

# RAIN CITY STRATEGY

a green infrastructure &  
urban rainwater management initiative

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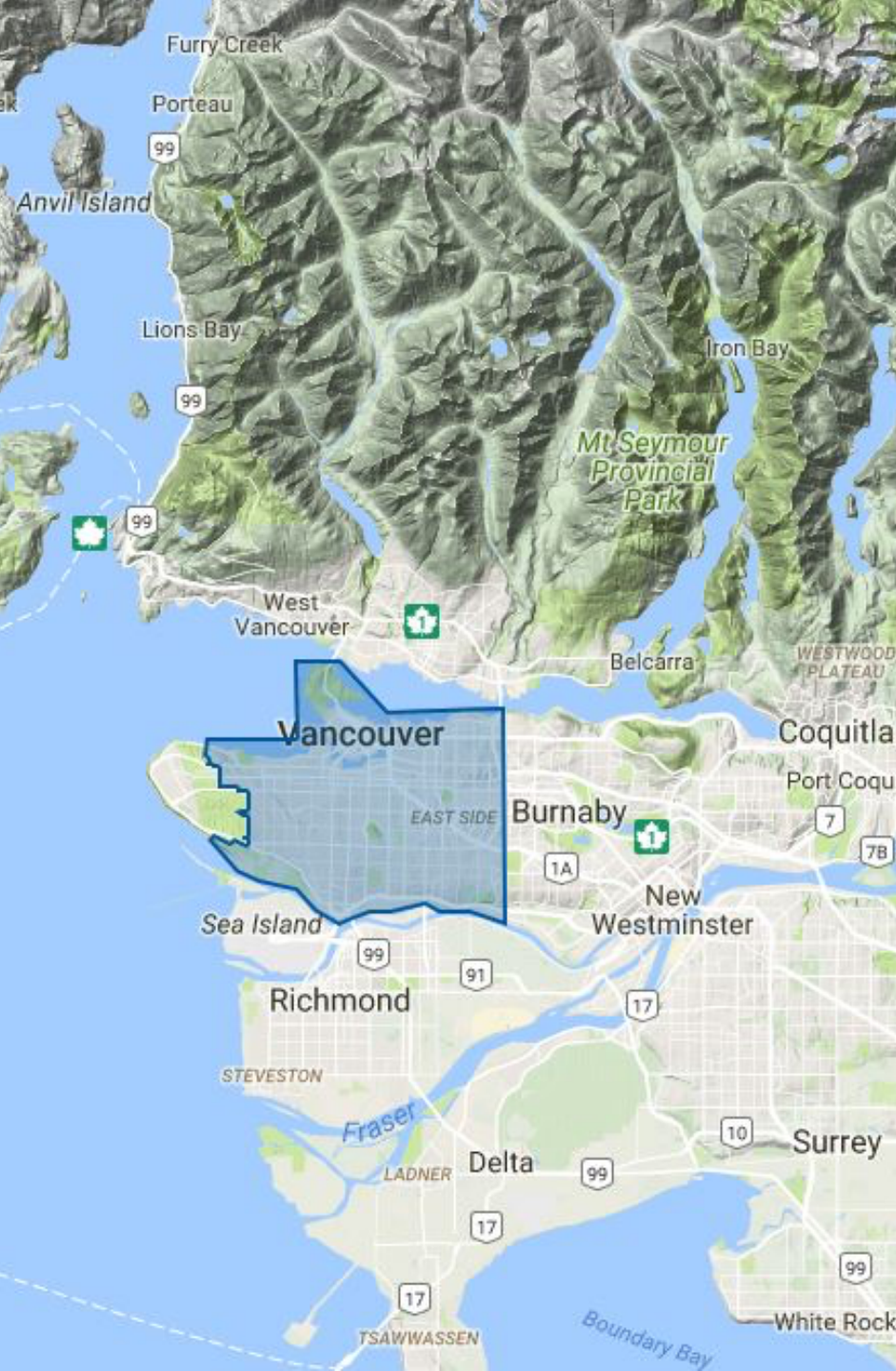
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# CONTEXT



“Vancouver is embracing rainwater as a valuable resource for our communities and ecosystems”





POPULATION **631,486**

SQUARE KILOMETERS **114**

POP. DENSITY **5492/km<sup>2</sup>**

RAINFALL **1,400 MM**

RAINY DAYS **161**



Single Family

**15%**

**41,330  
units**



High Rise

**30%**

**83,250  
units**



Multi-Family

**55%**

**159,310  
units**



# Vancouver is a city surrounded by water



Image: Overview of Vancouver's downtown peninsula  
Photo Credit: [www.fiercebiotech.com](http://www.fiercebiotech.com) 01/25/2017





The water is where we  
live, work and play



Our local waters  
and even the rain  
shapes who we are



Image: West Hastings Street, Vancouver  
Photo Credit: Dan Toulgoet

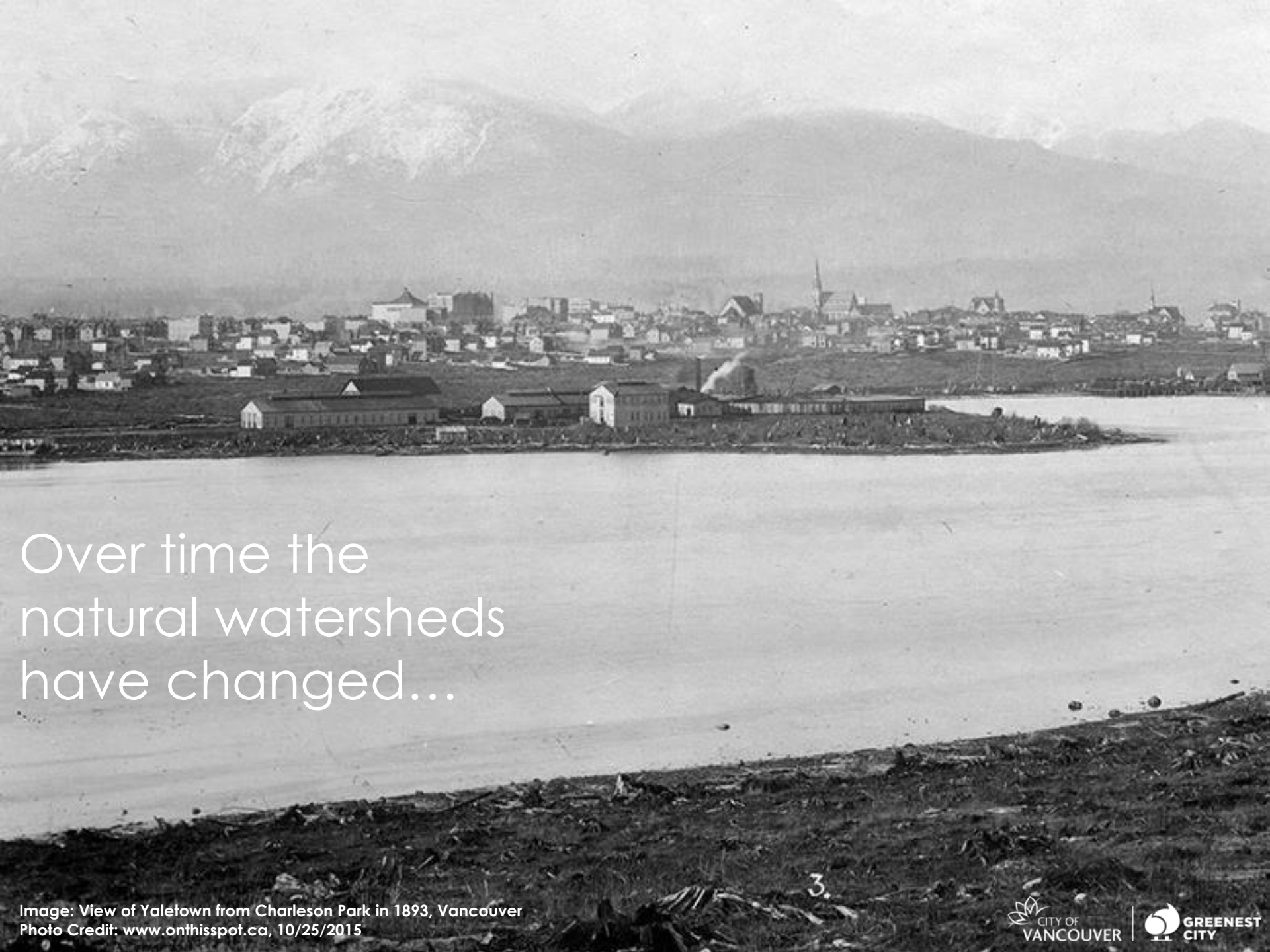




The city once was a  
temperate rainforest

Image: Capilano River Regional Park, North Vancouver  
Photo Credit: Robert Pennings





Over time the  
natural watersheds  
have changed...

to allow residents and businesses  
to prosper and grow



Image: View of Yaletown from Charleson Park in 2013, Vancouver  
Photo Credit: Wendy de Hoog



Think  
strategically  
about adapting  
for the future

**climate  
Change**

**water quality  
& ecosystem  
health**

**growth &  
utility servicing  
& economics**

**equity &  
reconciliation**





extreme rain  
events will be  
**36%**  
more intense



**33%**  
more rain on  
very wet days

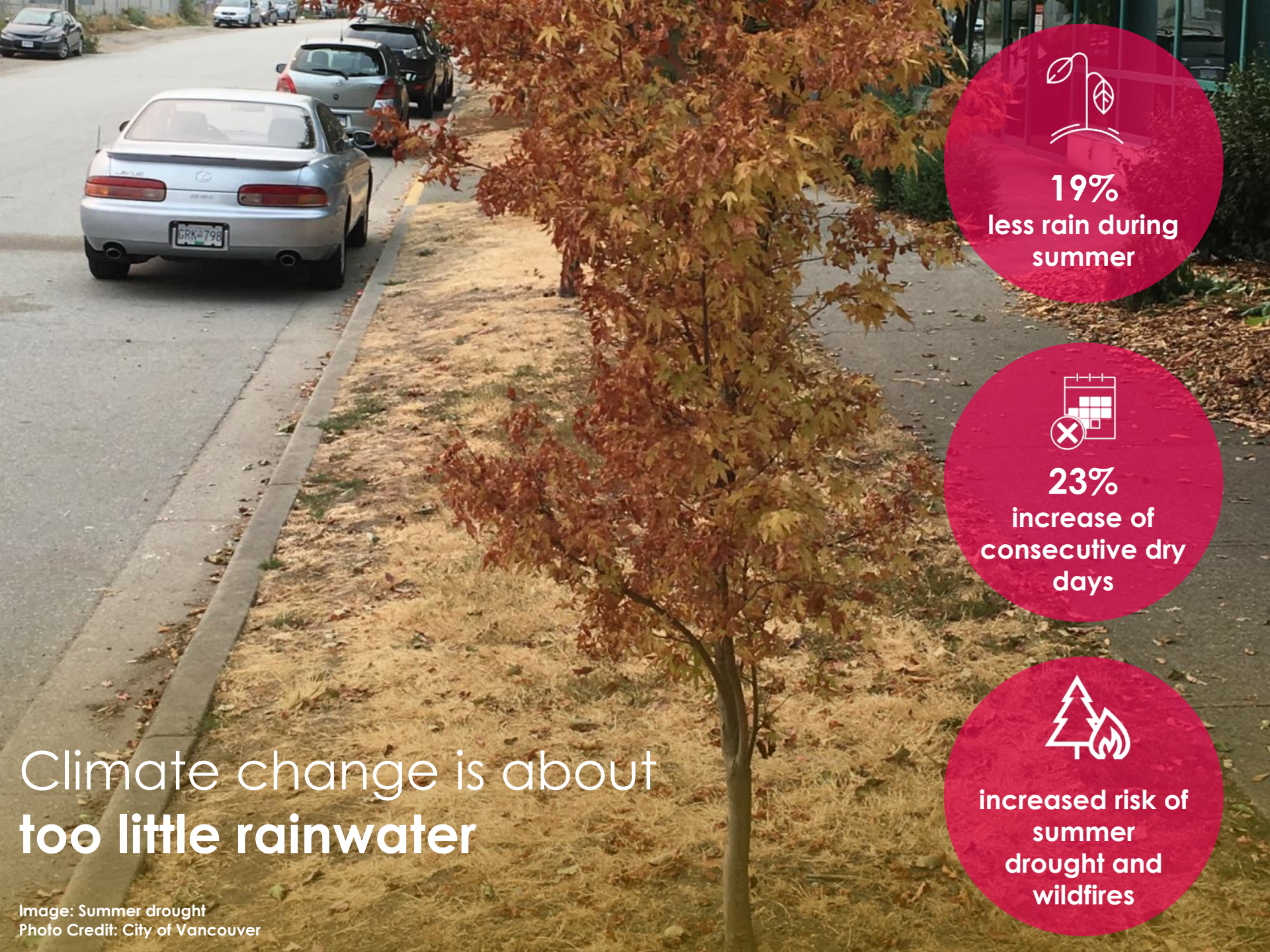


increased risk of  
overland &  
coastal flooding

# Climate change is about too much rainwater

Image: Overland flooding at Cambie St & W Broadway, Vancouver on October 12, 2017  
Photo Credit: Alexandra Coulliard





**19%**  
less rain during  
summer



**23%**  
increase of  
consecutive dry  
days



increased risk of  
summer  
drought and  
wildfires

Climate change is about  
**too little rainwater**

Image: Summer drought  
Photo Credit: City of Vancouver





More extreme heat is impacting public health and natural systems



# Water quality is impacted by

**combined sewer  
overflows (CSOs)**



**over 33 billion  
litres of combined  
sewage was  
discharged  
in 2018**



**ongoing efforts to  
mitigate  
combined sewer  
overflows since  
the 1970's**

**stormwater  
pollutants**

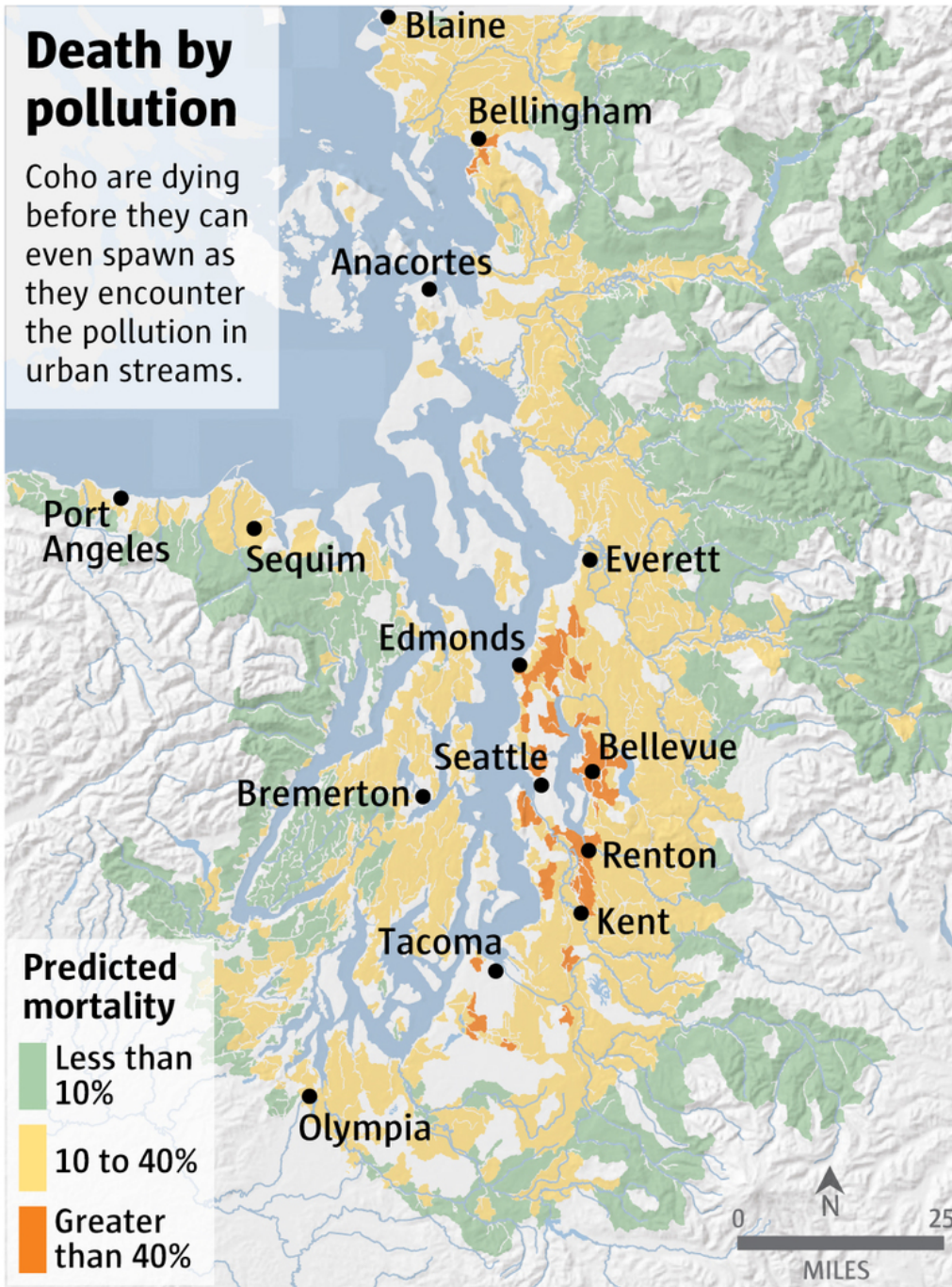
**pollutants**  
litter

tire debris  
copper & zinc  
oils & gasoline  
animal waste  
fertilizer  
micro-plastics  
sediment



## Death by pollution

Coho are dying before they can even spawn as they encounter the pollution in urban streams.



Sources: Esri, NOAA Fisheries

MARK NOWLIN / THE SEATTLE TIMES

## Washington Stormwater Centre Research

**Urban stormwater**  
“acutely lethal” to coho  
(tire preservative 6PPD)

Females in urbanized watersheds are dying before spawning

### Bio-retention

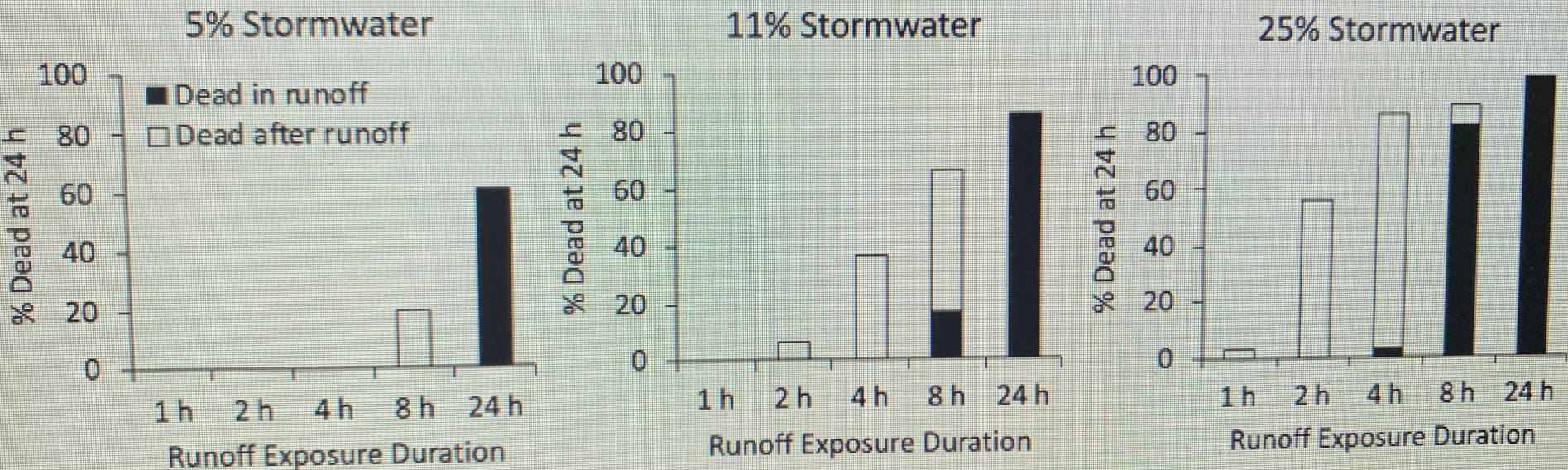
Coho exposed to urban stormwater died in 3 hrs

Coho remained healthy after stormwater filtered through GI



# Very little stormwater has a large impact

## What durations of urban runoff exposure kill coho?



*Prat unpublished*



# Servicing Growth + Asset Renewal



**+1 million  
regional new  
residents by  
2050**

**Opportunity for  
transformation  
through capacity  
upgrades &  
asset renewal**



5,023 views | Jan 22, 2013, 07:52pm

## Smart Communities will Build Green Infrastructure

The communities of the future will be smarter about their use of resources. That seems inevitable. More investment is flowing to

SLATE

News & Politics Culture Technology Business Human Interest

CRISIS CHRONICLE

METROPOLIS

## Tunnel Vision

Chicago tried to dig its way out of urban flooding decades before climate change made it a national crisis. Did the city, and its imitators, pick the wrong solution?

By HENRY GRABAR

JAN 02, 2019 • 5:50 AM



Construction workers lean in to discuss the project over the noises echoing throughout the Deep Tunnel.

David Schalliol

## Hot off the press

WAMU | FEB 22

## How D.C. Is Keeping Raw Sewage Out Of Rock Creek By 'Greening' The City



## With a Green Makeover, Philadelphia Is Tackling Its Stormwater Problem

*In a major initiative, Philadelphia is building an extensive network of rain gardens, green roofs, wetlands, and other infrastructure to capture stormwater. The goal is to prevent runoff from overwhelming sewers and polluting waterways and to help green America's fifth-largest city.*

BY BRUCE STUTZ • MARCH 29, 2018

# Equity and reconciliation with Indigenous Peoples

Reconciled  
Futures

Art Mentorship  
Camp for  
Indigenous  
Youth

Partnership  
between





# Supports value-for-investments + job creation



## What we build

Cost-effective services that support affordability and the needs of vulnerable populations and underserved areas



## Where we build

Prioritize placement and type of GRI to benefit people more affected by hazards, stressors and service deficits



## How we build

Engagement so community aspirations influence designs  
Green jobs, economic opportunity and accessible employment



## How we use GRI

Opportunities for enhancing access to and relationships with nature, education, capacity building and community building

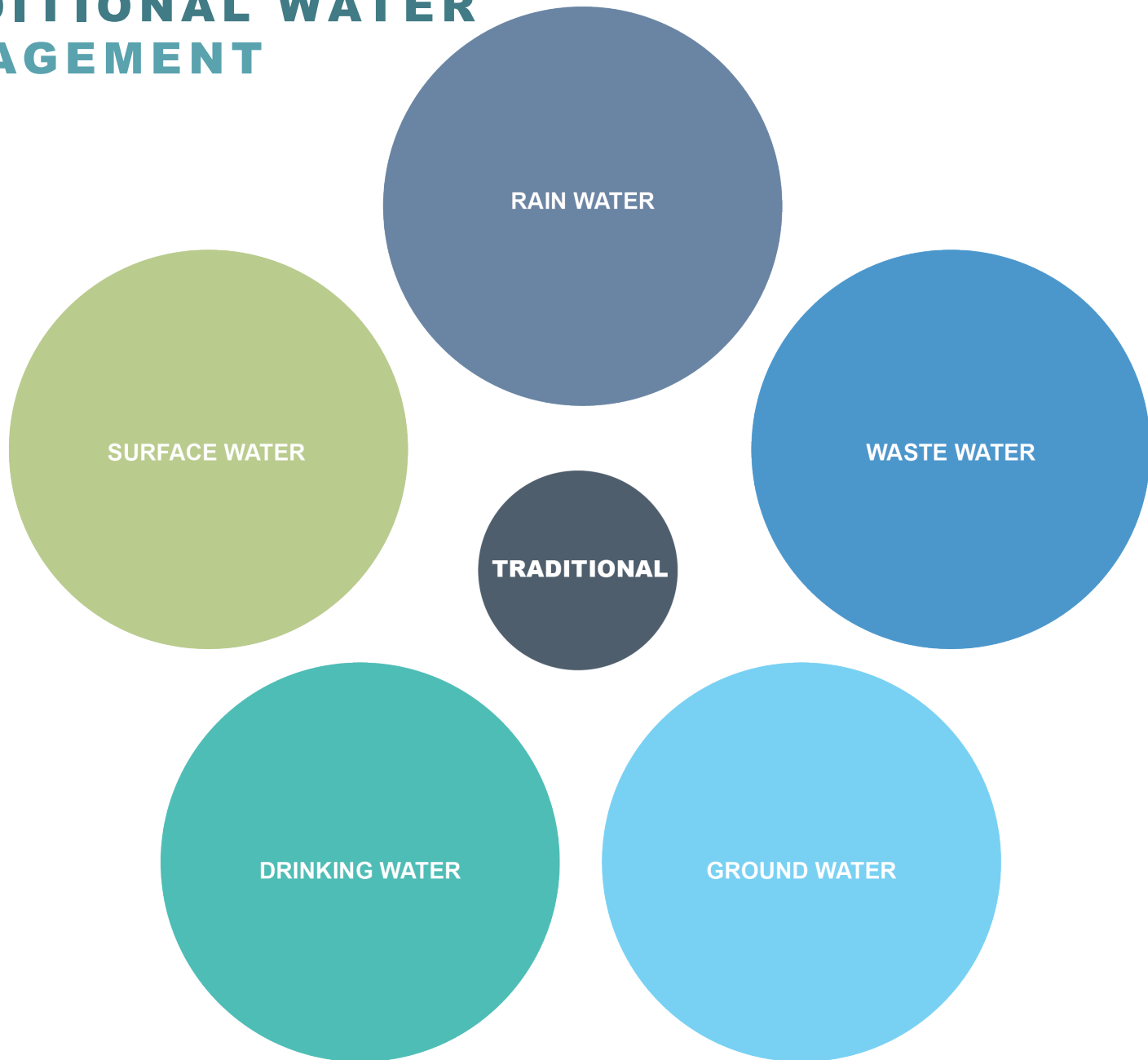


2

# **RETHINKING WATER MANAGEMENT THROUGH NATURE-BASED SOLUTIONS**

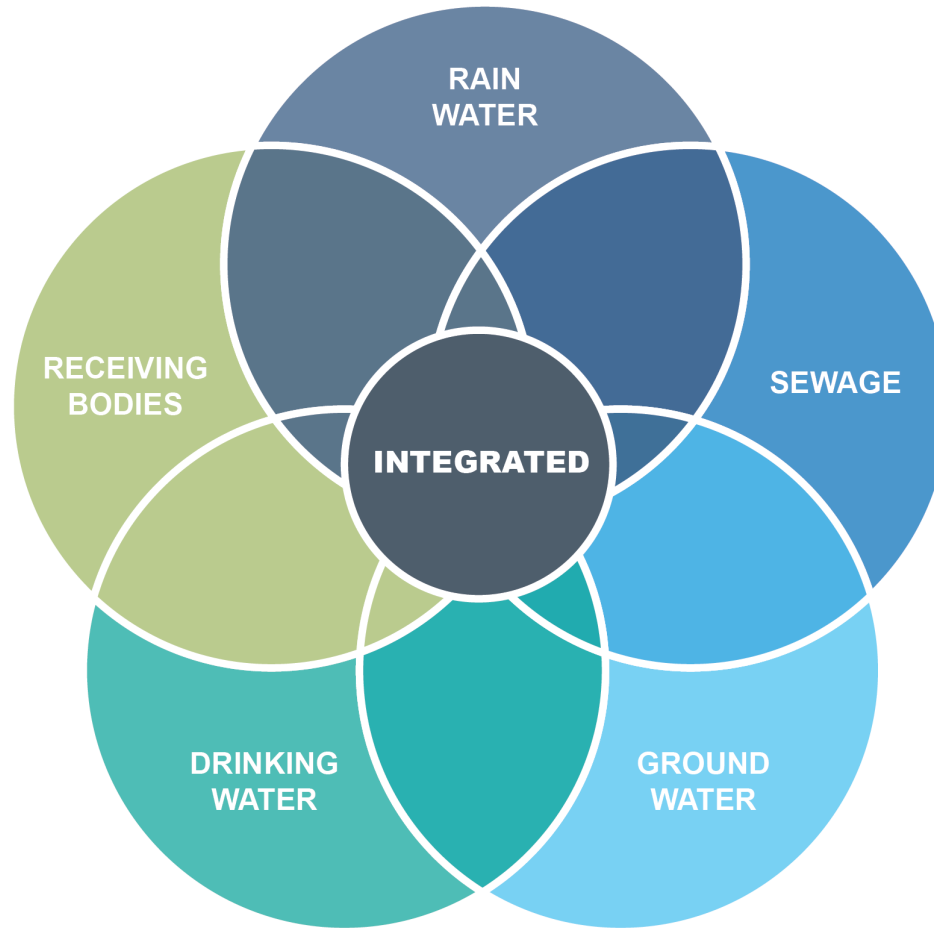


# TRADITIONAL WATER MANAGEMENT



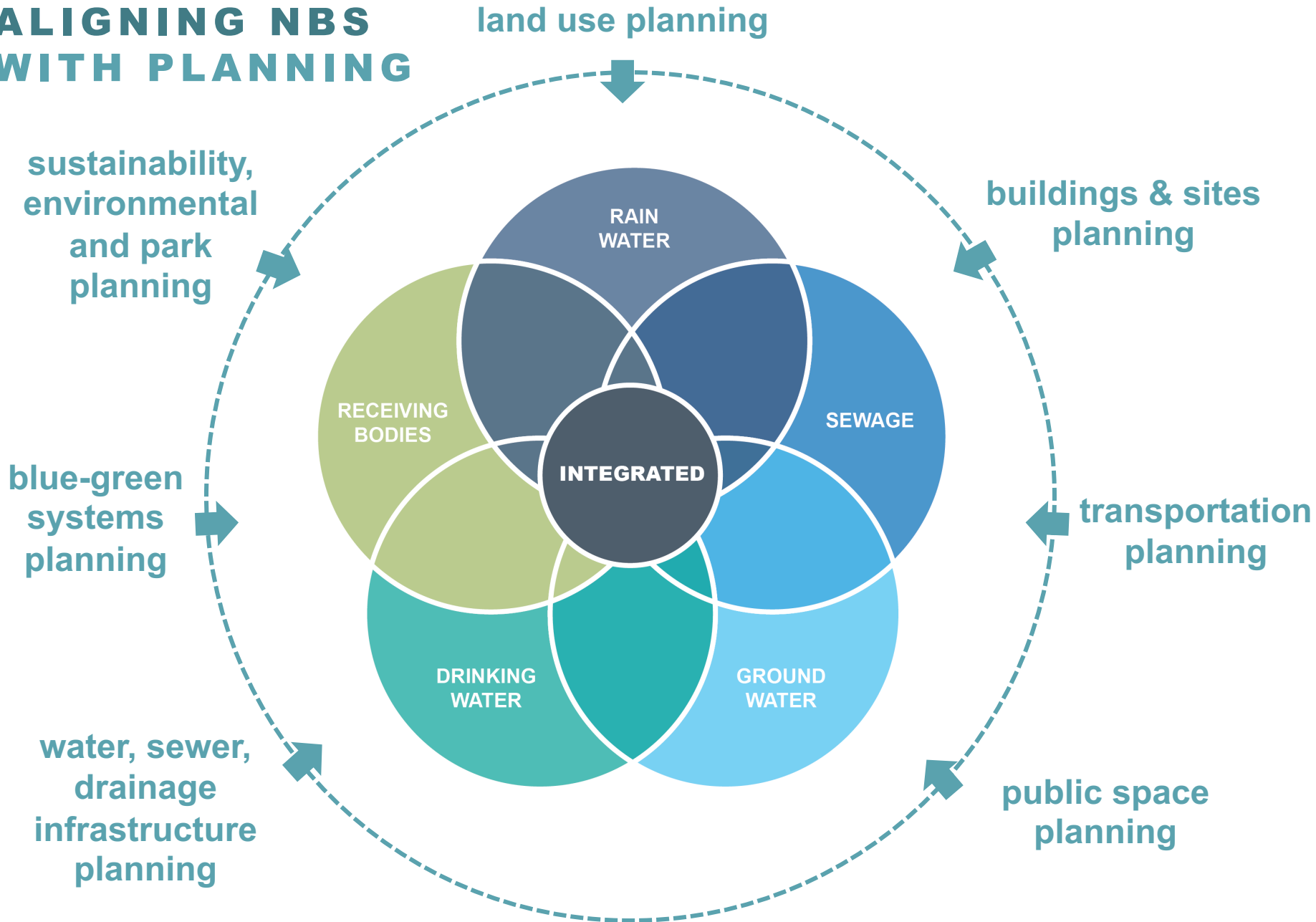


# INTEGRATION ELEVATES NATURE-BASED SOLUTIONS (NBS)





# ALIGNING NBS WITH PLANNING





3

# DEFINING GREEN INFRASTRUCTURE





# Green infrastructure

Uses vegetation, soils and other engineered systems and practices to mimic natural processes required to manage water and create resilient and healthier urban environments





# Green infrastructure has a positive impact

Promotes  
wellbeing

Mitigates  
pollution  
& reduces  
flooding

Enhances  
biodiversity

Inspires  
physical  
activity

Strengthens  
social ties



# Livability

Investments  
made in bringing  
nature back into  
the city will  
benefit people  
and our  
future resilience

Image: Winter in Oudolf's frosted Hummelo garden in the Netherlands  
Photo Credit: Hummelo: A Journey Through a Plantsman's Life





Rain garden



Non porous asphalt

Porous asphalt



Tree soil cells



Green roof



Street car





Absorbent  
landscape



Day-  
lighting  
streams



Rainwater  
harvesting



Detention  
tank



Wetland



Bioswale



4

# STRATEGY & TARGETS



# Rain City Strategy

9

transformative  
directions

3

action plans

Streets & Public Spaces  
Buildings & Sites  
Parks & Beaches

A high level, 30-year plan that aims to manage  
rainwater through green rainwater infrastructure that

protects

restores

mimics

the natural water cycle



# 9 Transformative directions

1. Strive to become a **water sensitive city**
2. Respond with urgency to **climate change**
3. Accelerate action to protect the **health and vitality** of surrounding waterbodies
4. Revitalize **watersheds and waterfronts** to enable communities and natural systems to thrive
5. Shape systems to integrate and **value all forms of water**
6. Explore intersectionality, **equity** and Indigenous **reconciliation** through urban water management
7. Drive **innovation** and system effectiveness through data and analytics
8. Enable a culture of **collaboration**
9. Invest in education, capacity building and partnerships to **mobilize action**

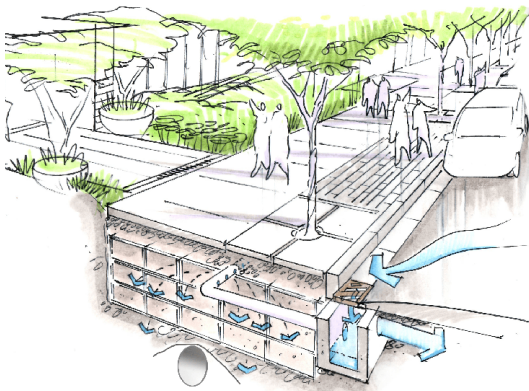


# 3 Action plans, 46 programs

## Streets & Public Spaces

Actively implementing capital projects

48mm /day



## Buildings & Sites

Rainwater mgmt reqts on private property

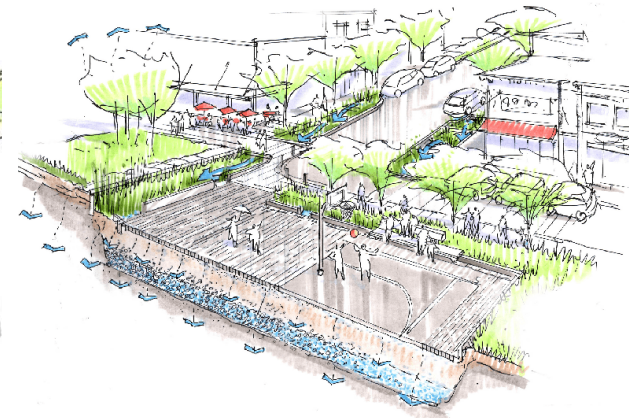
48mm /day  
by 2022




## Parks & Beaches

Actively implementing

48mm /day







**reduce  
volume of  
rainwater  
entering the  
pipe system**

**reduce  
pollutants  
in urban  
rainwater  
runoff**



**many  
co-benefits**

# Green Rainwater Infrastructure Water Mgmt Objectives

Image: Green rainwater infrastructure project at Yukon & W 63rd  
Photo Credit: Wendy de Hoog



Performance target

capture and clean  
a minimum of  
**90%**  
of Vancouver's  
average annual  
rainfall volume

Design standard

capture  
and clean  
**48 mm**  
of rainfall  
per day



# Citywide green rainwater infrastructure implementation target

becomes  
business as usual  
through

renewal,  
redevelopment  
retrofits





**CSLA  
National  
Award of  
Excellence**

Planning and  
Analysis

**Waters Next  
Award**

Stormwater  
Projects and  
Technology

**Waters Next  
Award**

2020 Project  
of the Year

**CIP National  
Award of  
Excellence**

Climate  
Change  
Planning

**PIBC Gold  
Award for  
Excellence**

Policy  
Planning City  
and Urban  
Areas

**BCWWA  
Excellence  
and  
Innovation in  
the Water  
and Waste  
Industry**

**UBCM  
Community  
Excellence  
Awards**

Sustainability

**International  
Erosion  
Control  
Association**

Environmental  
Excellence  
Award



## Rain City Strategy:

A Green Rainwater Infrastructure and  
Rainwater Management Initiative

5

# GREEN INFRASTRUCTURE IMPLEMENTATION IN VANCOUVER



# What we have been doing

Streets &  
Public Spaces

**264**

green rainwater  
infrastructure assets  
have been  
implemented

Buildings &  
Sites

**> 290**

sites have a rainwater  
management plan  
introduced rainwater  
harvest permit  
program

Parks &  
Beaches

**~240**

parks play a role in  
managing rainwater



# Green Rainwater Infrastructure Delivery in Vancouver

Since 2017 to the end of 2020,  
we've delivered:

**46** new GRI assets  
managing **2.9** ha of impervious area,  
cleaning and diverting from pipes  
**32** million litres of run-off per year



6

# **GREEN INFRASTRUCTION INNOVATIONS BLUE-GREEN ROOFS**



# VANCOUVER CITY HALL

## BLUE-GREEN ROOF DEMO + RESEARCH



Image: City Hall Blue-Green Roof Demo & Research Project, 2020  
Image Credit: Wendy de Hoog





# VANCOUVER CITY HALL

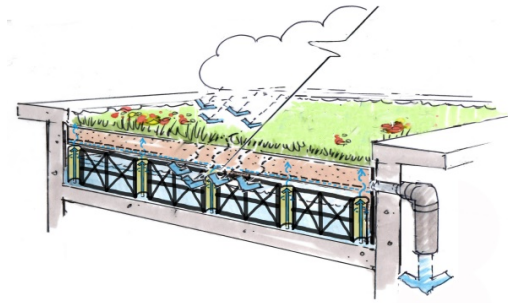
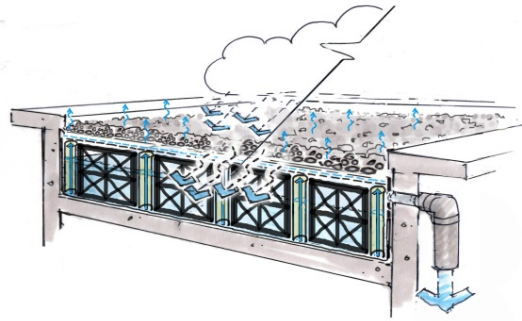
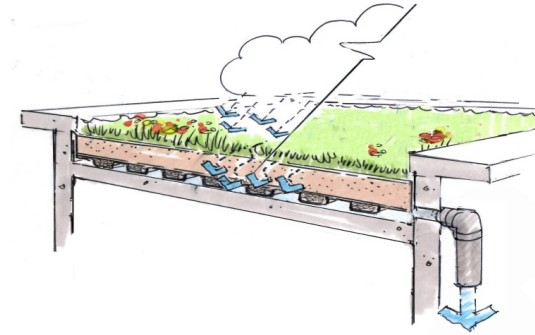
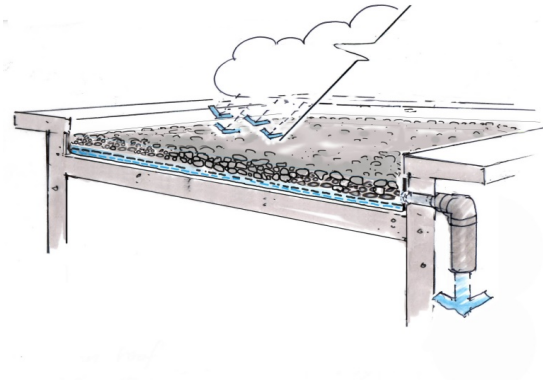
## BLUE-GREEN ROOF DEMO + RESEARCH

### PURPOSE:

1. Explore performance of four roofs:
  - Conventional
  - Green
  - Blue
  - Blue-Green

### DELIVERABLES:

1. Quantify runoff
2. Quantify insulation & urban heat mitigation
3. Measure moisture content of green & blue-green roofs

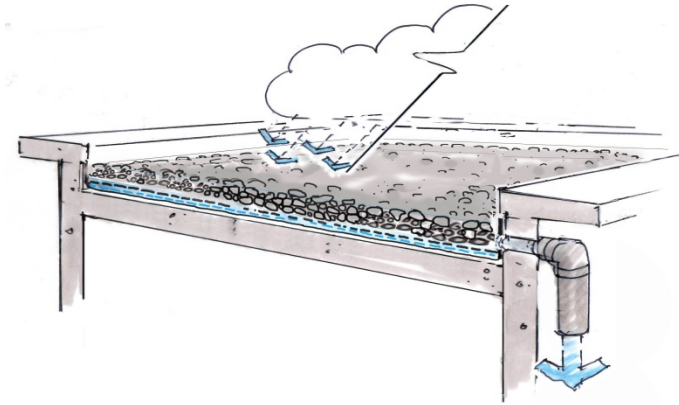


City of Vancouver Coord: Jenikka Javison  
BCIT Research: Harvey Takar  
BCIT Data & Analytics: Mehrnoosh Moghanian

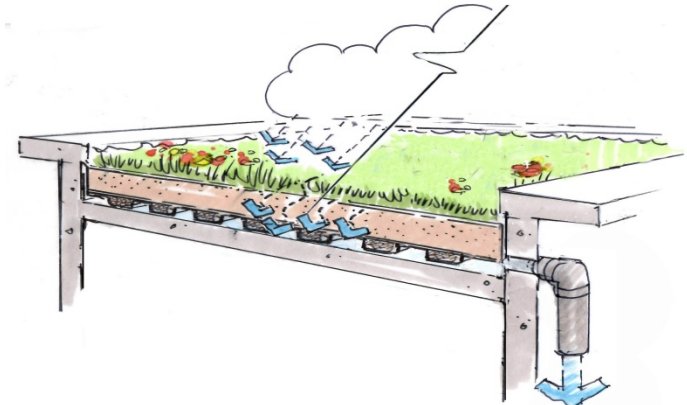


# VANCOUVER CITY HALL

## BLUE-GREEN ROOF DEMO + RESEARCH



**Conventional Roof**

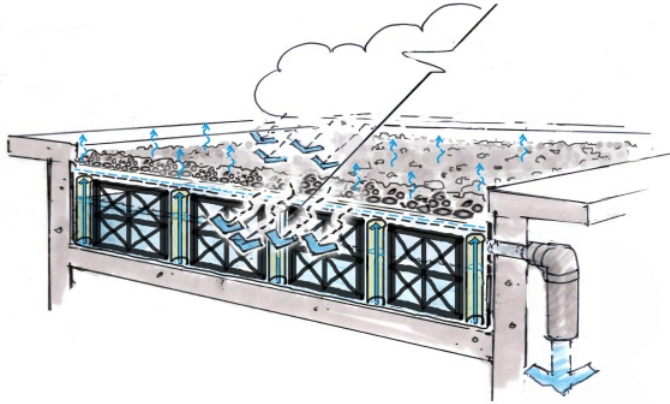


**Green Roof**

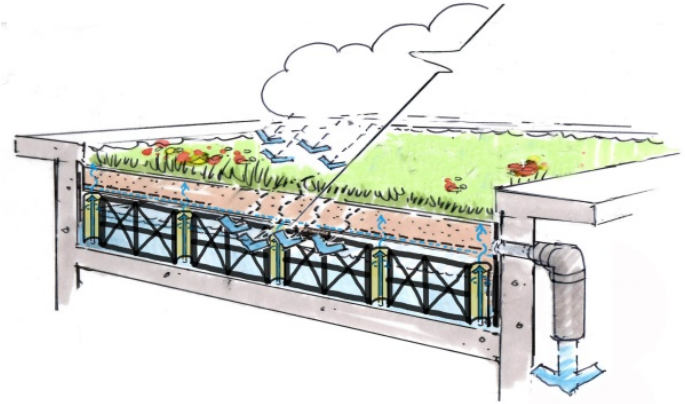


# VANCOUVER CITY HALL

## BLUE-GREEN ROOF DEMO + RESEARCH



**Blue Roof**



**Blue-Green Roof**

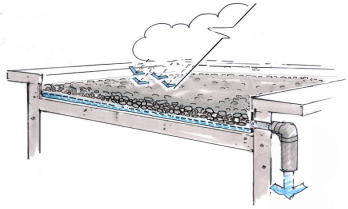




# KEY FINDINGS

## BLUE-GREEN ROOF DEMO + RESEARCH

### Conventional



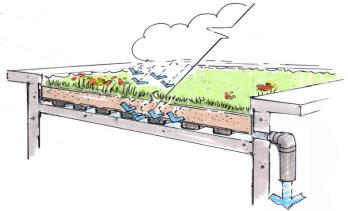
**Water Retained**  
*(Mar-Jun 2020)*

**Soil Moisture**  
*(Jul-Aug 2020)*

**Surface Temp**  
*(Jul-Aug 2020)*

**60°C**

### Green

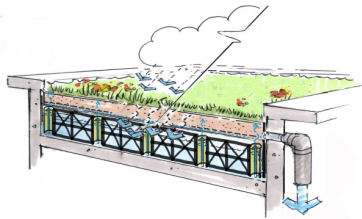


**65%**

**Declined**  
**20% to 0%**

**49°C**

### Blue-Green

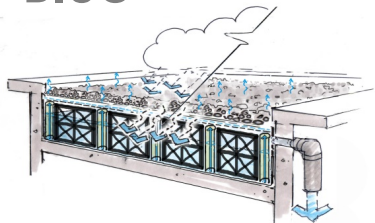


**67%**

**Maintained**  
**23-24%**

**36°C**

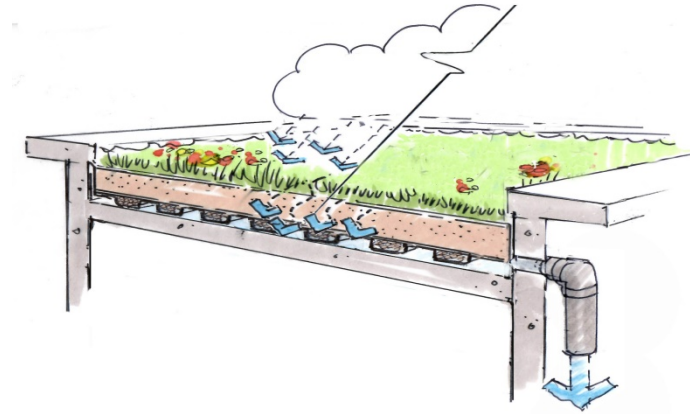
### Blue



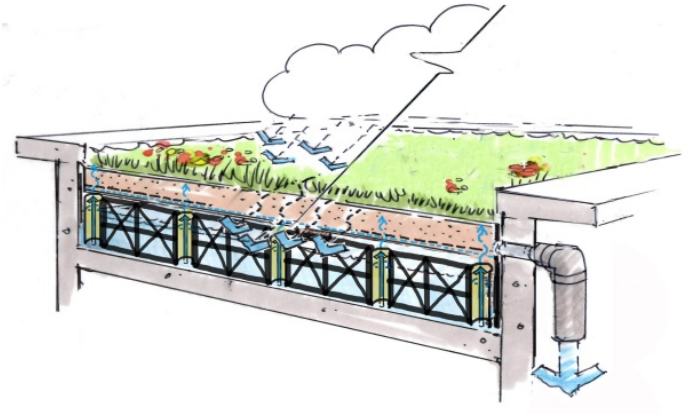
**42°C**

# PLANT HEALTH DURING HEAT WAVE

## BLUE-GREEN ROOF DEMO + RESEARCH



**Green Roof**



**Blue-Green Roof**





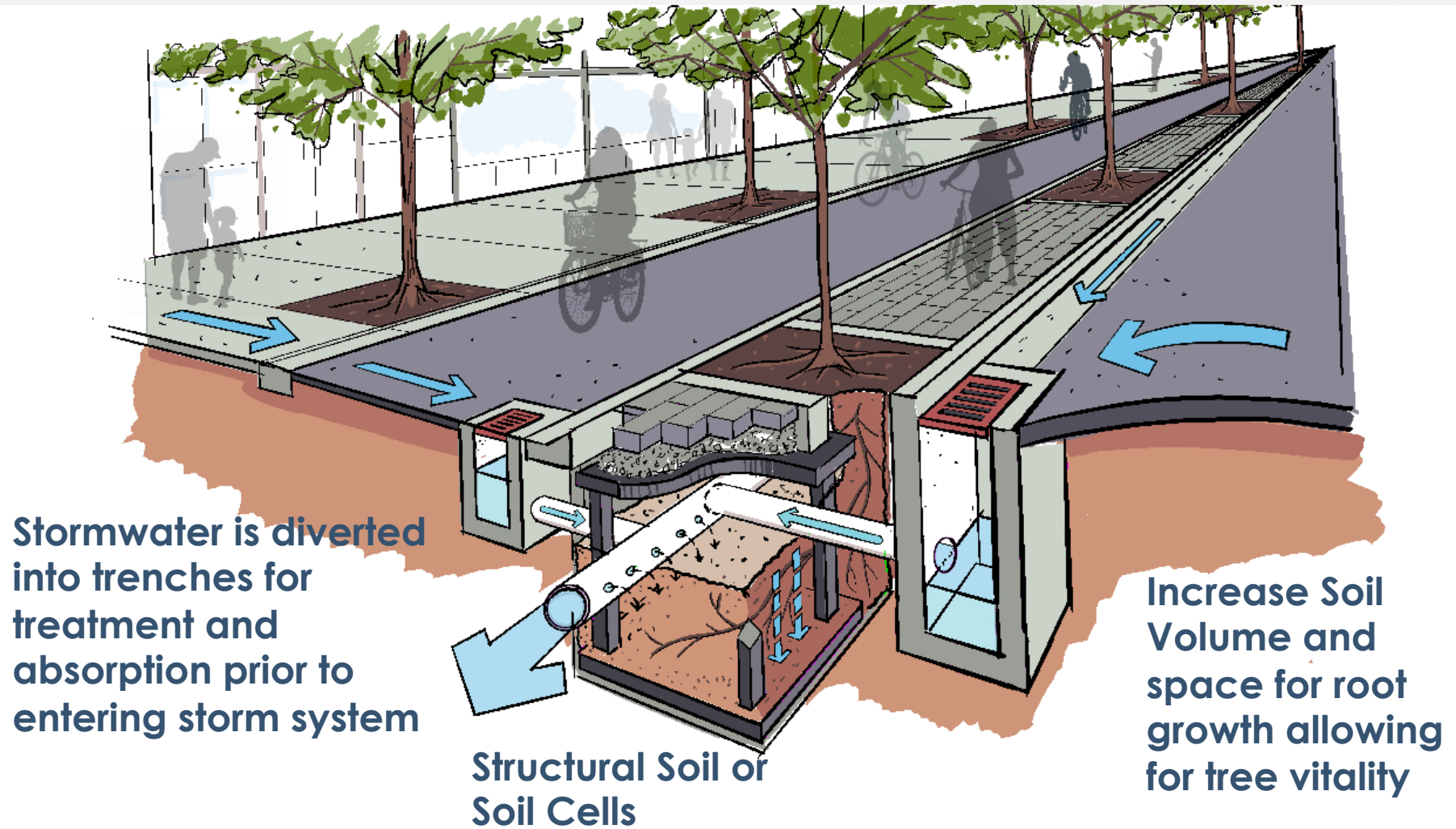
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# **GREEN INFRASTRUCTION INNOVATIONS**

## **RAINWATER TREE TRENCHES**

# INNOVATIVE TECHNOLOGY

## RAINWATER TREE TRENCH



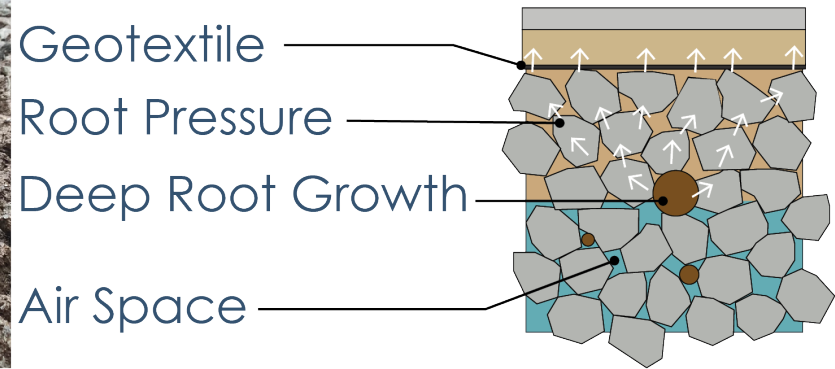
Rendering by Matt Gibbs, City of Vancouver

***Trees live 2-5 times longer & develop 25% larger canopy***



# STRUCTURAL SOIL

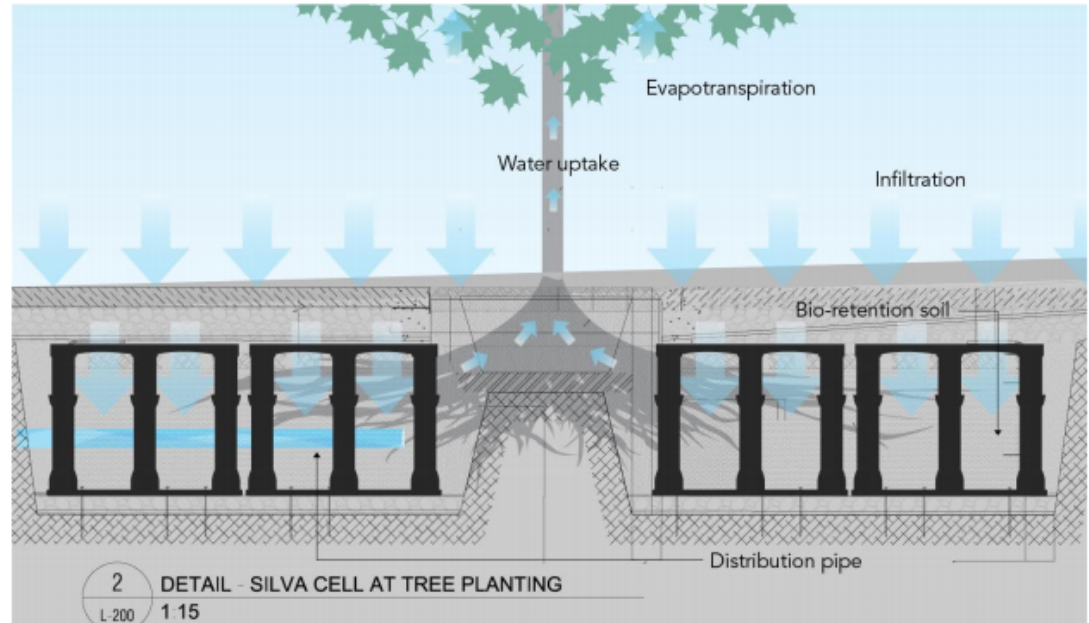
## DOWNTOWN RAINWATER TREE TRENCH



**Blend of Aggregates and Soil  
Mimics the Forest Floor**

# SOIL CELLS

## DOWNTOWN RAINWATER TREE TRENCH



North Carolina Stormwater Design Manual

### Growing Medium Soil Specification:

Compost **12-17%**

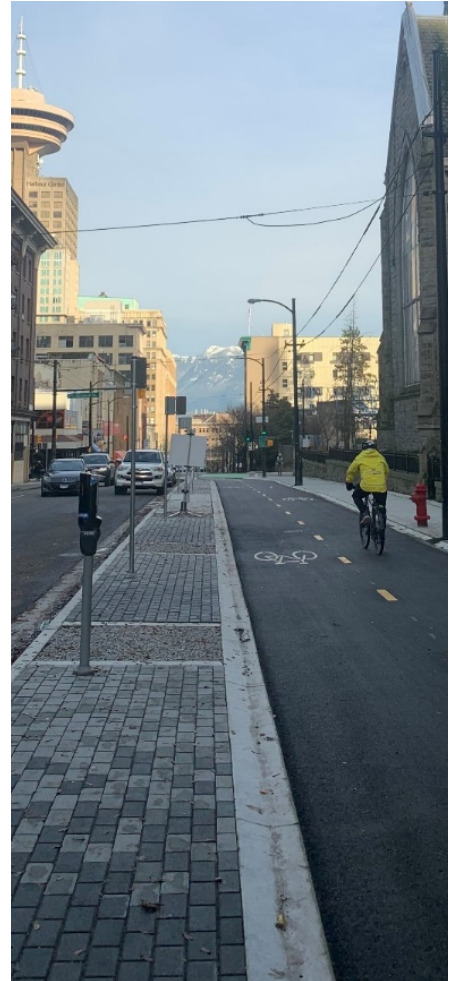
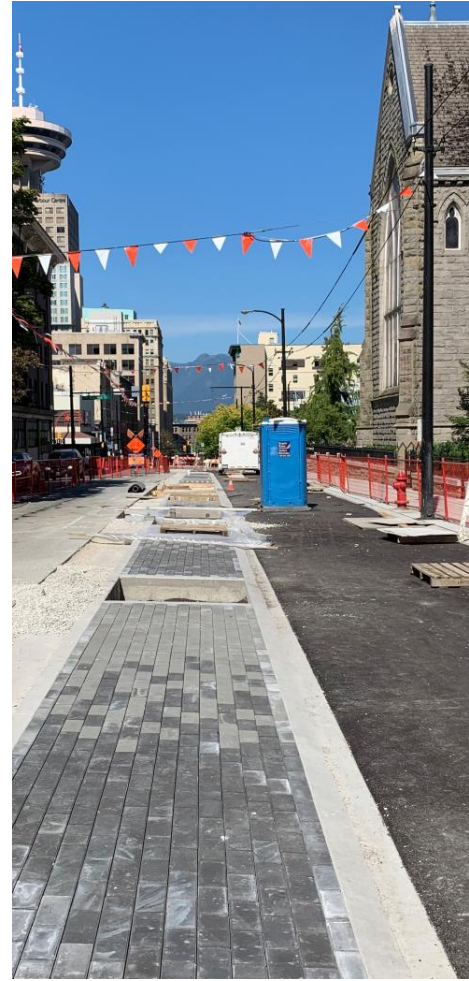
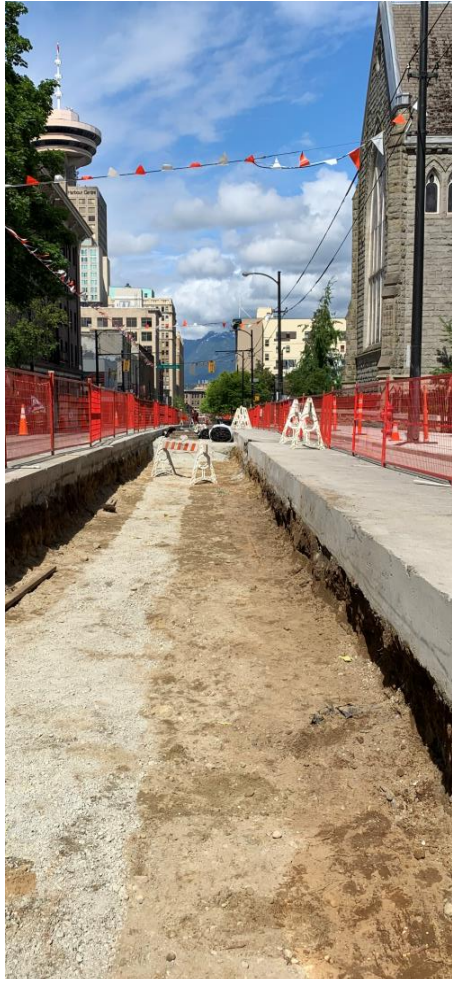
Coarse Sand **35-50%**

Topsoil **35-50%** (base planting soil mix)



# RICHARD STREET

## DOWNTOWN RAINWATER TREE TRENCH





# QUEBEC & 1<sup>ST</sup> STREET

## ARTERIAL STREET BIO-RETENTION & TREE TRENCH



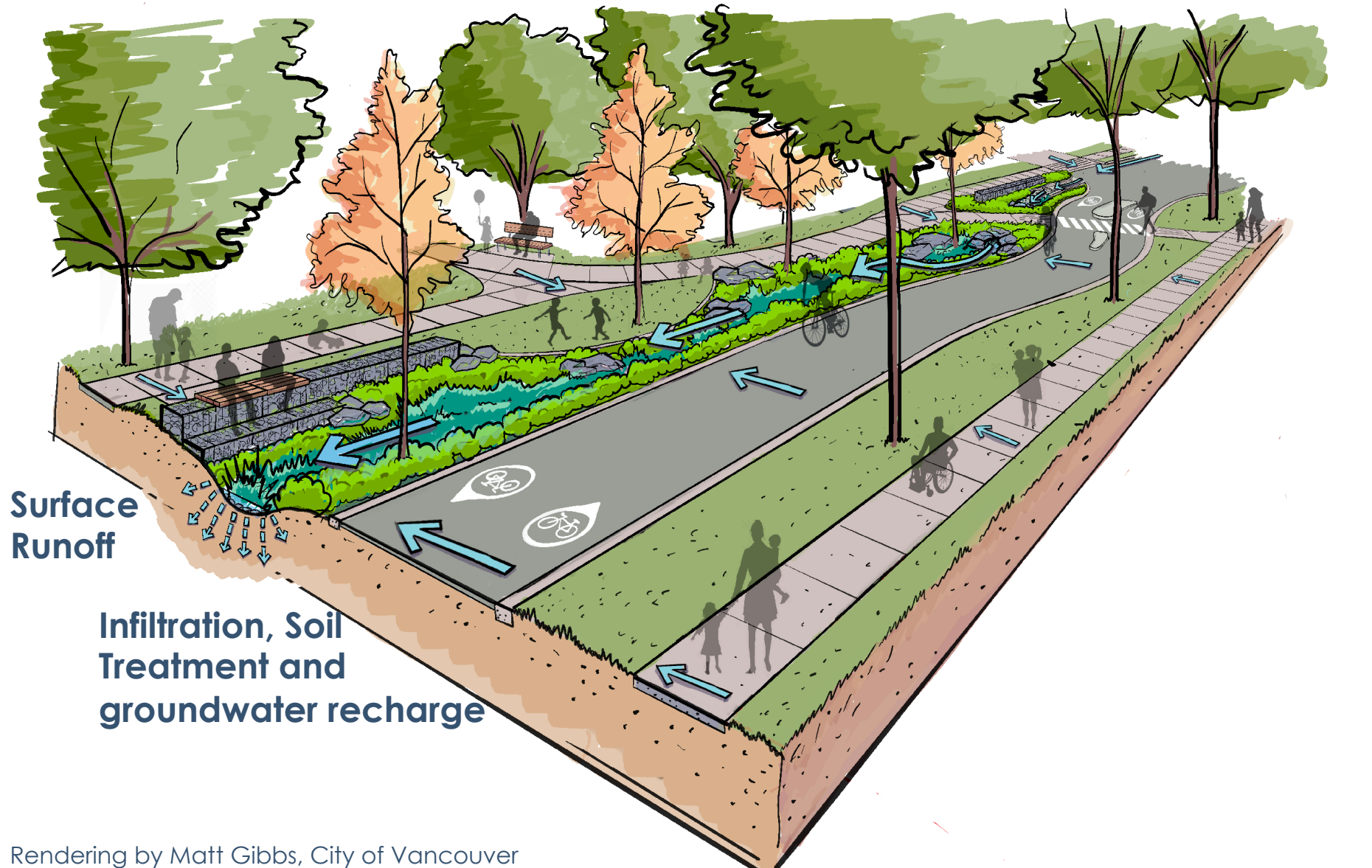


8

# GREEN INFRASTRUCTION INNOVATIONS BIORETENTION

# INNOVATIVE TECHNOLOGY

## BIORETENTION





# SUNSET PARK STREET CLOSURE

## BIORETENTION





# ENGINEERED SOILS

## BIORETENTION

### BENEFITS

- Readily purchased and can be custom blended
- Micro flora and fauna may be introduced (compost, inoculants)
- Uniform in appearance, free of weeds and stones
- Components such as biochar



Photo credit: Eagle Lake Supply

### CONSTRAINTS

- High sand mixes may **not be stable** in the long-term and need rejuvenation
- Lack of soil structure
- High Cost



# 63<sup>rd</sup> & YUKON STREET

## LOCAL STREET & PLAZA BIO-RETENTION



# SOIL RE-USE & AMENDMENTS

## BIORETENTION

- Test the Soil to determine custom blend
- Amend soils onsite with necessary growing medium (compost and sand)

### BENEFITS

- Cost savings
- Avoids expensive trucking and disposal of valuable resource
- Contains micro flora + fauna that support plant health and pollutant remediation
- Can retain natural structure that promotes aeration, water absorption, retention, and habitat for beneficial microorganisms



Photo from 63<sup>rd</sup> and Yukon During Construction

### CONSTRAINTS

- Requires space for soil blending
- May require multiple soil tests to attain proper soil specification



# SOIL RE-USE & AMENDMENTS

## BIORETENTION

### Soil Health at 63<sup>rd</sup> and Yukon



*topsoil stock, amendment, and re-use*



*fungal networks beginning to develop in the soils at 63<sup>rd</sup>*



The infographic features a central white circle with the text 'PLANT SELECTION' in teal. Surrounding this central circle are five teal circles, each containing white text. The background is a close-up photograph of bright yellow flowers, with a bumblebee visible on the left side. The teal circles are arranged in a ring around the center, with one circle on the left and four on the right.

Winter rain  
+  
summer  
drought

Limited long-  
term  
maintenance

Siting  
design  
guidelines

Stormwater  
absorption  
+  
treatment

**PLANT  
SELECTION**

Biodiversity  
+  
Place-  
making



# PLANTING ZONES

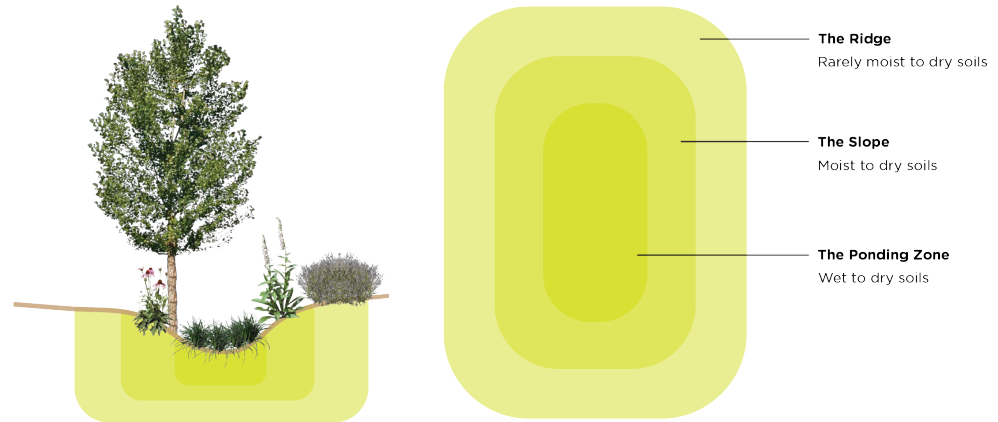
## BIORETENTION

Micro-  
climates

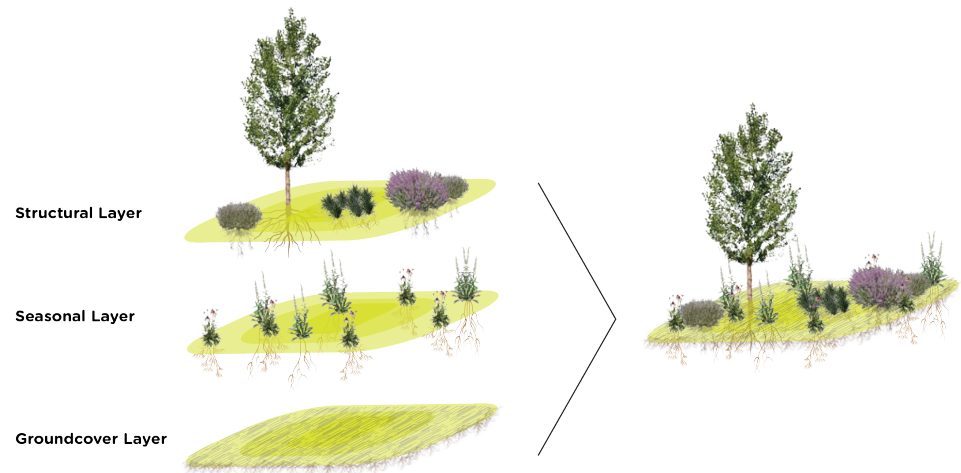
Density

Diversity

### Rain Garden Moisture Zones



### Planting Layers



# THANK YOU MERCI

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