Next Level™
STORMWATER MANAGEMENT

Engineering Vegetated Roof Systems to Optimize Stormwater Management Webinar (1 hr)

Learning Objectives

1. The distinction between stormwater retention and detention
2. The importance of detention in urban centres
3. Existing roof top technologies
4. Using biomimicry to re-engineer vegetated roofing system
5. Collaboration: Landscape Architects, Architects, Civil Engineers

STEP Webinar Series 2022-03-24

Why is stormwater management (SWM) important?

Green roof overview

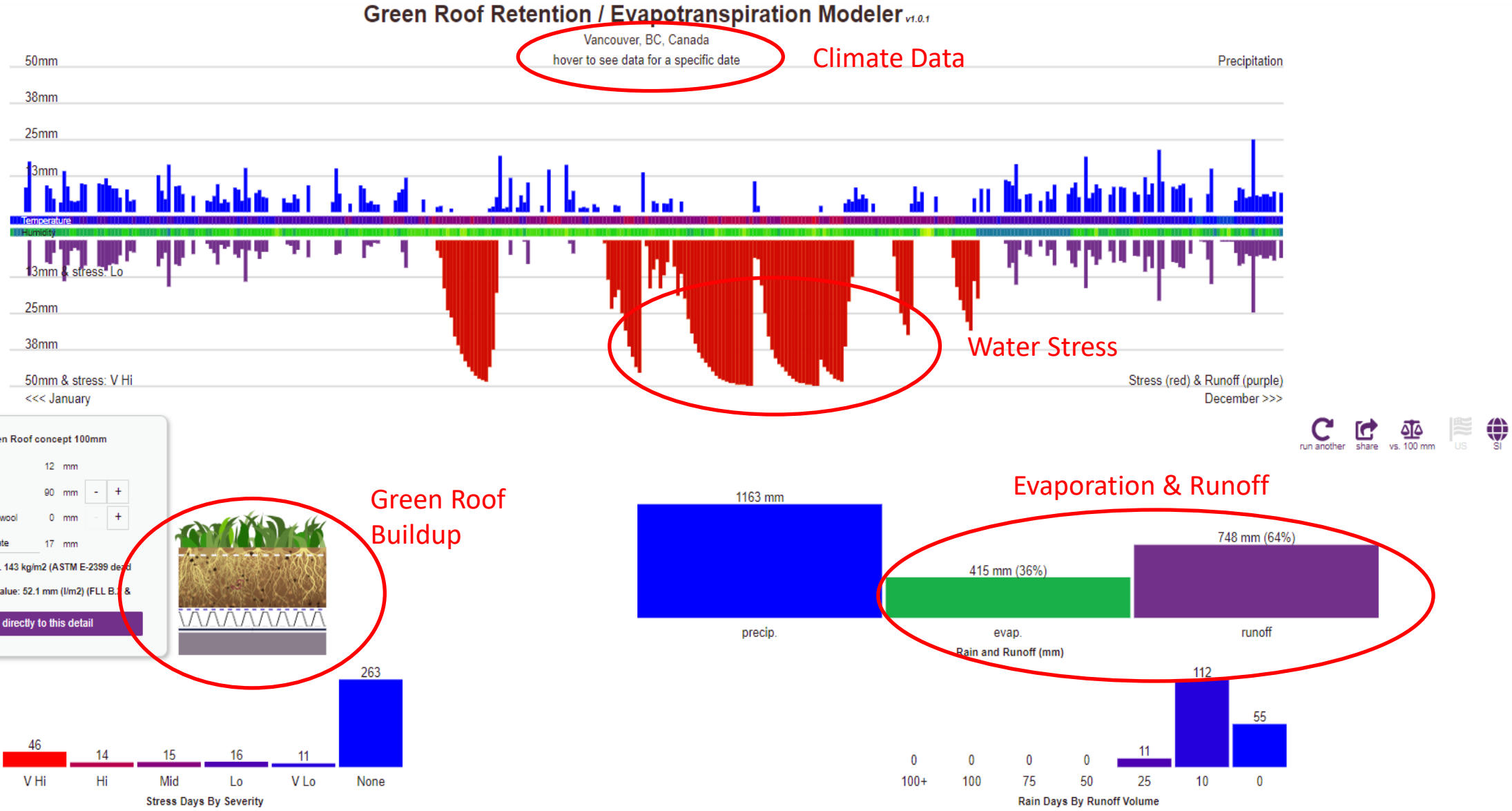
Green Roof's SWM abilities:

- Retention: Rain volume reduction
- Detention: Peak flow delay & reduction

Recap

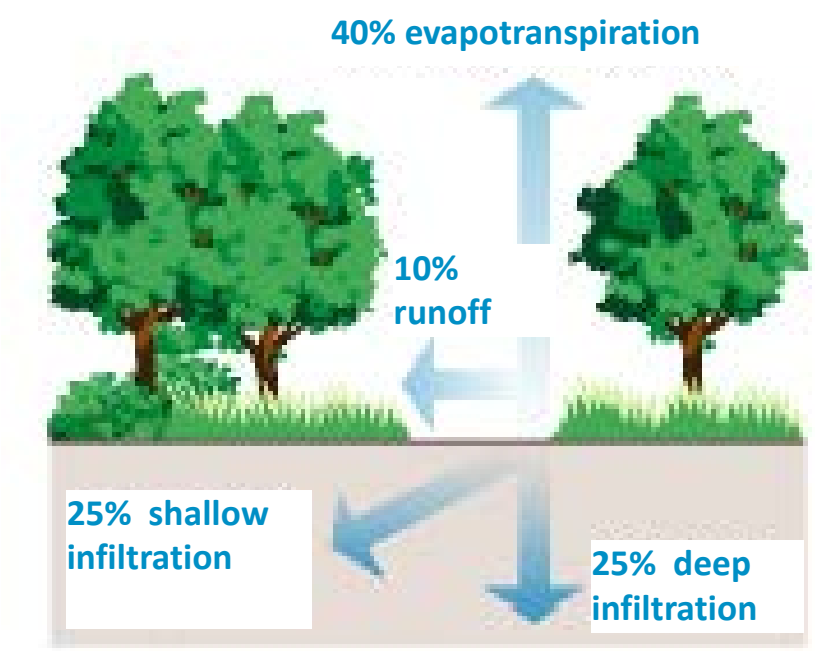
Alvin Curling Public School, Scarborough, ON

https://www.purple-roof.com/model

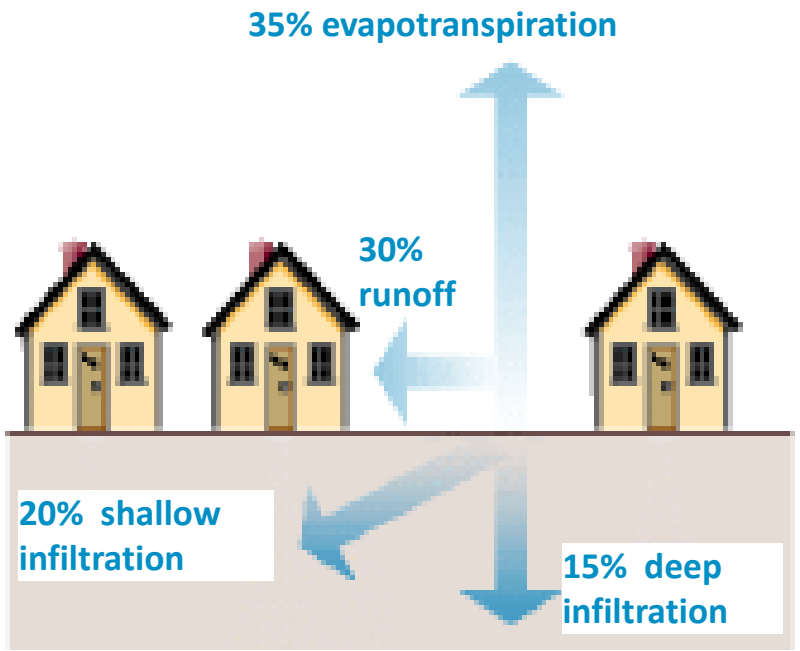


Urban stormwater challenges

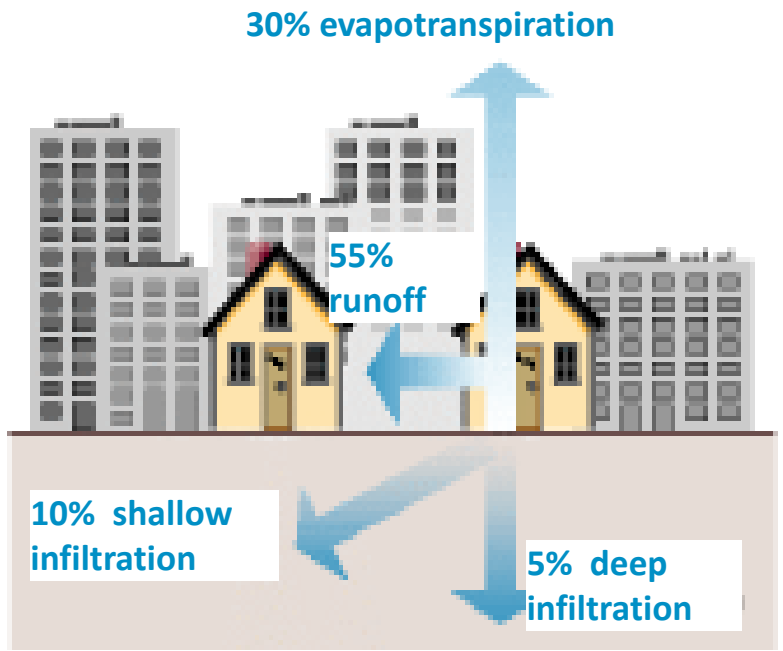
Urban stormwater challenge: Imperviousness



Rural - Natural Ground Cover

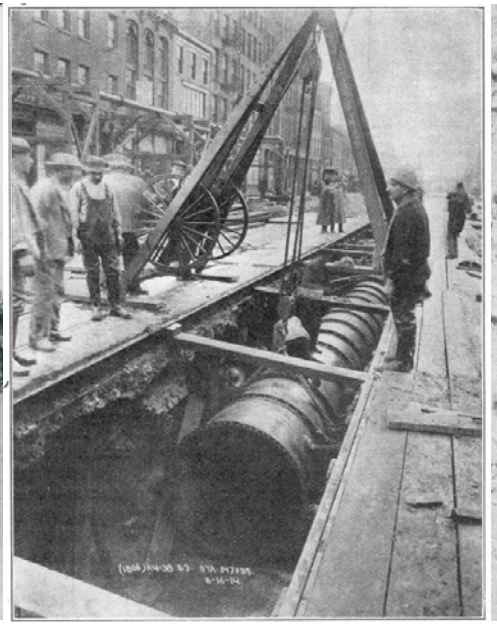


Suburban - 35-50% Impervious Surface

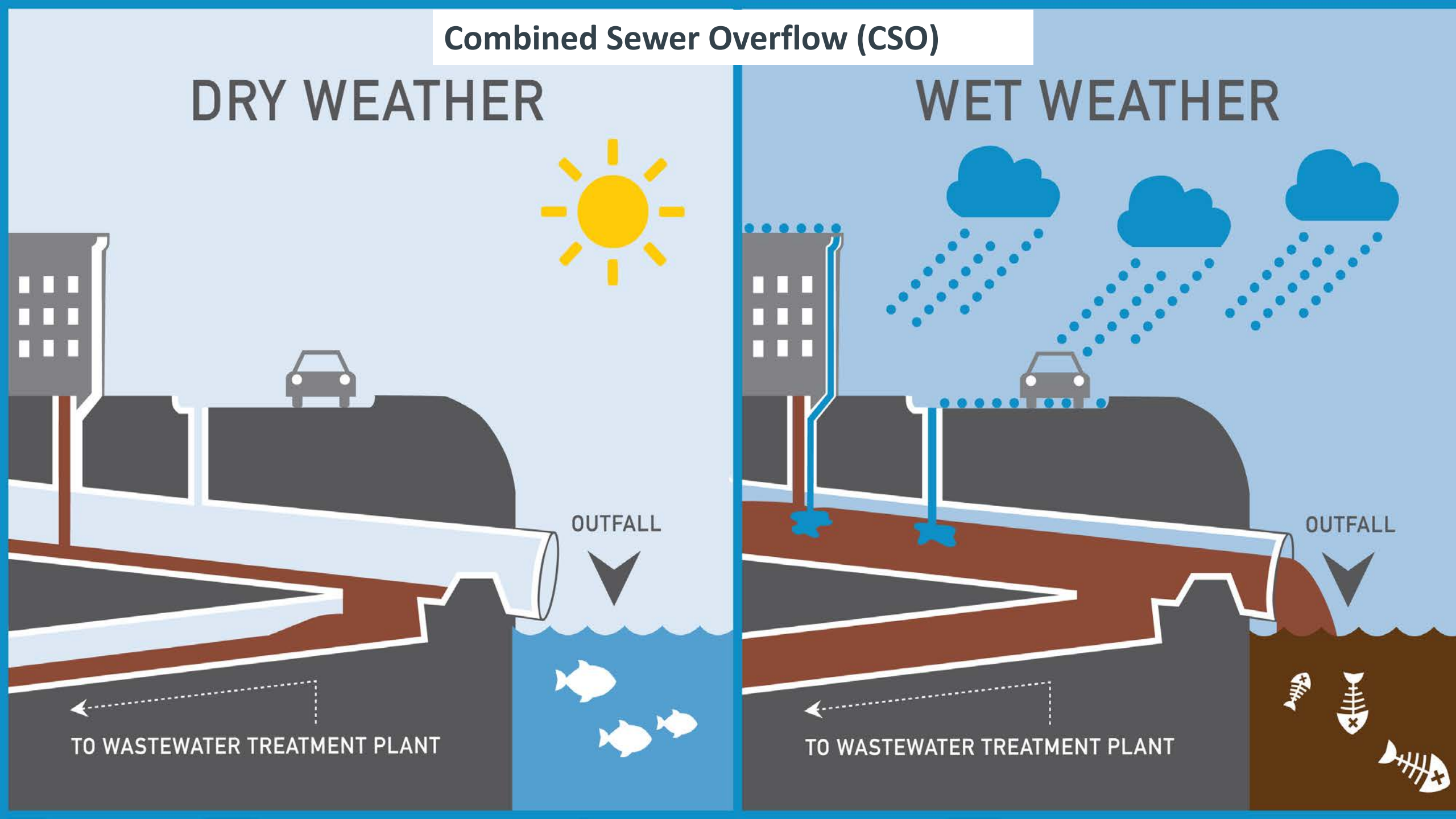


Urban 75 - 100% Impervious Surface

Urban stormwater challenge:
Aging infrastructure



Combined Sewer Overflow (CSO)



Stormwater charges
Property taxes → water bill

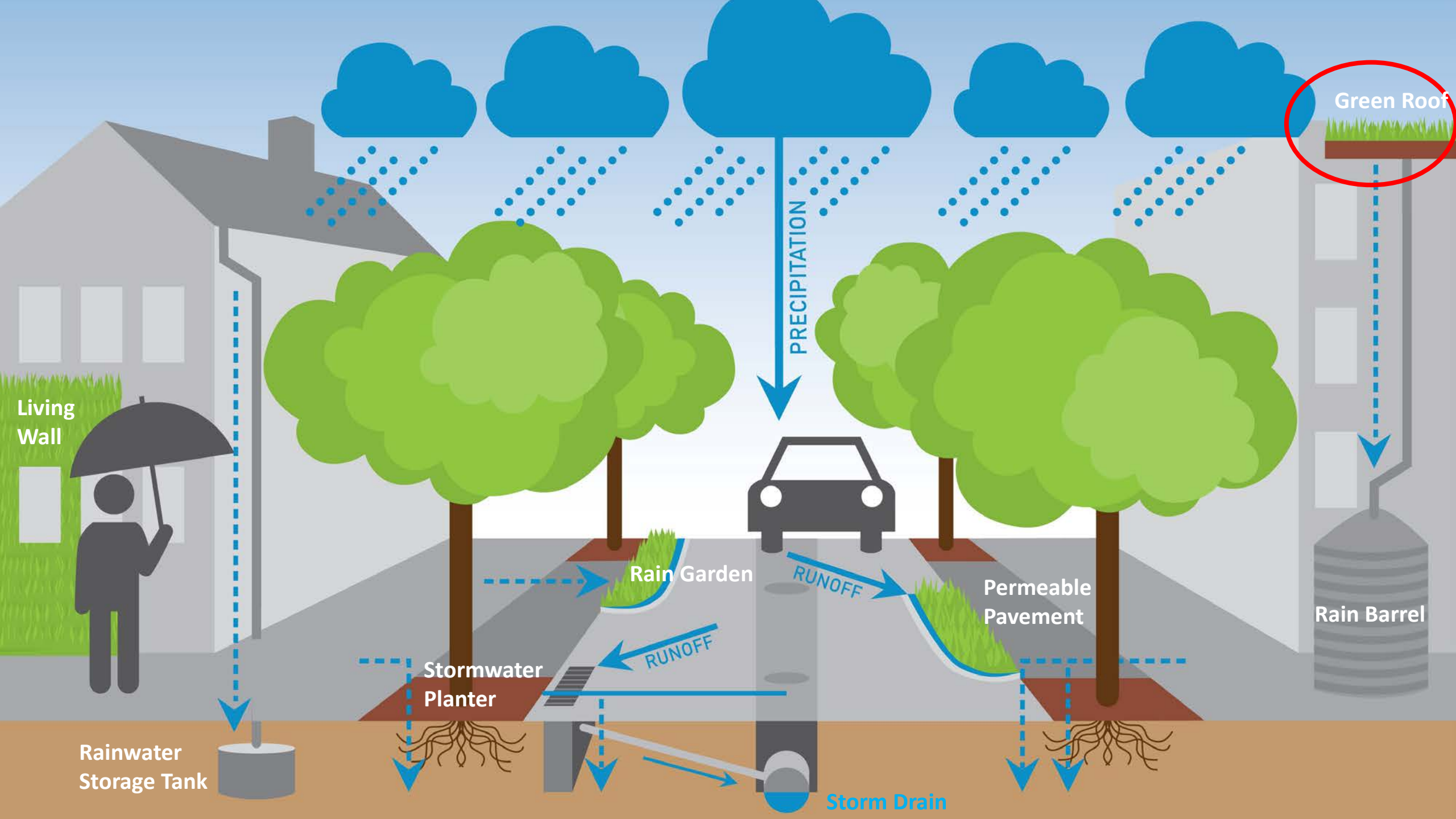
Mississauga: (2016) Single family: Five tiers of billing units based on roof area. Stormwater rate ($108.20) x stormwater billing units. Multi-residential and non-residential: hard surface individually assessed.

Brampton: (2020) Single family: Five tiers of fees based on roof areas ($45-160). Multi-family and non-residential: hard surface measured directly. $89.00 x every 234 m^2 of hard surface.

Newmarket: (2017) Size of the property ($m^{2)}$ x runoff level group rate ($0.016 - $0.082).

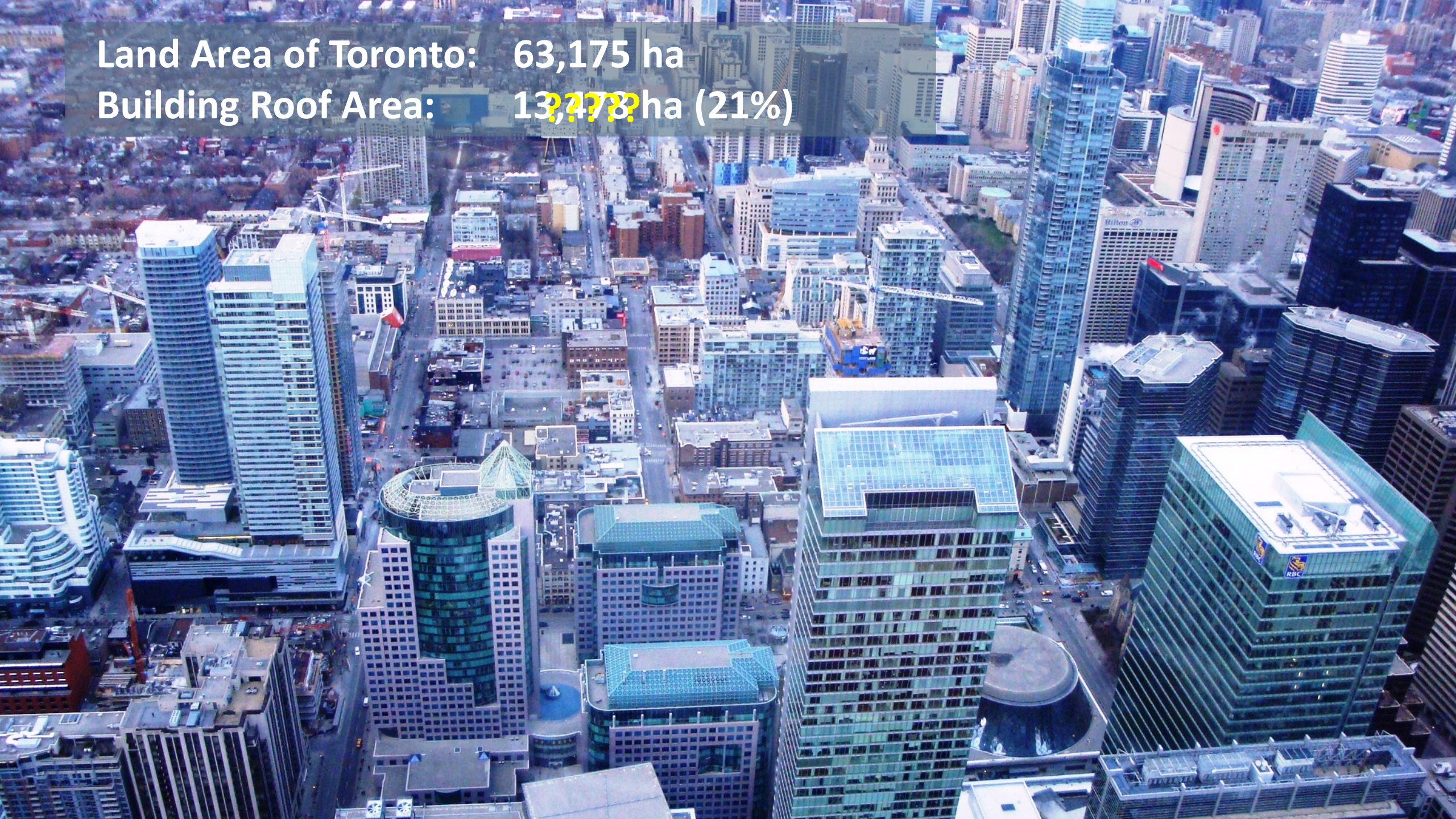
Aurora: (1998) Tiered flat rates. Residential: $5.44/month. Non-residential: $69.0/month Expected to double in next 10 years.

Toronto: None currently, however a charge for parking lot owners is being considered.


Green Roof
PRECIPITATION
Living Wall
Rain Garden
RUNOFF
Permeable Pavement
Rain Barrel
RUNOFF
Stormwater Planter
Rainwater Storage Tank
Storm Drain

Why Vegetated Roofs?

1. Manage rain where it falls (source control)
2. Rooftop are untapped real estate


Land Area of Toronto: 63,175 ha
Building Roof Area: 13,???? ha (21%)

Storm Water Management benefits:

1. Runoff volume reduction
2. Peak flow delay & reduction

Additional environmental benefits

- Reduce energy demand
- Mitigate urban heat island
- Extend roof membrane life
- Improve air quality
- Enhance biodiversity
- Amenity space

Why is stormwater management (SWM) important?

Green roof overview

Green Roof's SWM abilities:

- Retention: Rain volume reduction
- Detention: Peak flow delay & reduction

Recap

Broadway Tech Centre, Vancouver, BC

Vegetated Roof

0 | 7.5 cm | 15 cm | 20 cm

Growing medium depth (3”) (6”) (8”)

50 kg/m² (10 psf) | 100 kg/m² (20 psf) | 150 kg/m² (30 psf) | 200+ kg/m² (40+ psf)

Weight

Extensive **Semi-intensive** **Intensive**

Typical Components

Plants

Growing substrate

Engineered GM

Water retention layer

Filter

Drainage

Root protection

Edge restraint

Why is stormwater management (SWM) important?

Green roof overview

Green Roof's SWM abilities:

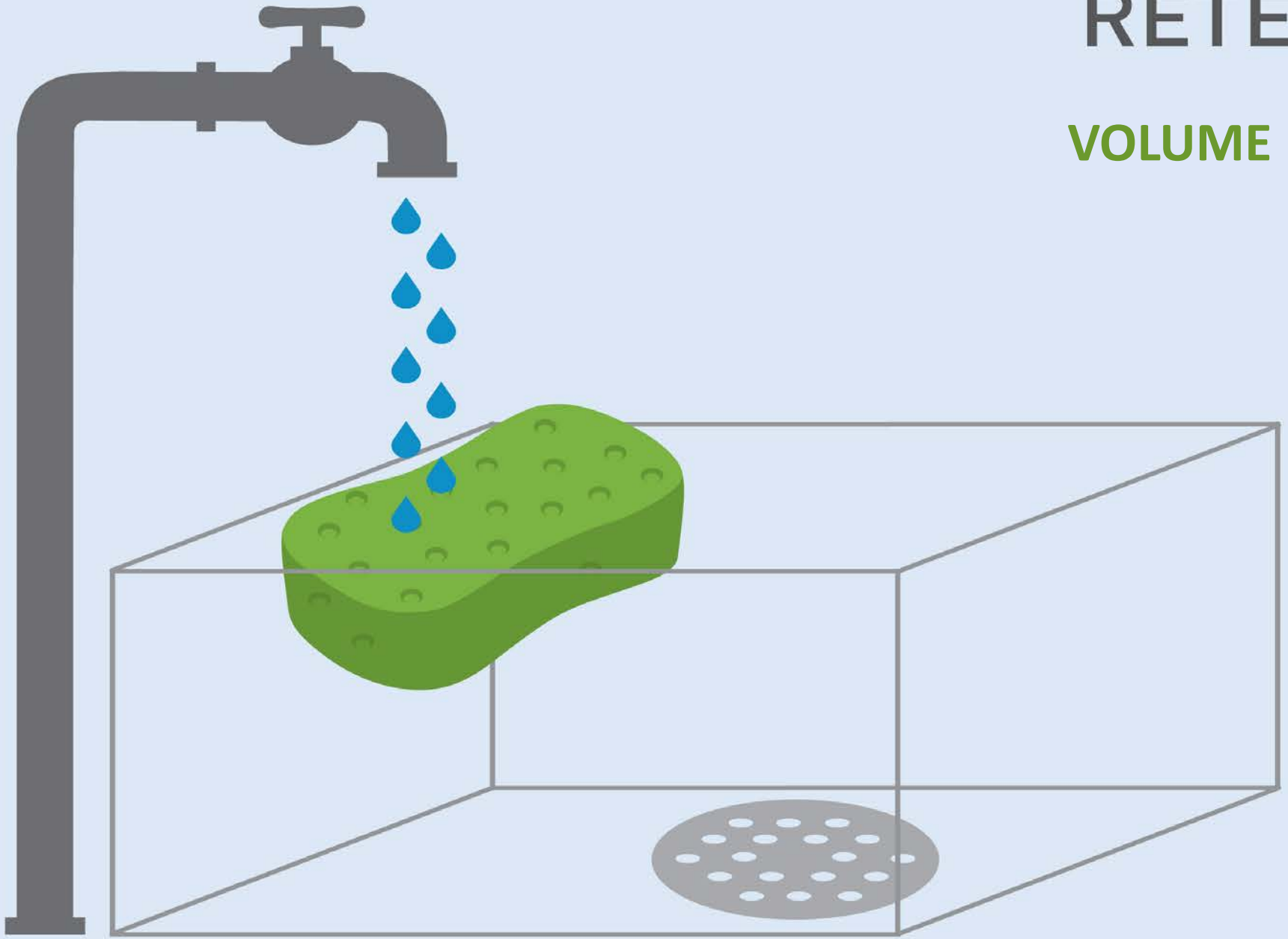
- **Retention: Rain volume reduction**
- **Detention: Peak flow delay & reduction**

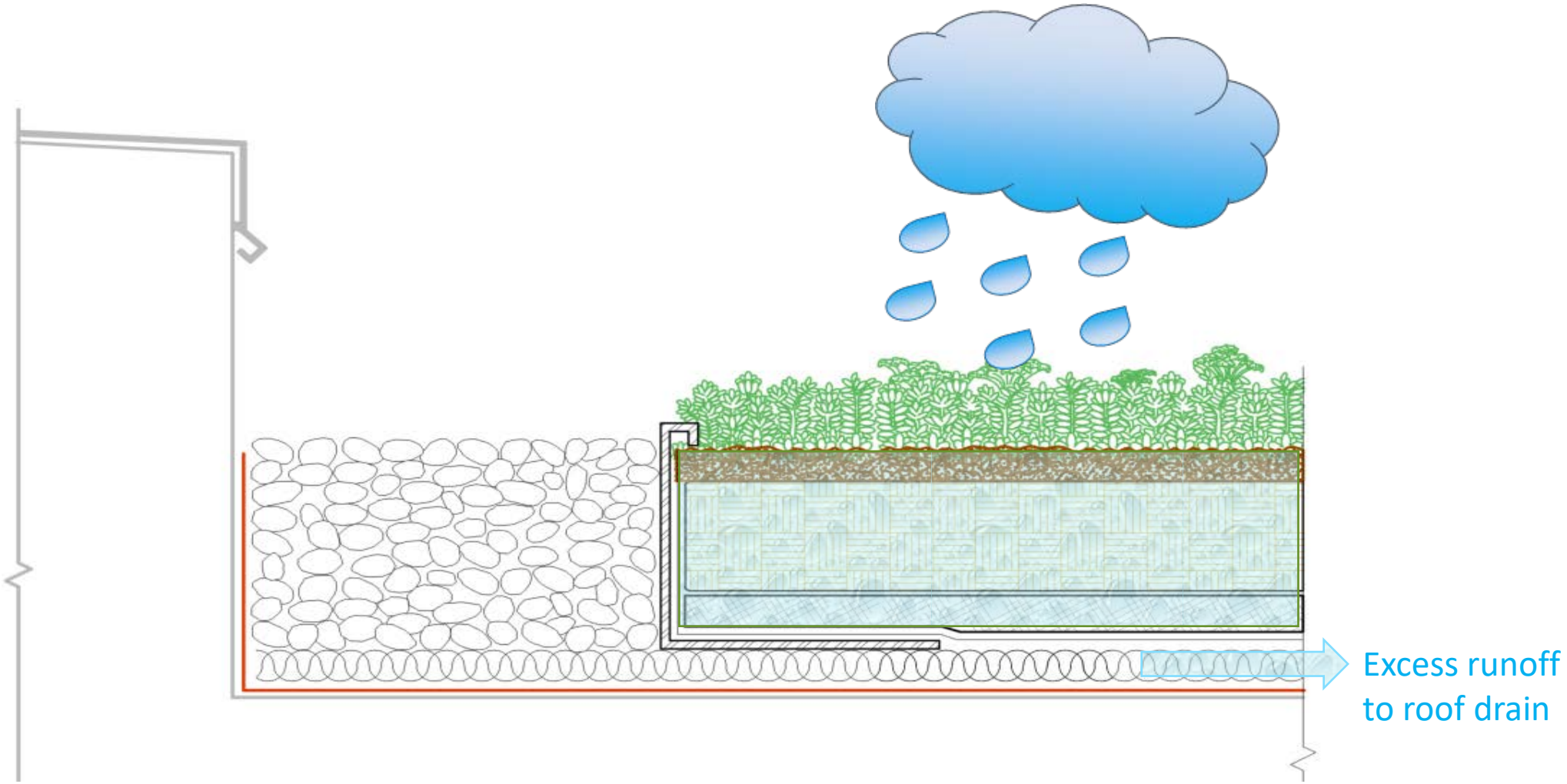
Recap

Golf Park Maisonneuve, Montreal, QC

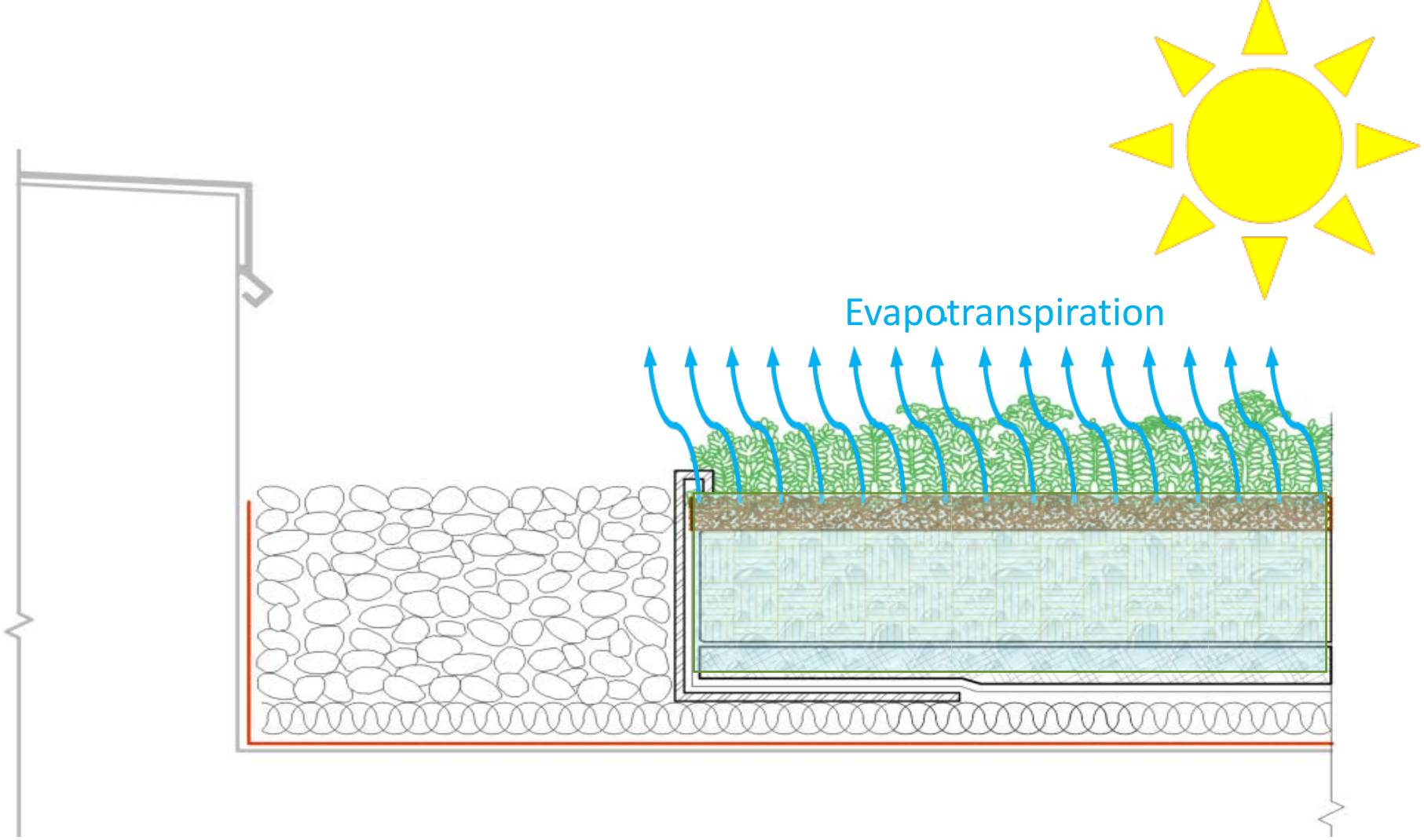
RETENTION

VOLUME REDUCTION





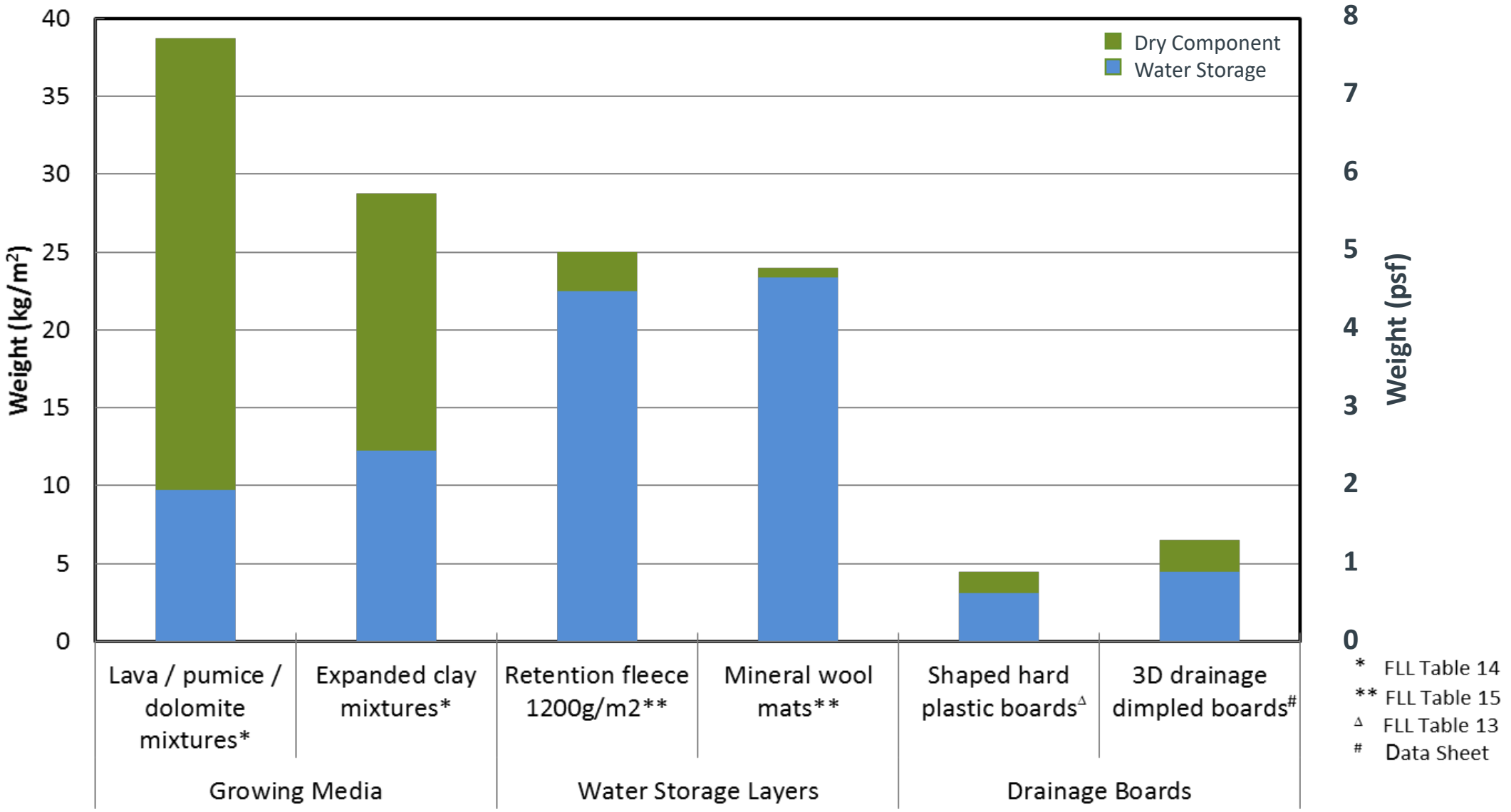
How Green Roofs Perform Retention (wetting cycle)



How Green Roofs Perform Retention (Drying cycle)

How can retention be improved?

Water storage capacity comparison (normalized to 25 mm / 1” thickness)



Lightweight water storage layer





Water storage layer provides enhanced retention

Green Roof Retention / Evapotra

purple-roof.com/model

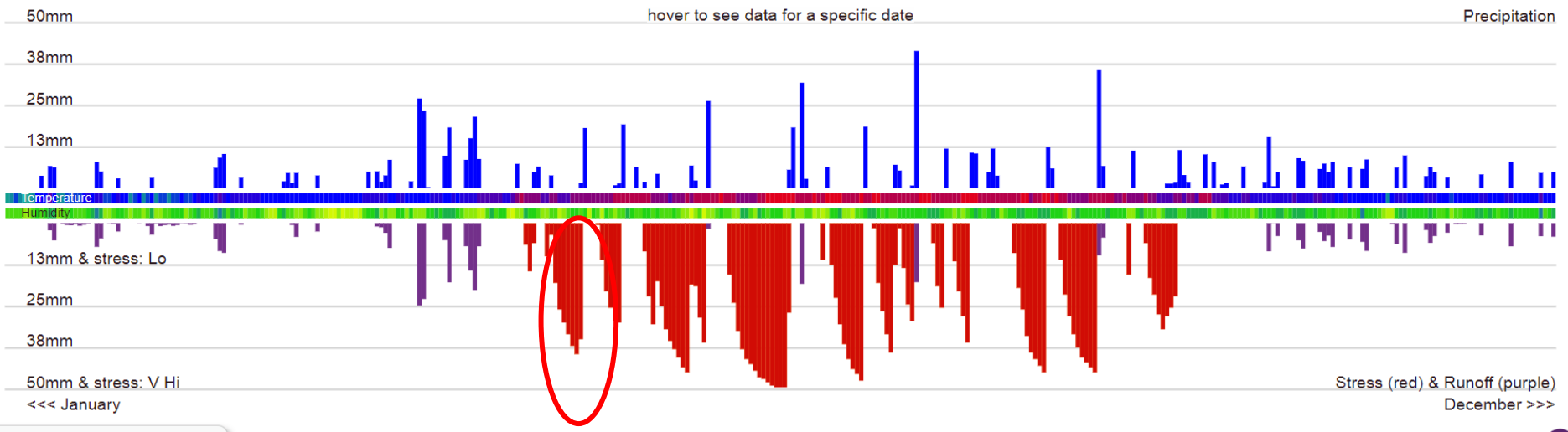
The Purple-Roof Concept

Top Menu Menu

Green Roof Retention / Evapotranspiration Modeler v1.0.1

Toronto, ON, Canada (1991)

hover to see data for a specific date



run another share vs. 100 mm US SI

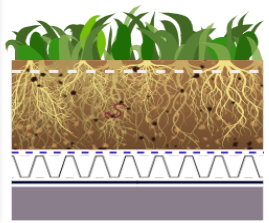
Traditional Green Roof concept 100mm

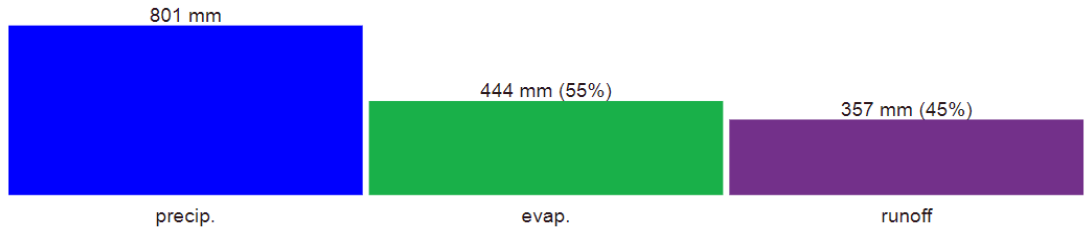
Sedum Mat	12	mm	
Green roof soil	90	mm	- +
Needled mineral wool	0	mm	- +
Dimpled drain plate	17	mm	

Weight: approx. 143 kg/m2

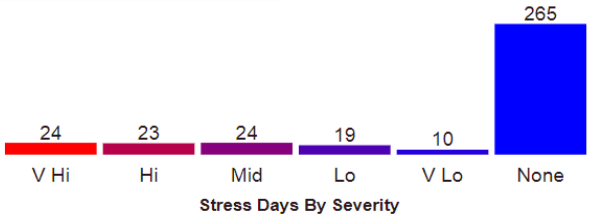
ASTM E2399 max retention value: 52.1 mm (l/m2)

Go directly to this detail

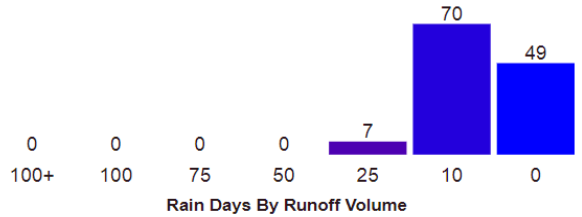




Rain and Runoff (mm)



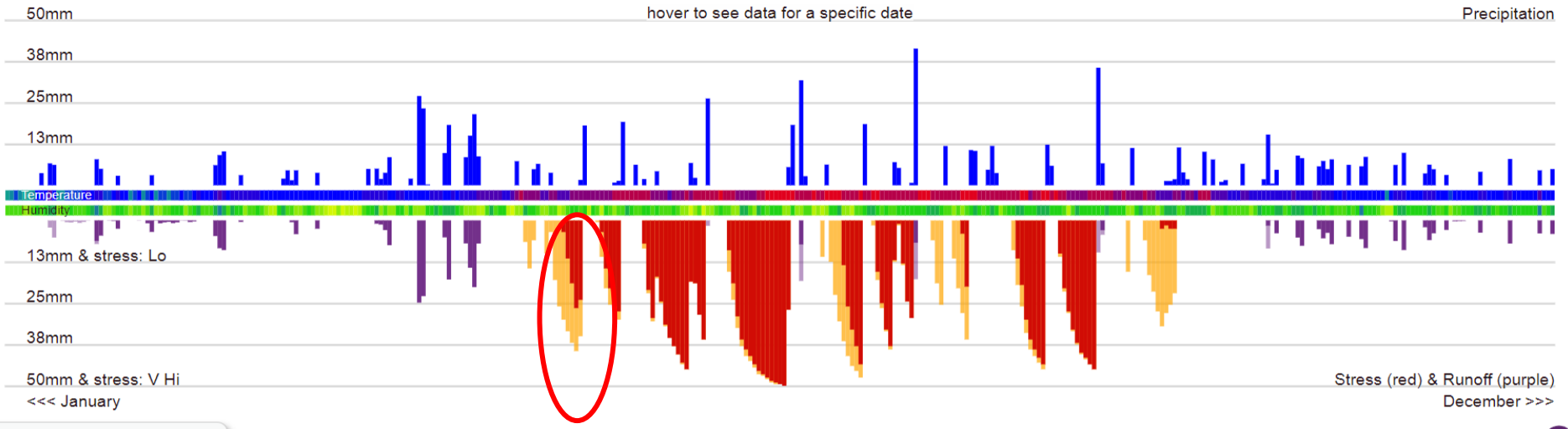
Stress Days By Severity



Rain Days By Runoff Volume

Green Roof Retention / Evapotranspiration Modeler v1.0.1

Toronto, ON, Canada (1991)



run another | share | vs. 100 mm | US | SI

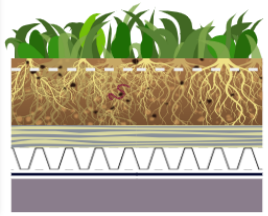
Sponge Roof concept 70+25

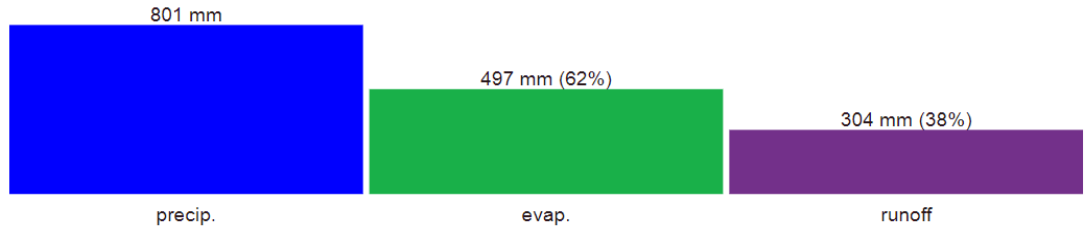
Sedum Mat	12	mm	
Green roof soil	60	mm	- +
Needled mineral wool	25	mm	- +
Dimpled drain plate	17	mm	

Weight: approx. 130 kg/m2

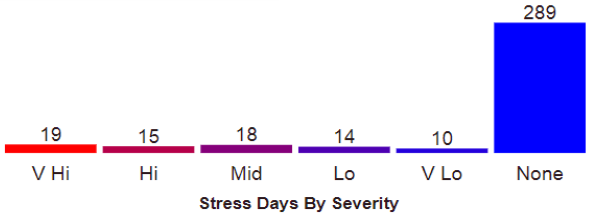
ASTM E2399 max retention value: 60.7 mm (l/m2)

Go directly to this detail

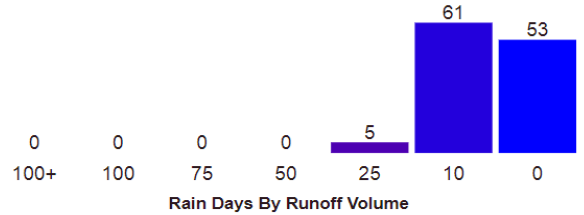




Rain and Runoff (mm)



Stress Days By Severity



Rain Days By Runoff Volume

	Typical green roofs
PRO – Retention: Volume reduction	✓
PRO – Additional environmental benefits	✓
CON – Do not retain SW when already wet.	✓
CON – Dependant on dry weather to “recharge” in order to handle the next rain event	✓

Why is stormwater management (SWM) important?

Green roof overview

Green Roof's SWM abilities:

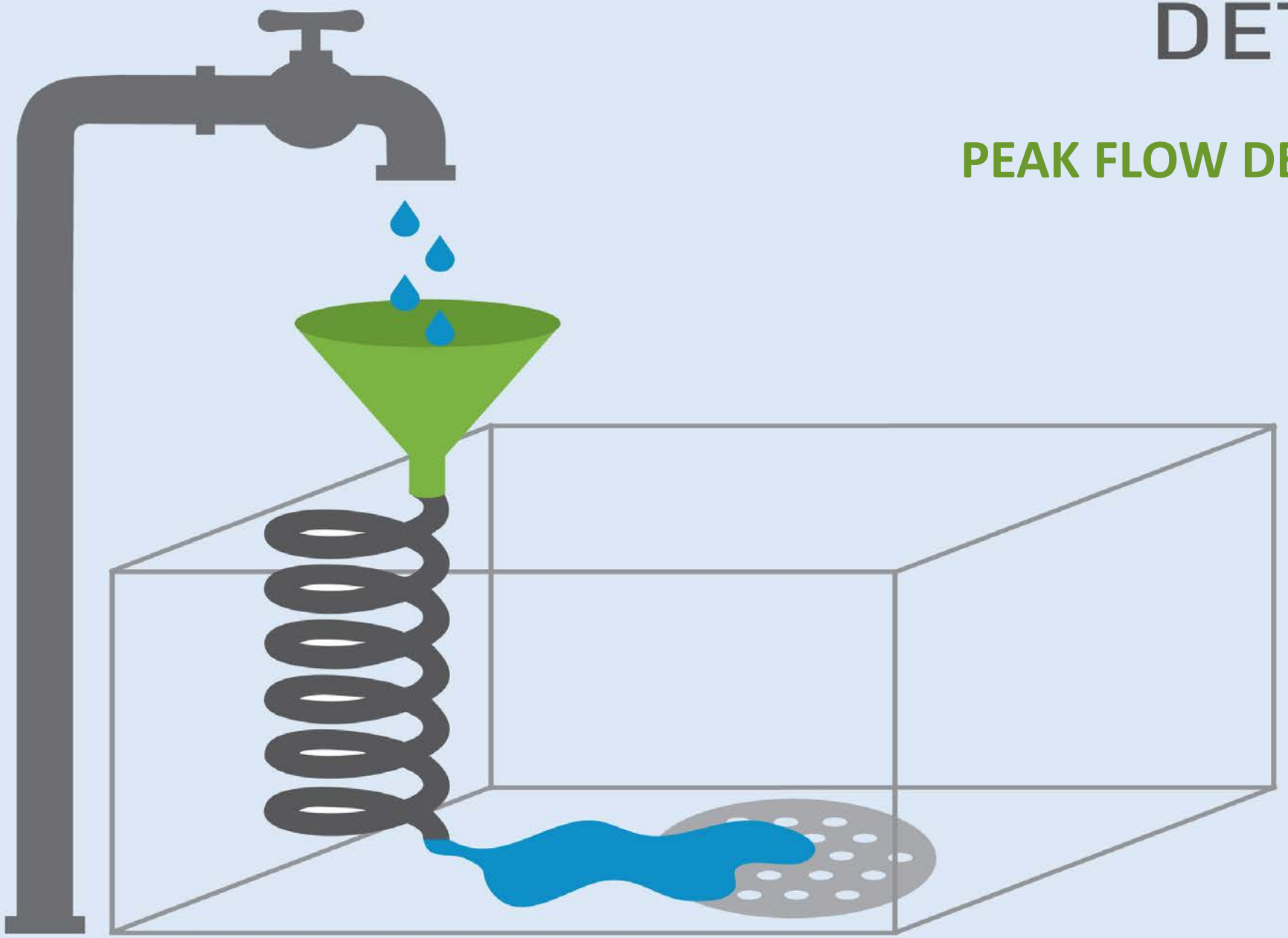
- Retention: Rain volume reduction
- Detention: Peak flow delay & reduction

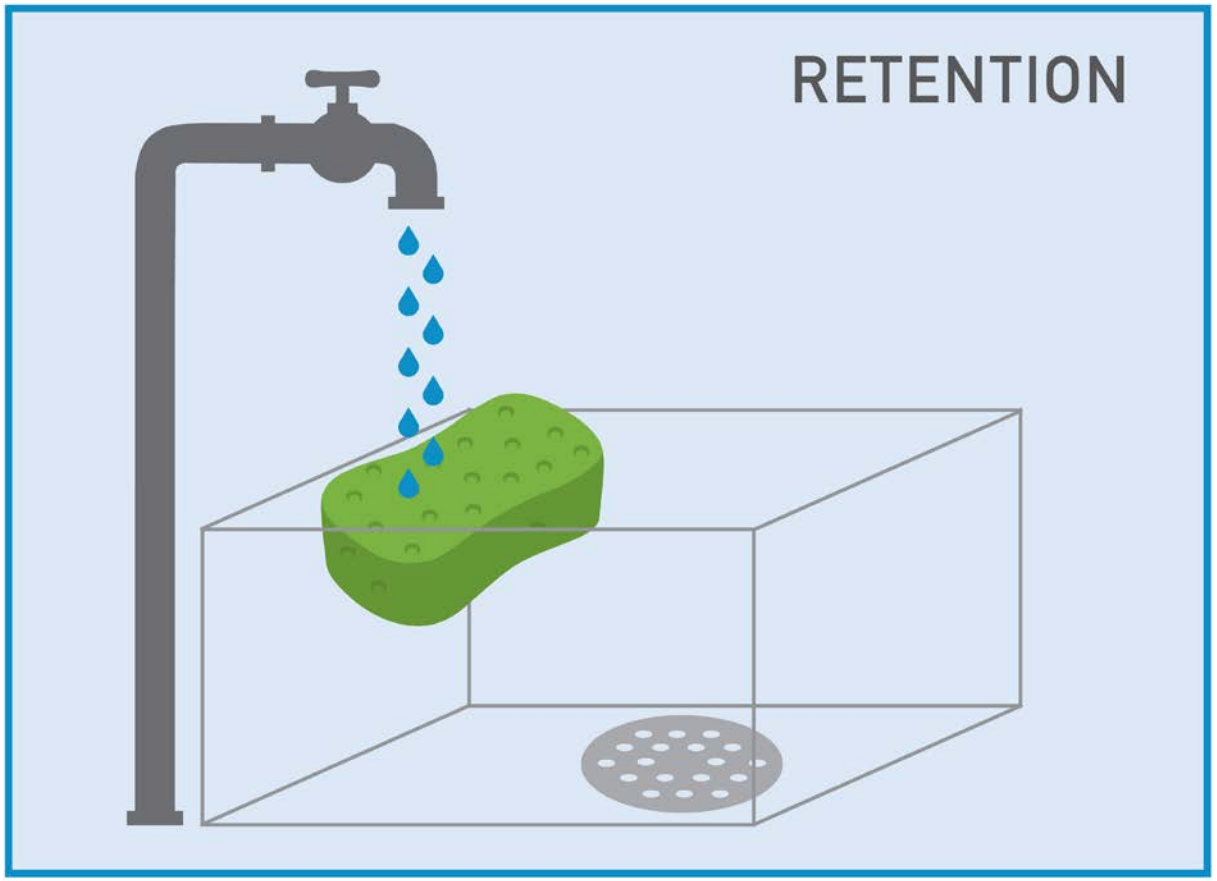
Recap

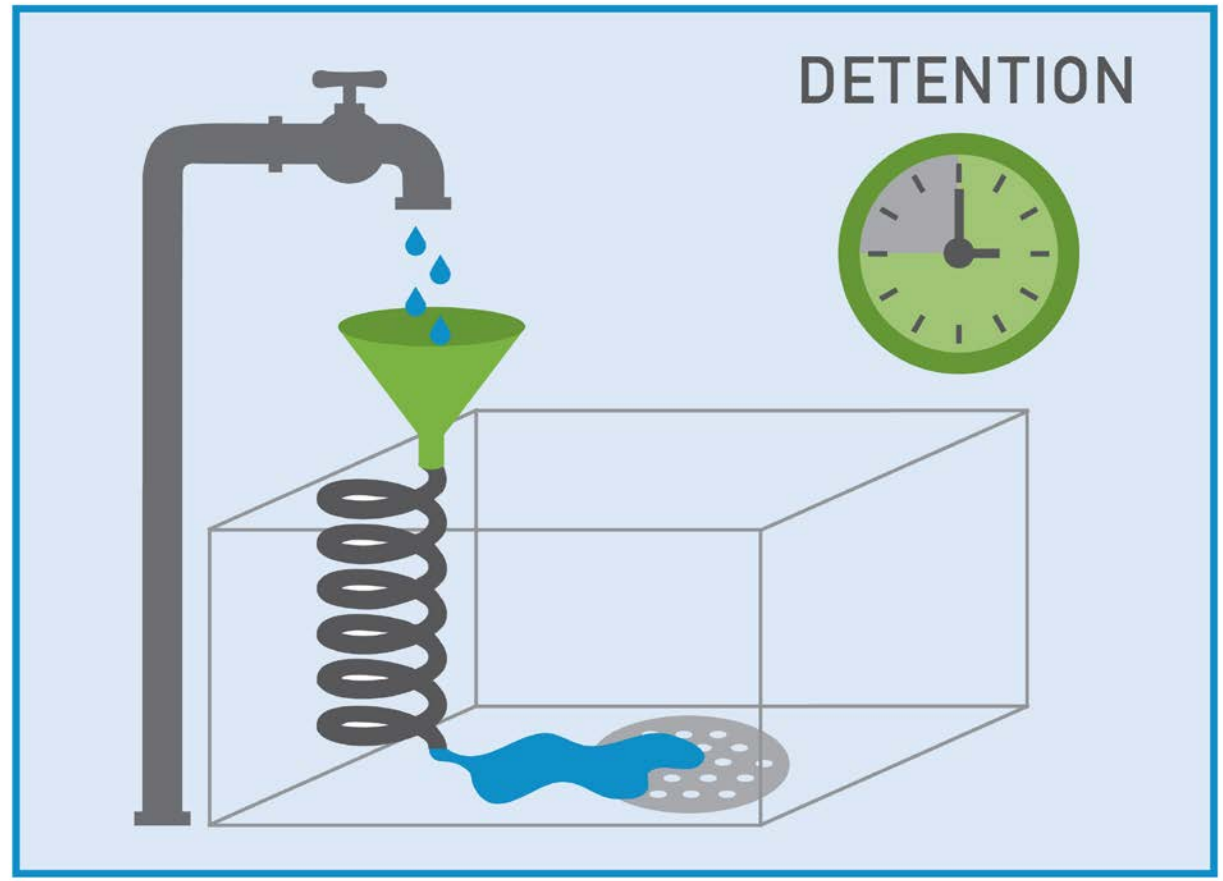
Private residence, White Rock, BC

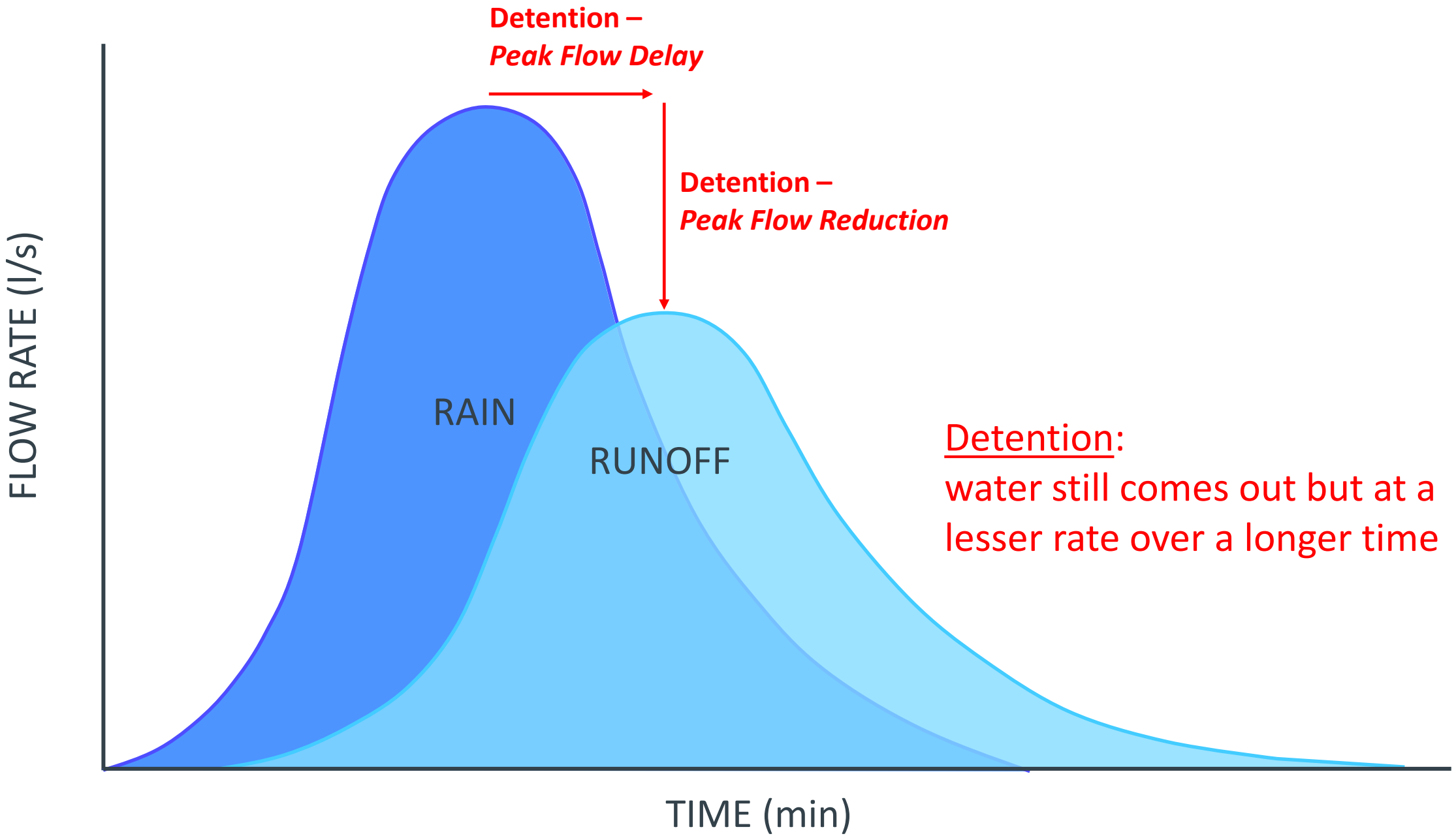
DETENTION

PEAK FLOW DELAY & REDUCTION




RETENTION

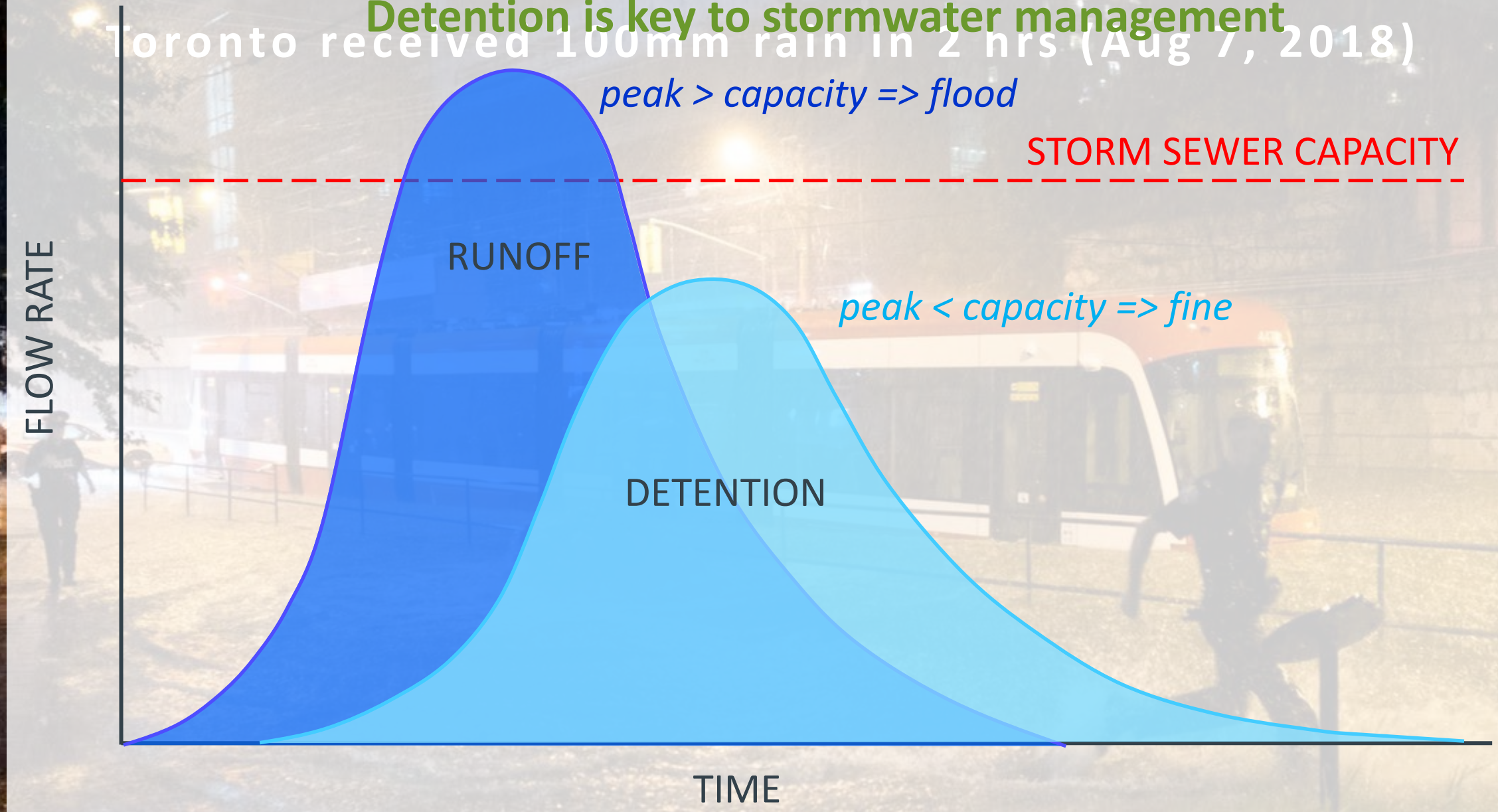

DETENTION



Detention:
water still comes out but at a lesser rate over a longer time

Detention is key to stormwater management

Toronto received 100mm rain in 2 hrs (Aug 7, 2018)



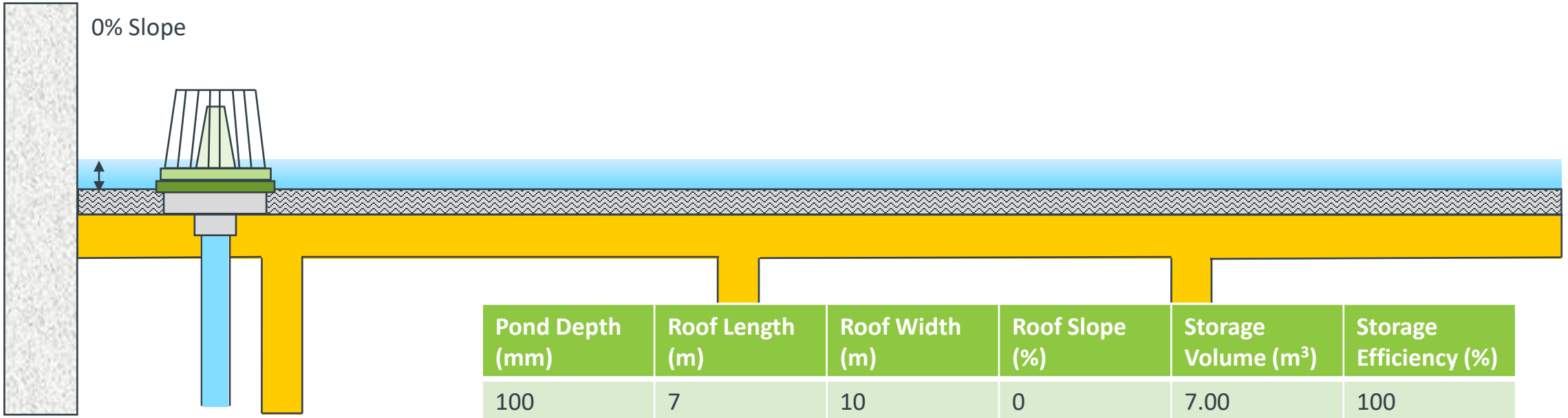
Underground Storage Tank


Blue Roof

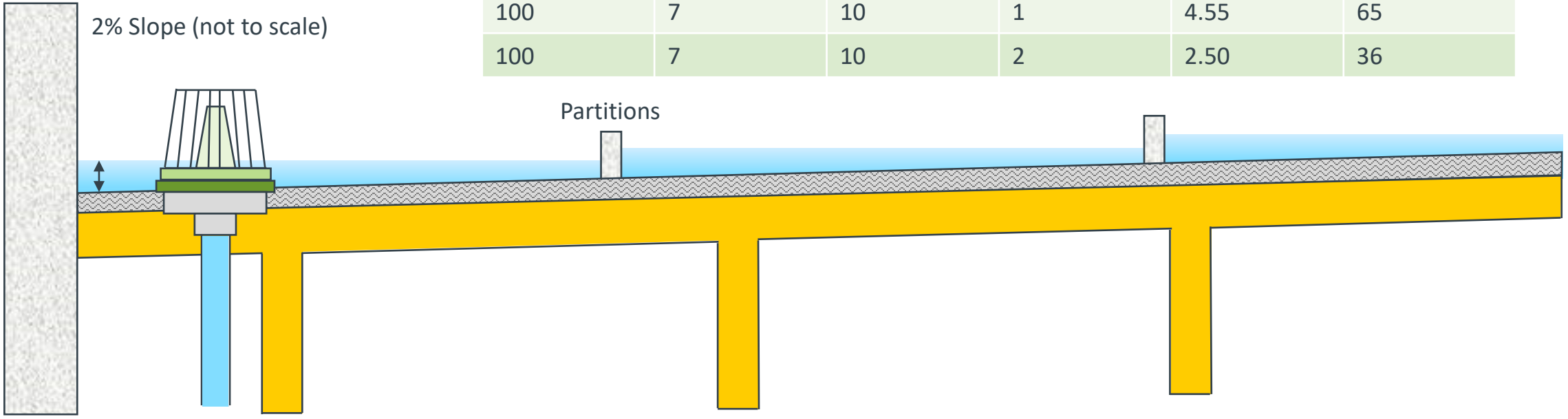

Bioswale

Blue-Green Roof

Blue Roofs need 0% slope for efficiency



Pond Depth (mm)	Roof Length (m)	Roof Width (m)	Roof Slope (%)	Storage Volume (m^3)	Storage Efficiency (%)
100	7	10	0	7.00	100
100	7	10	1	4.55	65
100	7	10	2	2.50	36

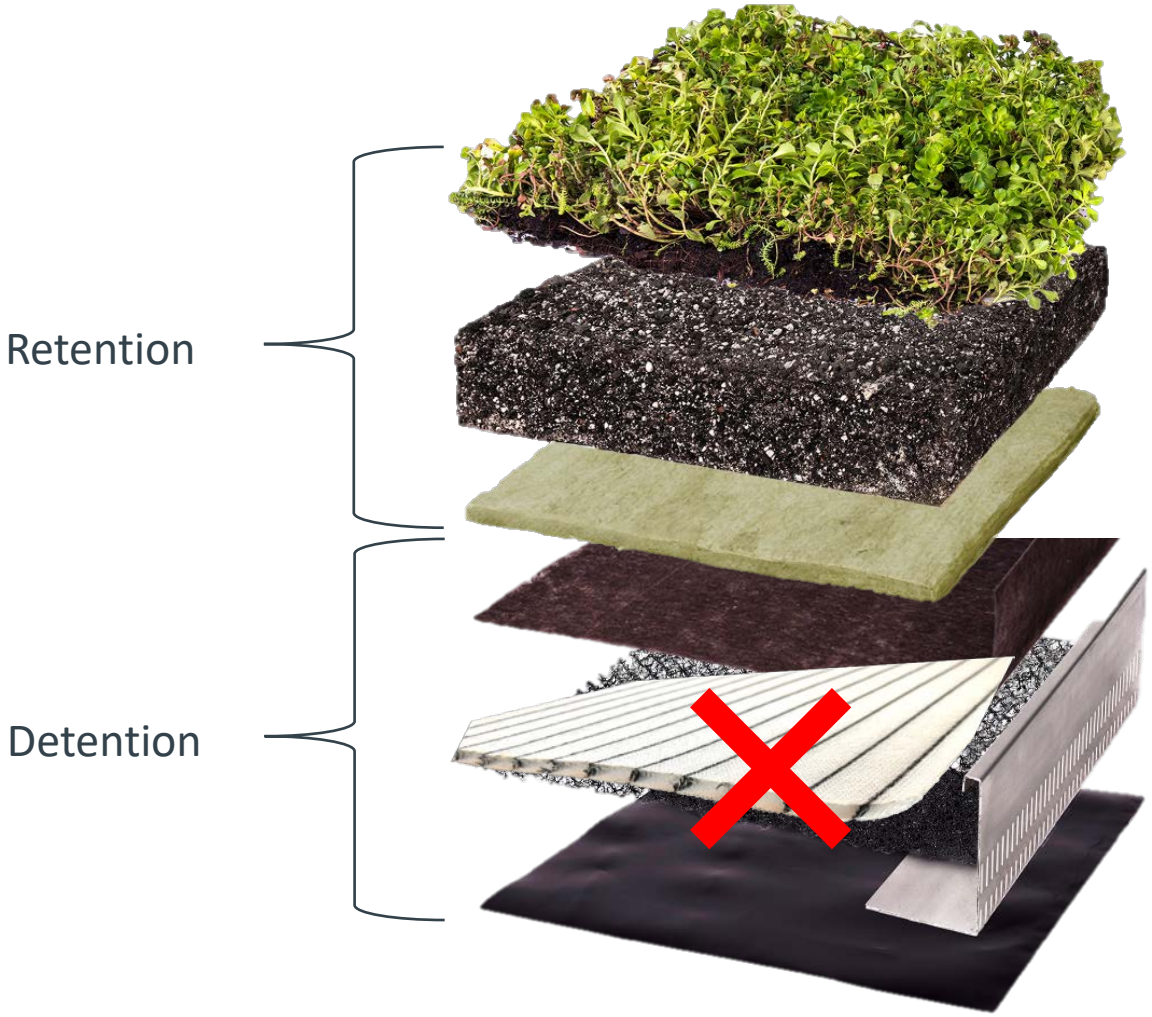


Is there a more efficient solution?

A vegetated roof that emulates friction in nature
(tall reeds, plants, leaves on a forest floor)

Biomimicry

Blue meets (smart) Green

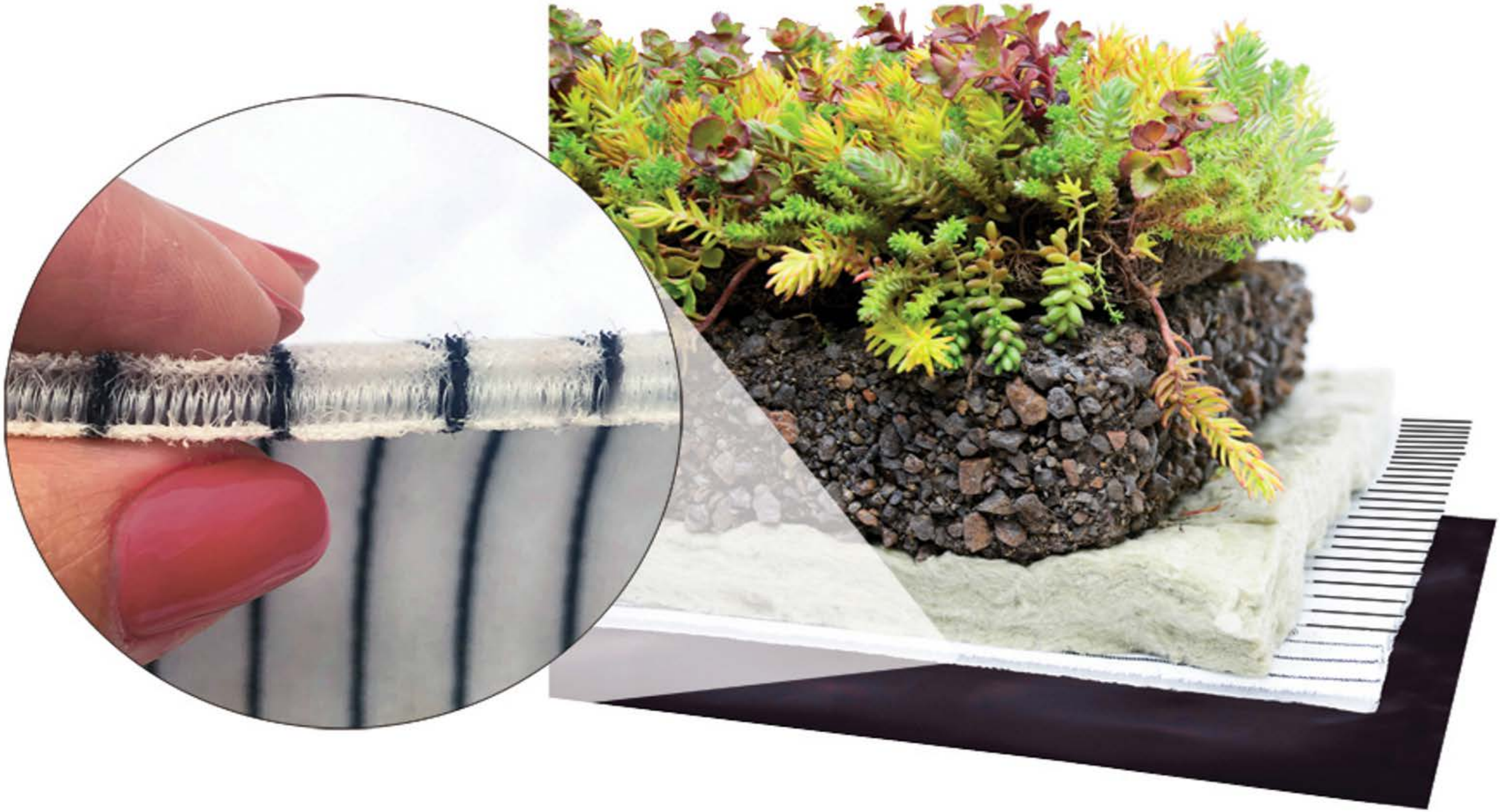


Substitute the typical free-flow drainage mat for a “friction“ layer that slows water flow.

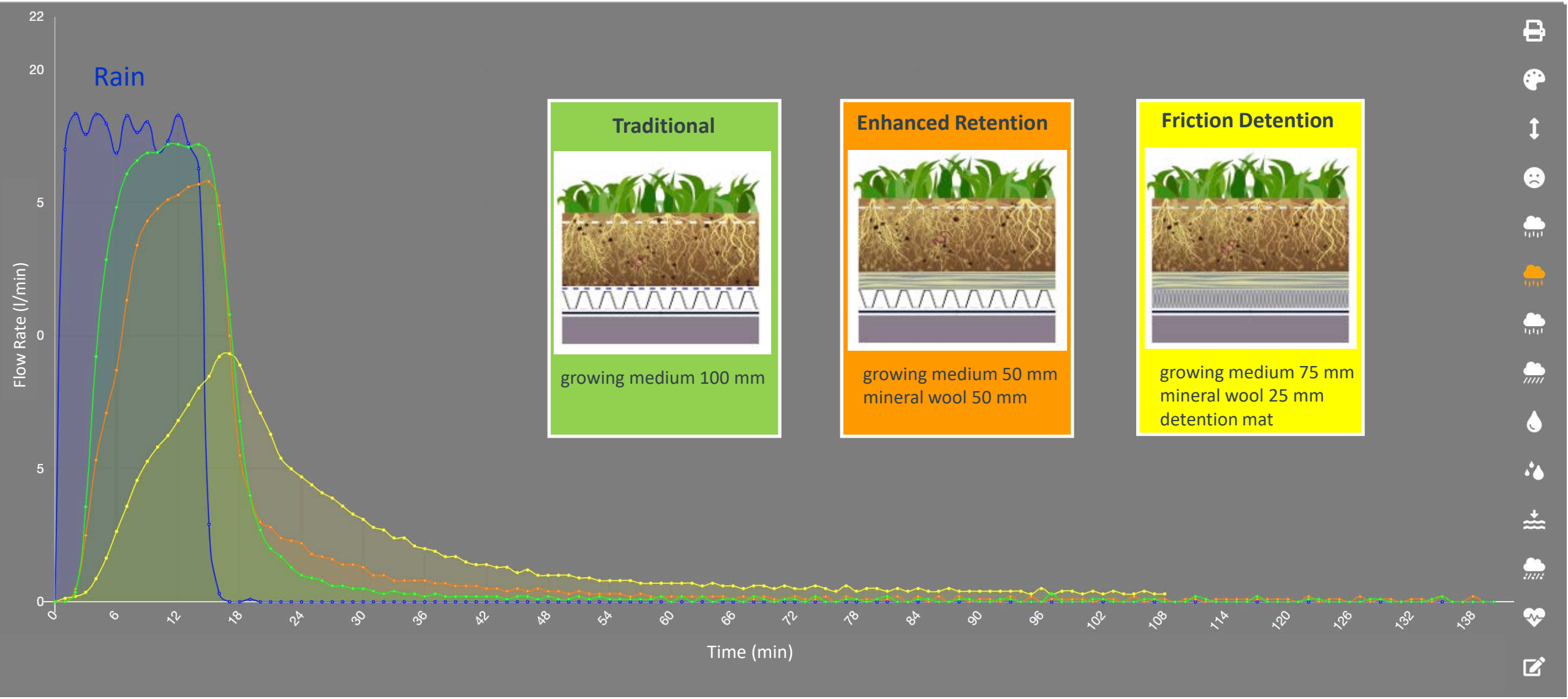
Friction Detention Green Roof

Friction Detention Green Roof

A “friction” layer or
“detention mat” has thousands of
vertical fibers that slow water flow.



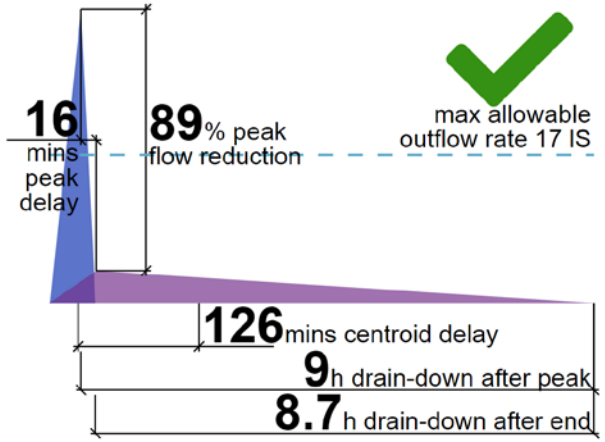
Runoff Hydrographs of Different Profiles



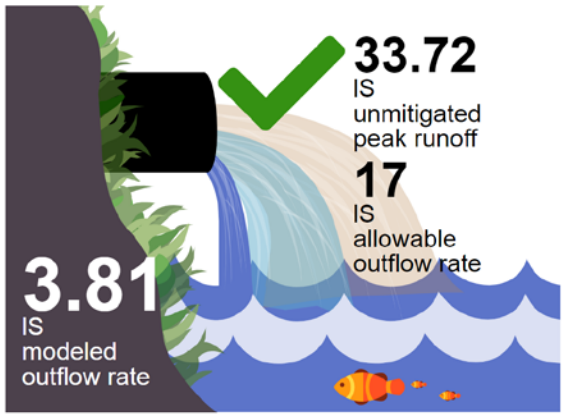
Data Source: Green Roof Diagnostics

Collaboration between disciplines

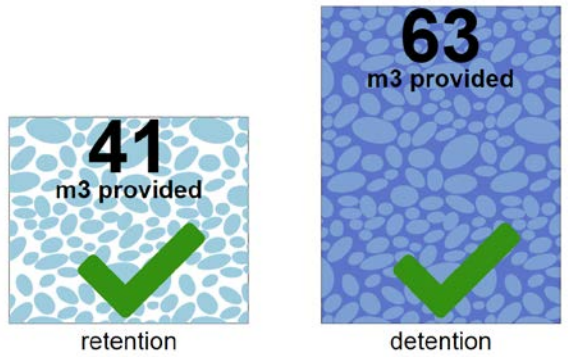
Civil Engineering • Architecture • Landscape Architecture



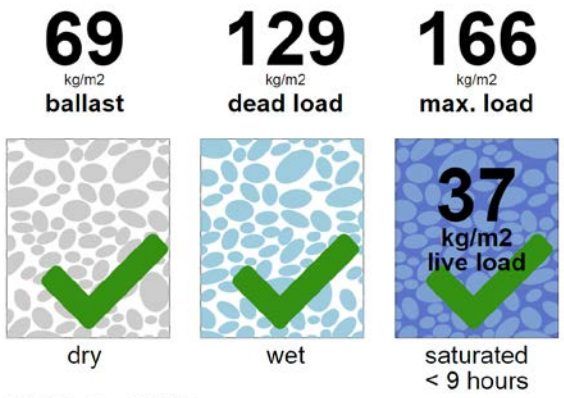
1. Overall Project Diagrammatic Hydrograph
Design Storm: R8 distribution, 47.5 mm total volume, 60 minutes total duration



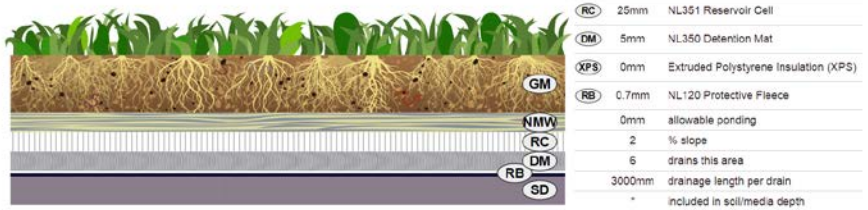
2. Overall Project Diagrammatic Flow Rate Compliance
Design Storm: R8 distribution, 47.5 mm total volume, 60 minutes total duration



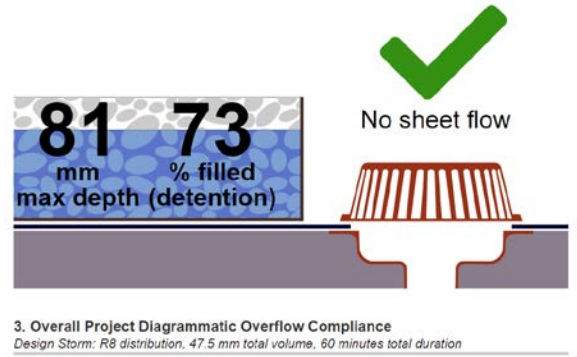
4. Overall Project Storage Summary



6. Main Roof Area Weight Summary



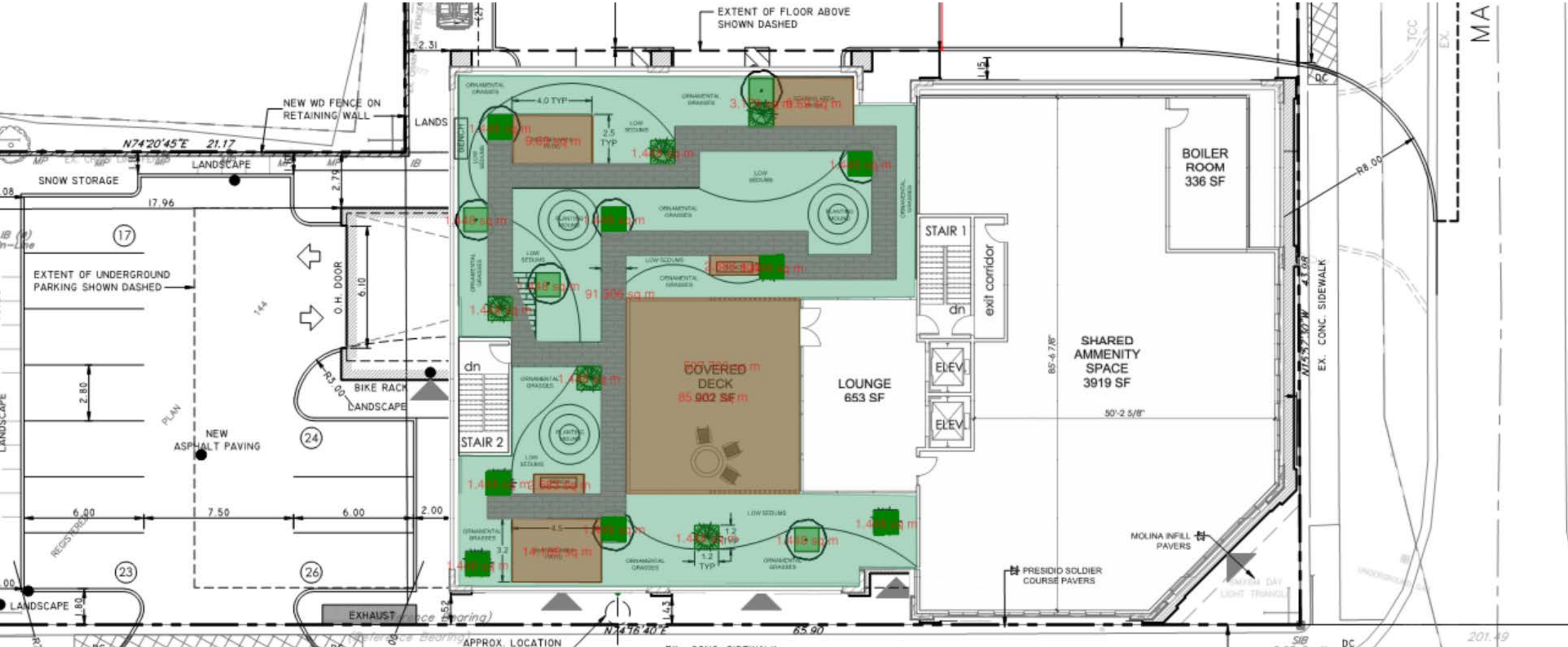
	thickness	component
VE	0mm	Sedum Blanket
GM	75mm	NL600 Growing Media
NMW	25mm	NL501 Needled Mineral Hydro Blanket
RC	25mm	NL351 Reservoir Cell
DM	5mm	NL350 Detention Mat
XPS	0mm	Extruded Polystyrene Insulation (XPS)
RB	0.7mm	NL120 Protective Fleece
	0mm	allowable ponding
	2	% slope
	6	drains this area
	3000mm	drainage length per drain
	*	included in soil/media depth



3. Overall Project Diagrammatic Overflow Compliance
Design Storm: R8 distribution, 47.5 mm total volume, 60 minutes total duration

Collaboration between disciplines

Civil Engineering • Architecture • Landscape Architecture



Why is stormwater management (SWM) important?

Green roof overview

Green Roof's SWM abilities:

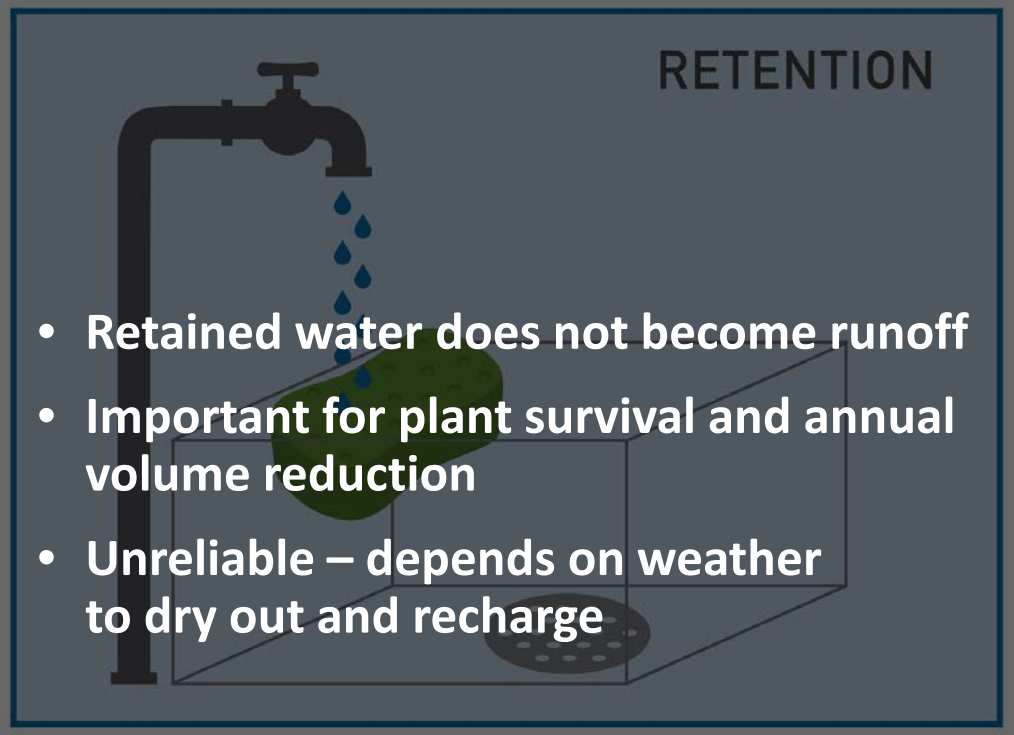
- Retention: Rain volume reduction
- Detention: Peak flow delay & reduction

Recap

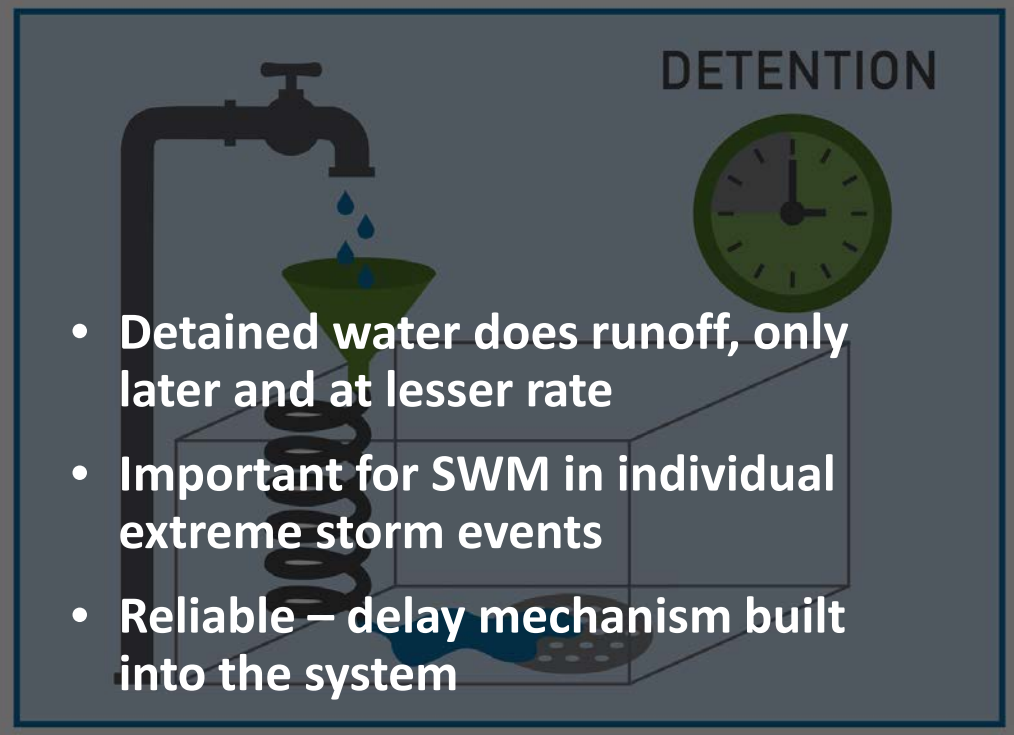
Charles P. Allen High School, Bedford, NS

Key Takeaways

Green roof manages runoff via 2 key mechanisms – retention & detention



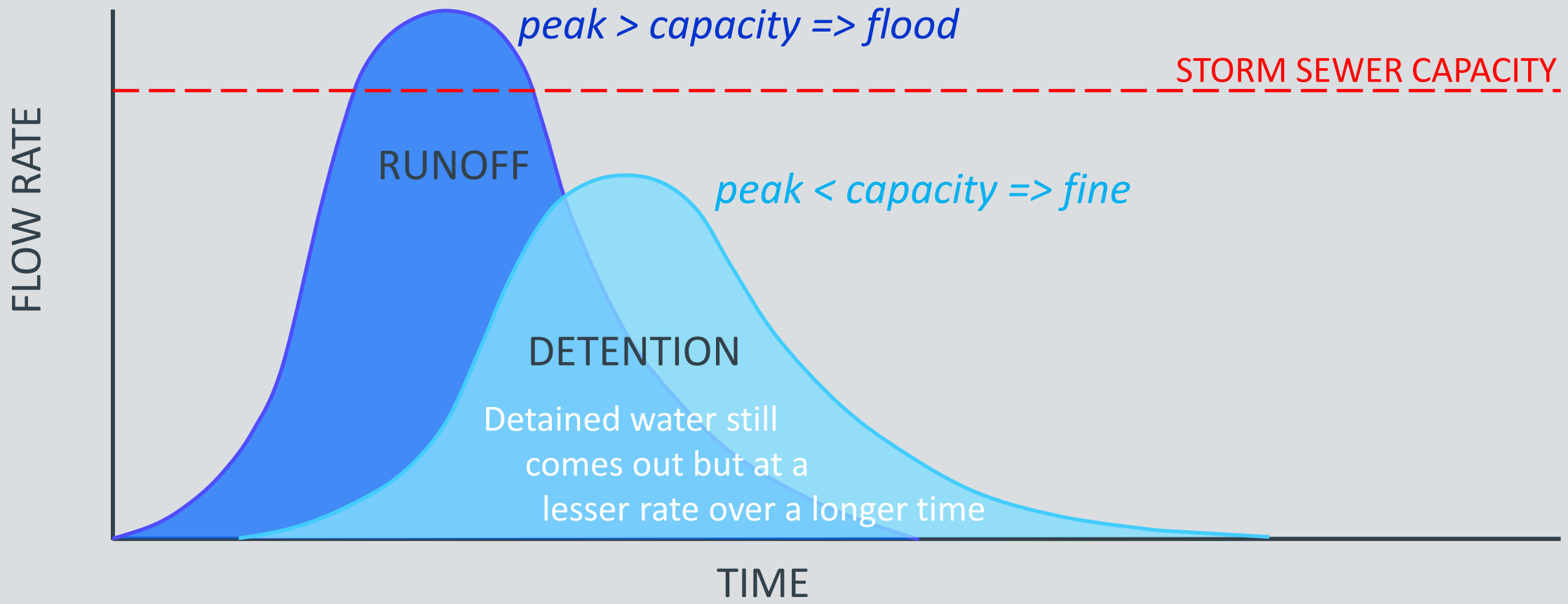
- **Retained water does not become runoff**
- **Important for plant survival and annual volume reduction**
- **Unreliable – depends on weather to dry out and recharge**



- **Detained water does runoff, only later and at lesser rate**
- **Important for SWM in individual extreme storm events**
- **Reliable – delay mechanism built into the system**

Key Takeaways

Detention is key to stormwater management



Key Takeaways

Friction Detention Green Roof stood out among detention tools





	Storage Tank	Blue Roof	Bioswale	Blue-Green Roof	Friction-Detention Green Roof
PRO – Detention (run off delay)	✓	✓	✓	✓	✓
PRO – Volume reduction		✓	✓	✓	✓✓
PRO – Additional environmental benefits			✓	✓	✓
PRO – Frees up real estate		✓		✓	✓
PRO – Smaller/Irregular shape roofs					✓
CON – Clogging	✓	✓	✓	✓	
CON – Uses up valuable real-estate	✓		✓		
CON – Serves only one purpose	✓				
CON – Rooftop personnel safety		✓			
CON - Diseases		✓			
CON – 0% slope		✓		✓	


Questions?

Next Level™
STORMWATER MANAGEMENT

THANK YOU!

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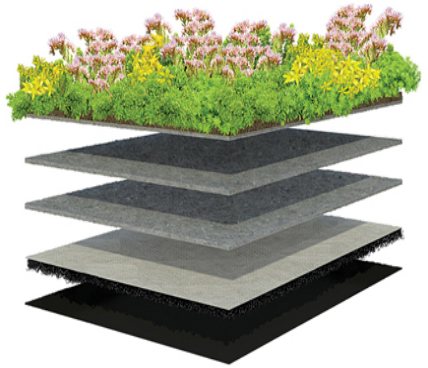
James Weldon – Technical Sales Representative James@nlsm.ca **647-290-4460**

Alpine Meadow



LiteN'Less™

StormCap™

StormCap™+Detention

Technical advice, design and planning

Budgetary estimates and quotes

Certified installer training

Single source solutions – one stop shop

Coordinate delivery of all products to site

Supervise, inspect and review final installation

Warranty