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

Sandford Fleming Forum
May 9th, 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

Non-potable uses
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

*Non-potable Uses*
• 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 24th
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
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

FCM
FEDERATION OF CANADIAN MUNICIPALITIES
FÉDÉRATION CANADIENNE DES MUNICIPALITÉS

Region of Peel
Working for you

GTAA
PARTNERS IN PROJECT GREEN

Sustainable Technologies
EVALUATION PROGRAM

MISSISSAUGA
Project Team
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$^3$ + rainwater harvesting tank 5 m$^3$
  - Total storage for the entire system is 21 m$^3$

• 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 \(1.58 \text{ m}^3/\text{day}\)
• Current average potable and non-potable water demand \(5.68 \text{ m}^3/\text{day}\)

• Smart blue roof with rainwater harvesting system can meet water demands of \(8.84 \text{ m}^3/\text{day}\)
  
  *(if rainwater was stored on roof for a maximum of three days)*

• Opportunity to expand non-potable uses at CVC office
  
  *(i.e. 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/m² GHG Reduction
# Financial Feasibility

## Economies of Scale

<table>
<thead>
<tr>
<th>Benefits, Savings &amp; Costs</th>
<th>CVC Head Office</th>
<th>Street Scale</th>
<th>Neighbourhood Scale</th>
</tr>
</thead>
</table>

### BEHAVIOUR
- Annual Stormwater Benefits & Savings to Landowner
- Annual Stormwater Benefits & Savings to Municipality
- Annual Water Purchasing Cost Savings
- Annual Energy Savings
- Total Annual Cost Savings

### COSTS
- Total Retrofit Cost
- Annual Operation & Maintenance Costs
- Total Costs

<table>
<thead>
<tr>
<th>Cost/Benefit</th>
<th>Poor</th>
<th>Moderate</th>
<th>Best</th>
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22.) I see value in building a smart blue roof demonstration/pilot project at the CVC head office in Mississauga? (multiple choice)

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<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Totals</th>
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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)

<table>
<thead>
<tr>
<th>Planning and design</th>
<th>Approvals and construction</th>
<th>Operation and maintenance</th>
<th>Performance monitoring</th>
<th>Rooftop site visit</th>
<th>Lessons learned</th>
<th>Totals</th>
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Uptake & Implementation
inspired by nature