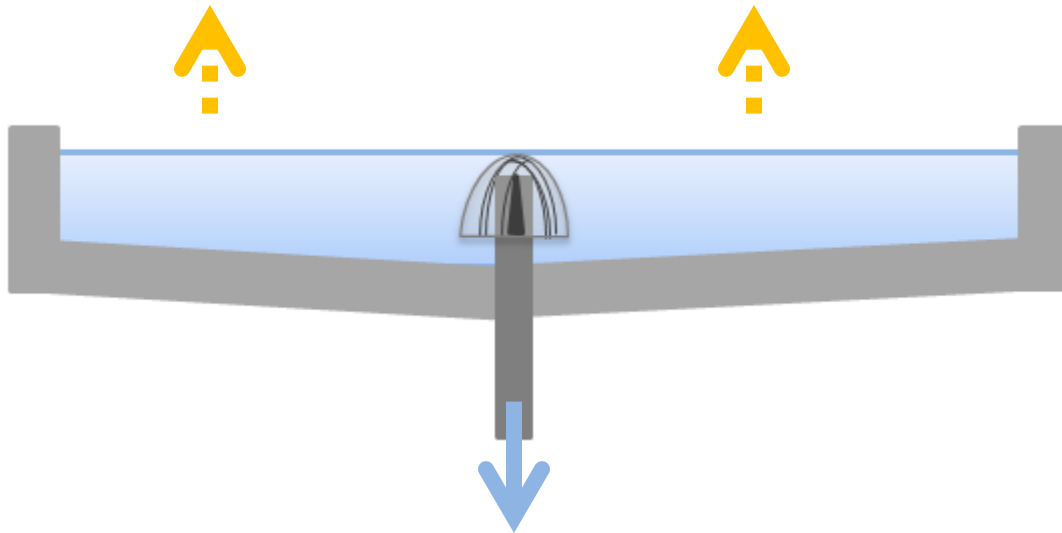


Blue Roof



## Defining Blue Roofs

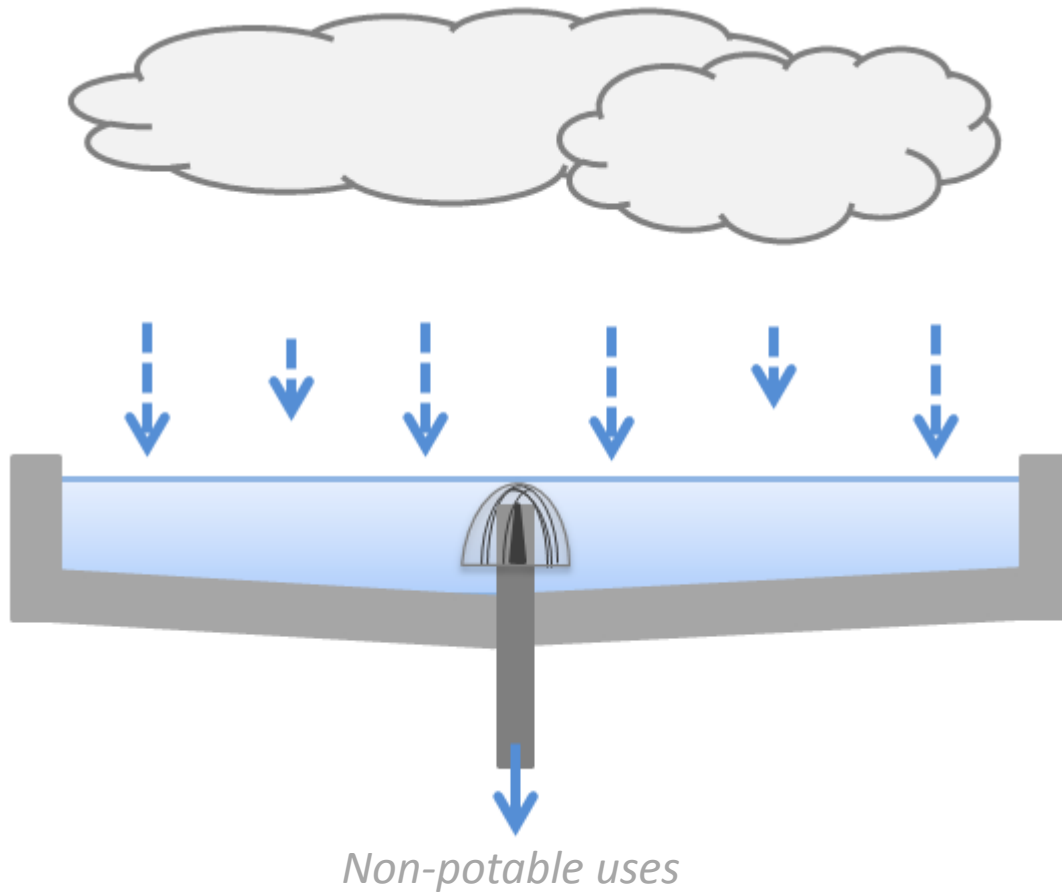
- Temporary detention of rainwater on flat, low-sloped roofs
  - System stores and slowly releases stormwater





# Blue Roofs Improve Resiliency Against...

## 1. Flood Conditions

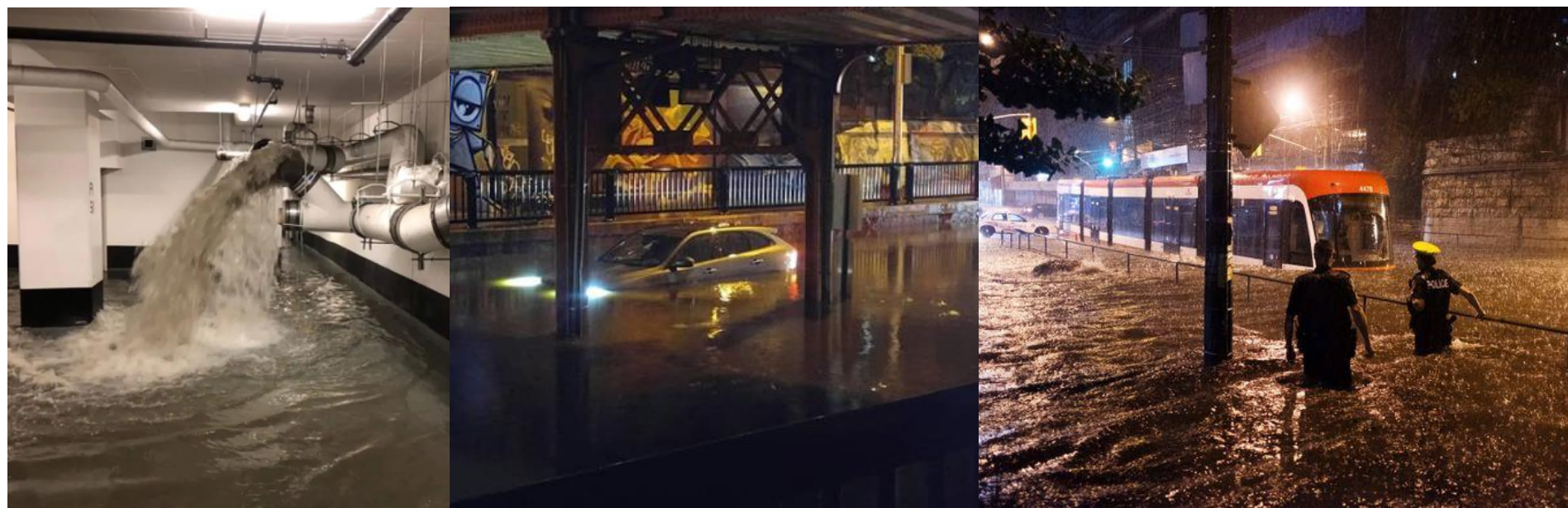


# August rainstorm caused \$80M in damage, Insurance Bureau says



Severe weather events have caused nearly \$1B in damage so far this year in Ontario

CBC News - Posted: Sep 07, 2018 3:00 PM ET | Last Updated: September 7, 2018



## Flooding from storm turns Toronto streets into rivers

BY NEWS STAFF

POSTED AUG 7, 2018 10:13 PM EST LAST UPDATED AUG 8, 2018 AT 11:41 AM EST



# Severe Weather Causes \$1.9 Billion in Insured Damage in 2018

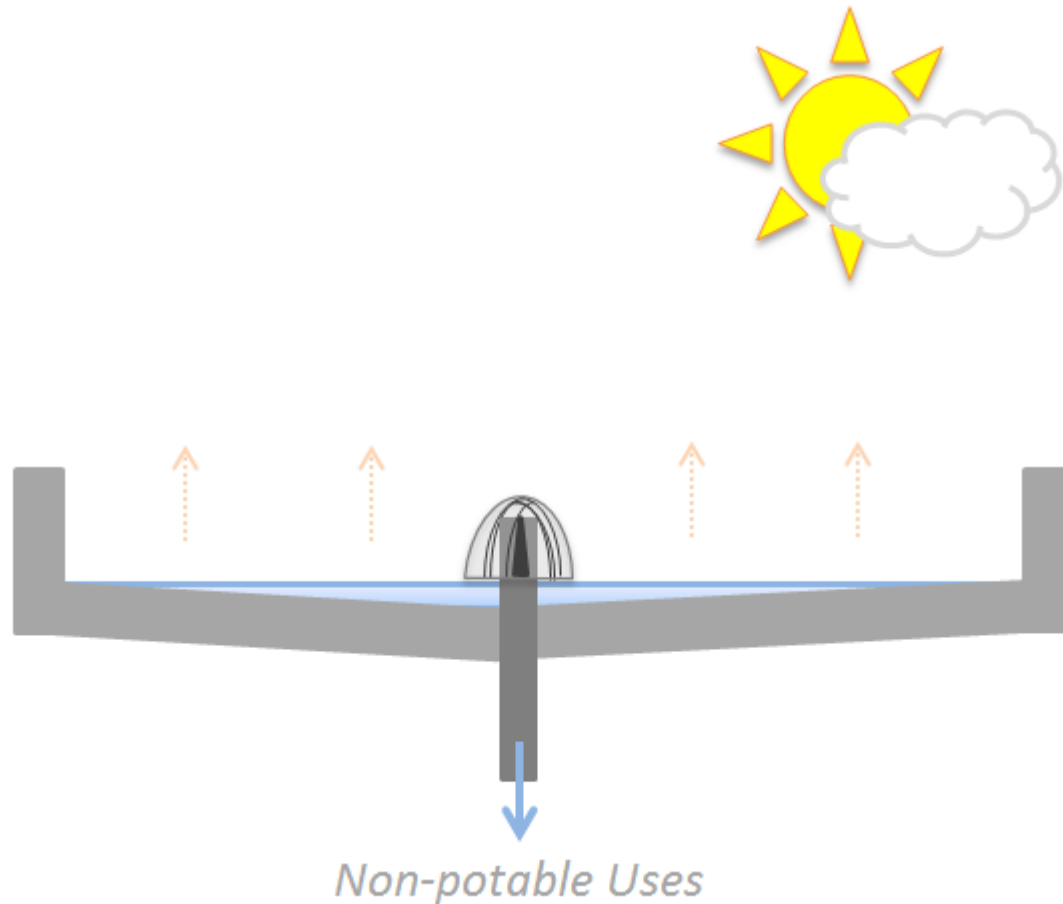
**January 16, 2019 (OTTAWA)** – Severe weather across Canada continues to highlight the financial costs of climate change to insurers and taxpayers. In 2018, insured damage for severe weather events across Canada reached \$1.9 billion, according to Catastrophe Indices and Quantification Inc.

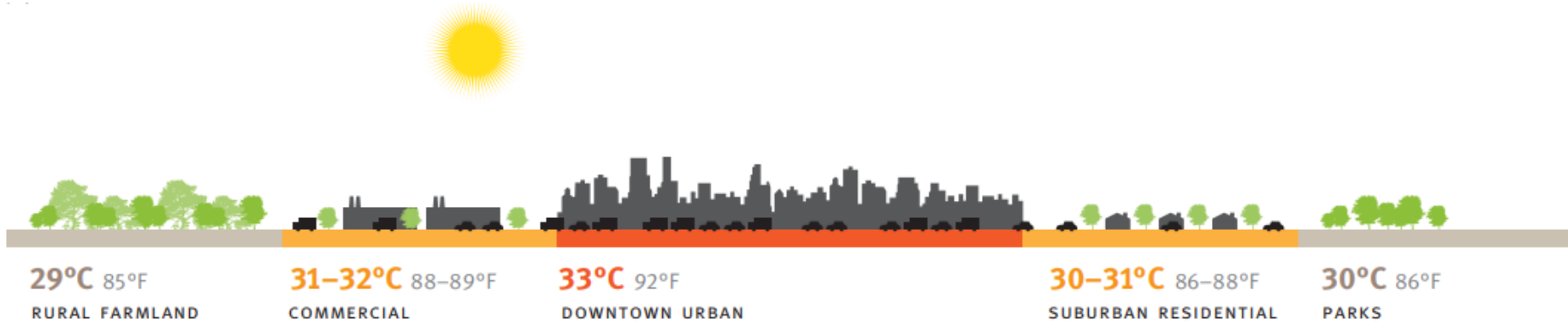
Ice storms, floods, windstorms and tornadoes, did damage to homes, vehicles and commercial properties across the country.

Notably, 2018 has the fourth-highest amount of losses on record. However, unlike the Quebec ice storm in 1998, the Calgary floods in 2013 or the Fort McMurray wildfire in 2016, no single event caused the high amount paid out for losses. Instead, Canadians and their insurers experienced significant losses from a host of smaller severe weather events from coast to coast.

# Blue Roofs Improve Resiliency Against...

## 2. Drought Conditions





- In 2016, there were 56 days in Mississauga with temperatures recorded above 30°C
- In 2017, the hottest day of the year in Mississauga was recorded at 37.9°C on September 24<sup>th</sup>







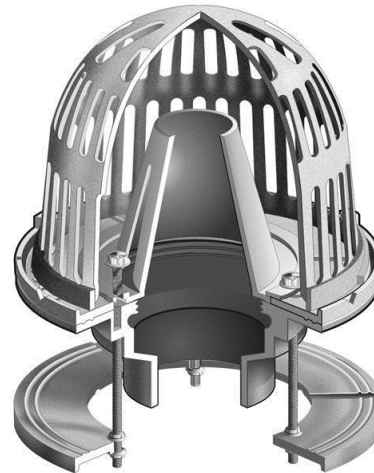
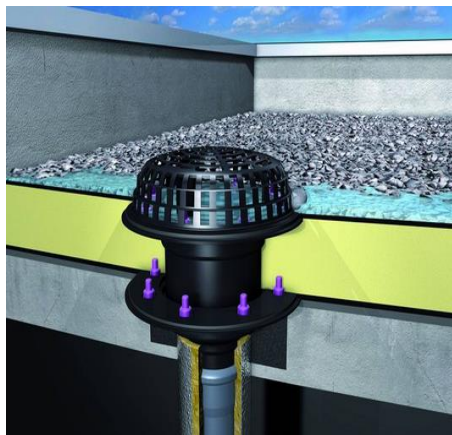
**STORMWATER AS AN ASSET  
RATHER THAN A LIABILITY**

# Setting Precedence for Blue Roofs

## Green Roofs



## Flow Control Roof Drains



- ✓ Structural Capacity
- ✓ Waterproofing
- ✓ Building & Plumbing Code acceptance



# Active vs. Passive Blue Roofs

## Active

- Valve configuration and controller used to regulate roof discharge
- Controller programmed to optimize release of ponded water
- “Smart” system approach



## Passive

- Use of stagnant hydraulic structures such as weirs, drains, orifice plates to regulate the release of rainwater from a rooftop





Infrastructure  
Canada

Canada

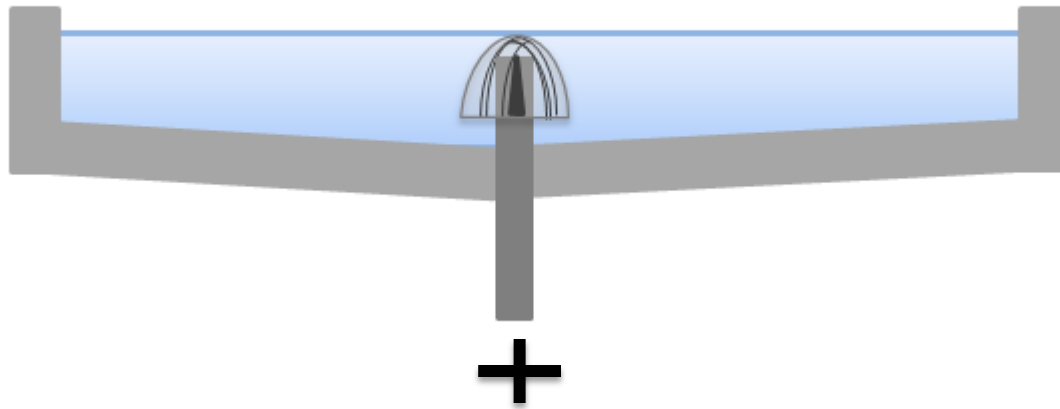


# SMART CITIES CHALLENGE

#smartcitiesCanada

# Coupling with Smart Blue Roof Systems

*Smart Blue Roof*



*Rainwater Harvesting Tank*



*Enhanced Grass Swale*



*Subsurface Chambers*



# **Smart Blue Roof Technical and Financial Feasibility**





# Project Support



FEDERATION  
OF CANADIAN  
MUNICIPALITIES

FÉDÉRATION  
CANADIENNE DES  
MUNICIPALITÉS



# Project Team



**Credit Valley  
Conservation**  
inspired by nature

**Ryerson  
University**

**Ryerson  
Urban Water**



**Enviro-Stewards**  
Engineers & Scientists



# CVC Head Office





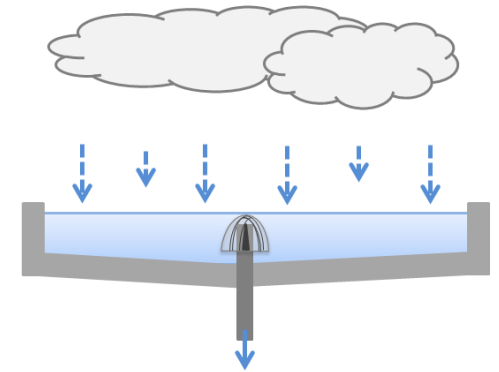
# Smart Blue Roofs...



- ✓ Optimized system
  - ✓ Stormwater management
  - ✓ Water Efficiency
  - ✓ Energy Efficiency
- ✓ Benefits individual buildings, municipalities and the community

# Technical Feasibility Stormwater Management

- Roof structural capacity equivalent to 180 mm ponding depth
- Blue roof storage volume 16 m<sup>3</sup> + rainwater harvesting tank 5 m<sup>3</sup>
  - Total storage for the entire system is **21 m<sup>3</sup>**
- Smart blue roofs provide:
  - Peak flow control
  - Runoff mitigation



*(100-year Mississauga design storm event captured by system)*

# Technical Feasibility

## Water Reuse

- Current average non-potable water demand **1.58 m<sup>3</sup>/day**
- Current average potable and non-potable water demand **5.68 m<sup>3</sup>/day**

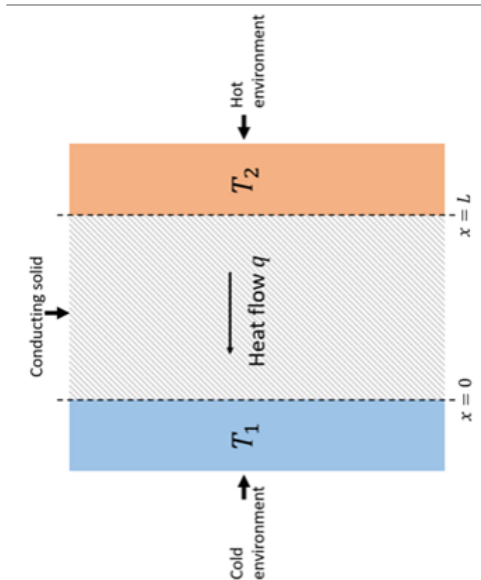


- Smart blue roof with rainwater harvesting system can meet water demands of **8.84 m<sup>3</sup>/day**  
*(if rainwater was stored on roof for a maximum of three days)*
- Opportunity to expand non-potable uses at CVC office  
(ie. irrigation)



# Technical Feasibility

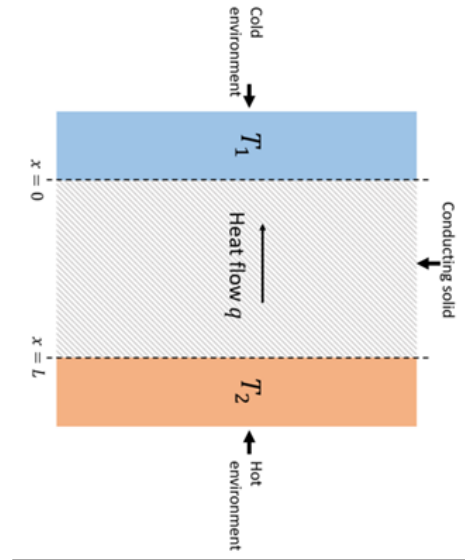
## Evaporative Cooling



**CVC Office Without Smart Blue Roof**

Heat flows into ceiling through roof from liner

21.3 GJ of heat is added onto the HVAC system load



**CVC Office With Smart Blue Roof**




Heat flows from ceiling through roof into water

13.3 GJ of heat is removed from the load on the HVAC system

**0.56 kg/y/m<sup>2</sup> GHG Reduction**

# Financial Feasibility

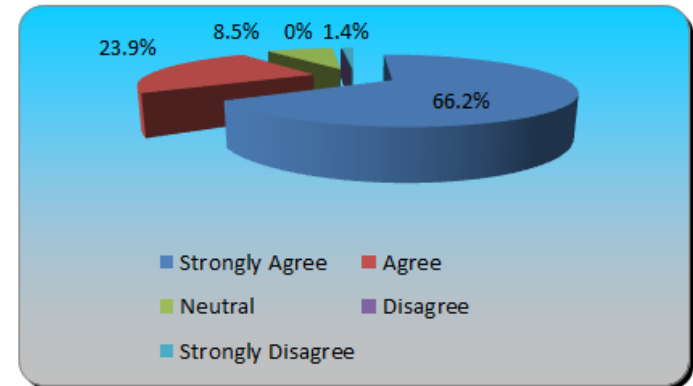
## Economies of Scale

Benefits, Savings & Costs	<p><b>CVC Head Office</b></p> 			<p><b>Street Scale</b></p> 			<p><b>Neighbourhood Scale</b></p> 		
	<b>BENEFITS</b>								
	Annual Stormwater Benefits & Savings to Landowner								
	Annual Stormwater Benefits & Savings to Municipality								
	Annual Water Purchasing Cost Savings								
	Annual Energy Savings								
	Total Annual Cost Savings								
	<b>COSTS</b>								
	Total Retrofit Cost								
	Annual Operation & Maintenance Costs								
Total Costs									
<b>Cost/Benefit</b>	<b>Poor</b>			<b>Moderate</b>			<b>Best</b>		

# Smart Blue Roof GTA Interest

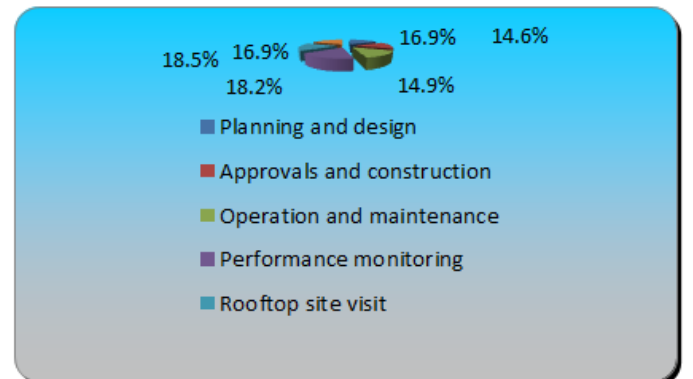
22.) I see value in building a smart blue roof demonstration/pilot project at the CVC head office in Mississauga? (multiple choice)

	Responses	
Strongly Agree	47	66.20%
Agree	17	23.94%
Neutral	6	8.45%
Disagree	0	0%
Strongly Disagree	1	1.41%
<b>Totals</b>	<b>71</b>	<b>100%</b>

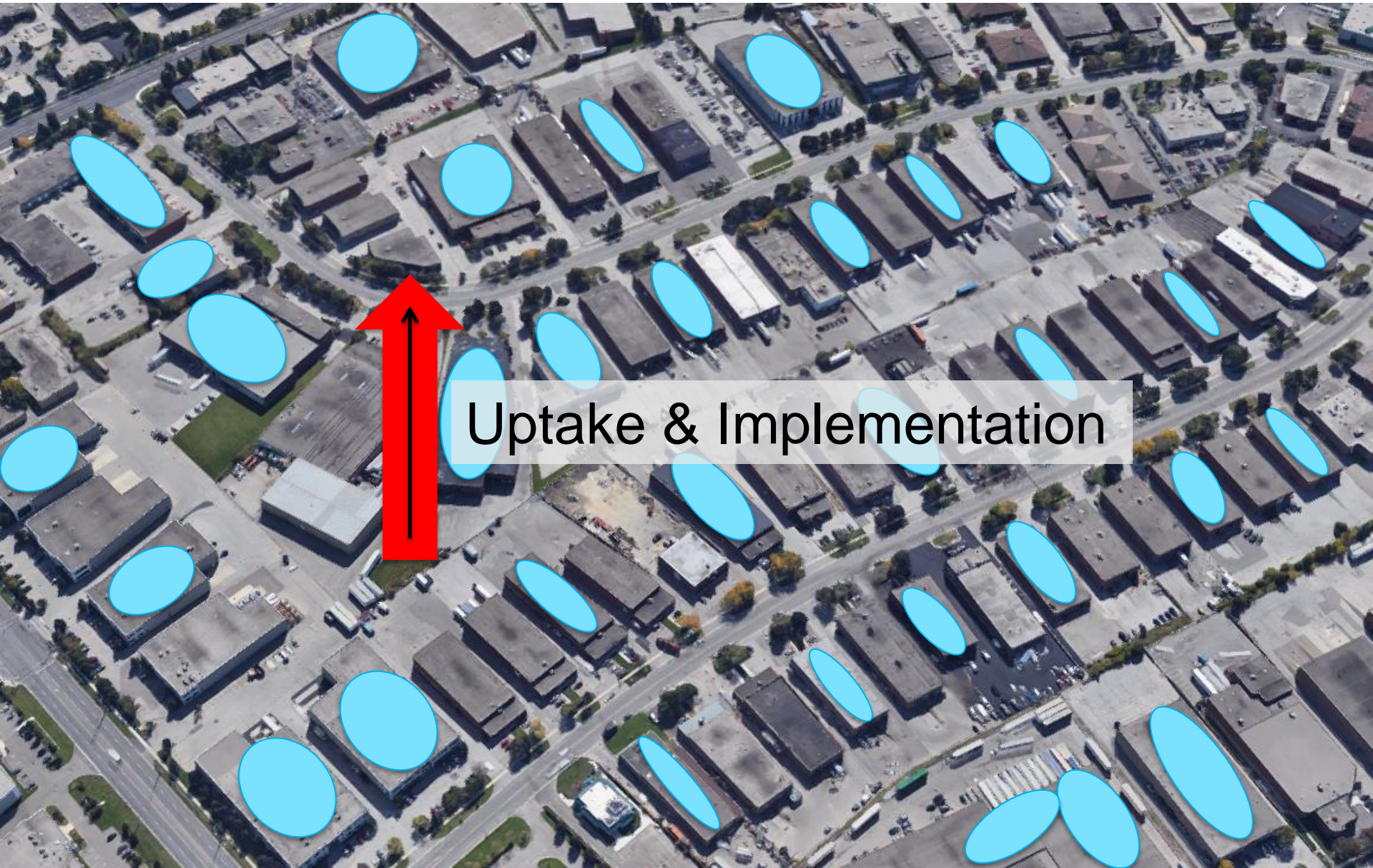


23.) Should Credit Valley Conservation implement a pilot smart blue roof at their head office I would be most interested in the following: Select all that apply (multiple choice)

	Responses	
Planning and design	52	16.88%
Approvals and construction	45	14.61%
Operation and maintenance	46	14.94%
Performance monitoring	56	18.18%
Rooftop site visit	52	16.88%
Lessons learned	57	18.51%
<b>Totals</b>	<b>308</b>	<b>100%</b>







Uptake & Implementation

**inspired by nature**

