

# Improving Coastal Flood Adaptation Approaches to Minimize Infrastructure Risk Using Engineers Canada PIEVC Protocol

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Asset Management BC  
Natural Risks and Natural Capital

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KEEP BACK 10'



DO NOT ENTER



# Surrey: Sustainable Service Delivery (SSD)

## SSD

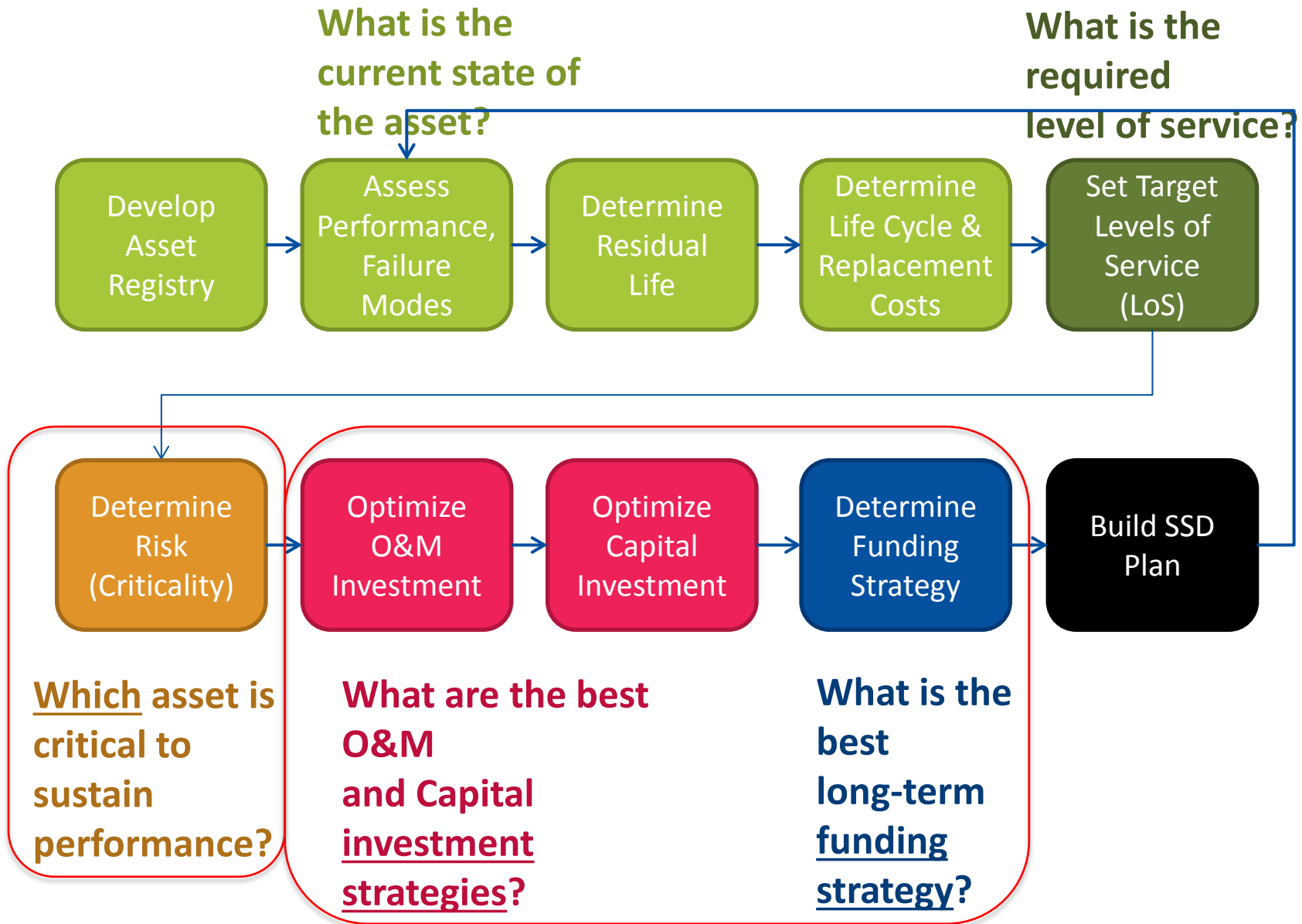
SSD ensures that current community needs, and how the services are delivered (technically, financially, environmentally) do not compromise the ability of future generations to meet their needs.

## Asset Management (AM)

AM is an integrated process related to our assets, data management and finances so that informed decisions can be made to support SSD.



# Step-by-Step Approach (by US EPA)

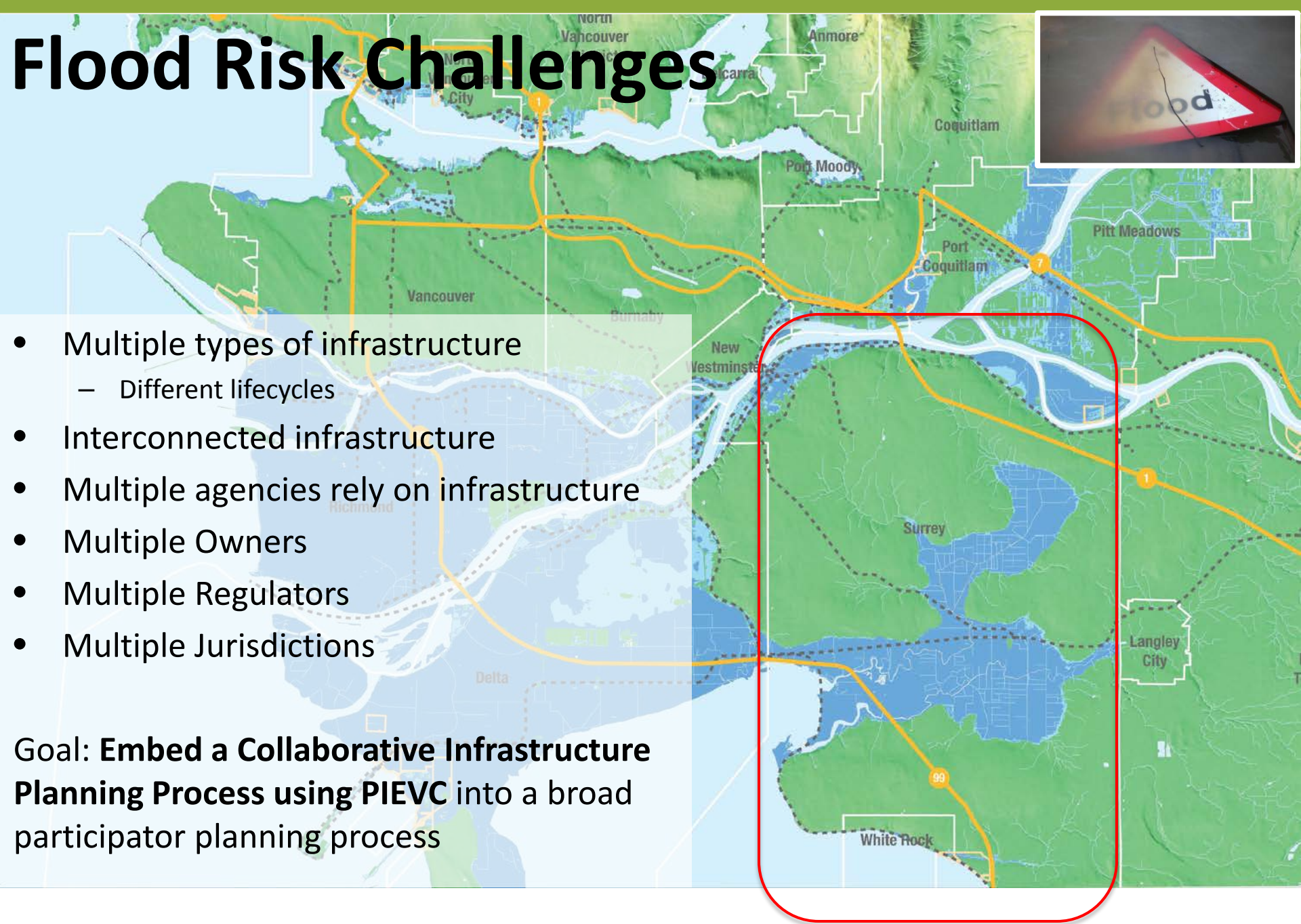


# Flood Risk Challenges



- Multiple types of infrastructure
  - Different lifecycles
- Interconnected infrastructure
- Multiple agencies rely on infrastructure
- Multiple Owners
- Multiple Regulators
- Multiple Jurisdictions

Goal: Embed a **Collaborative Infrastructure Planning Process using PIEVC** into a broad participator planning process





# COASTAL AND RIVER FLOODING

1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100 2100

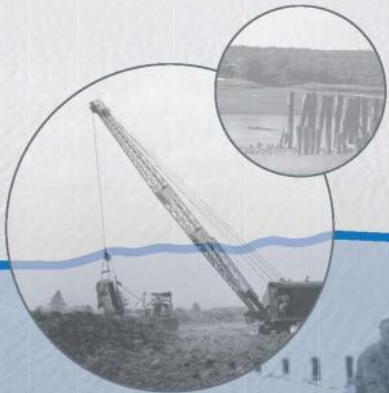
## Major Coastal and River Flood Events



## A Changing Shoreline

In 1890, dyking of Mud Bay begins. Shortly afterwards, dyking and damming of the Serpentine and Nicomekl Rivers begins. By 1953, a timber sea wall at Crescent Beach is constructed.

Since then, residents of Surrey's Coastal Floodplain have relied on a system of dykes and sea dams to protect themselves from ocean and river flooding.



Sea Level Rise with Ground Subsidence

1.2 Metres

Metre



TODAY

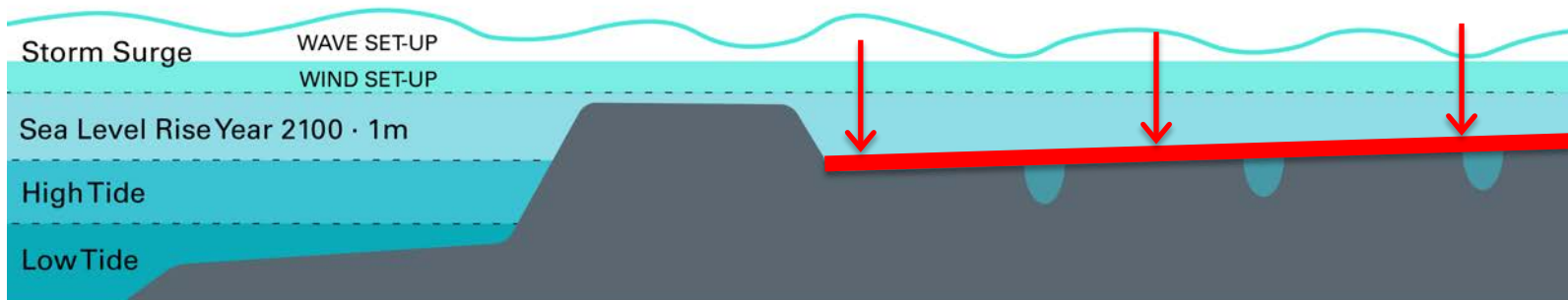
## An Evolving Future

As our climate continues to change and sea levels continue to rise over the coming years, it is anticipated that the frequency and intensity of major coastal and river floods will also increase.

The Province has directed municipalities to plan for at least 1m sea level rise by 2100. In Surrey, and elsewhere in the Lower Mainland, most drainage systems are not designed for projected changes.

# Climate Change and Flood Hazards

- Sea level rise, ground subsidence and dyke settlement
- Sea level rise combined with more frequent and more intense storm surges increases the risk of dyke breaches – overtopping, failures, and piping



# 10 Year Servicing Plan

Funding for the 10 Year Servicing Plan:

- Drainage Utility Fees collected on all properties (\$223/\$409)
- Development Cost Charges collected from new development



10 Year Servicing Plan assigns budgets to different programs within each utility with program allocations:

- \$5 M allocated to Climate Change and related hazards for studies, partnerships, modelling, mapping and data collection.





# 2015

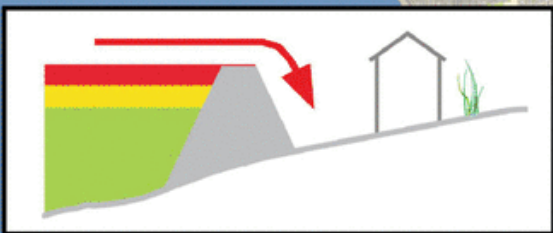


200 year event

- 200 year events become <2 year events by 2100 (lower reaches)
- 10 out of 13 bridges across the floodplain will be submerged or partially submerged in the future – structures have not been designed for this condition

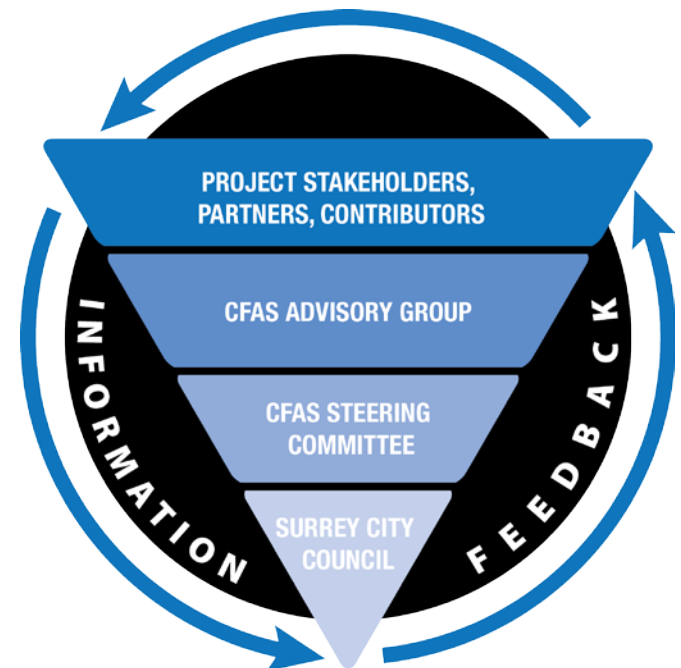
## Lowland Drainage Infrastructure at Risk

200 year floodplain



# Coastal Flood Adaptation Strategy

- Council endorsed recommendations to develop a Surrey Coastal Flood Adaptation Strategy in 2017
- Participator Process with many stakeholders and partners:
  - Farmers and agricultural community
  - Residents, businesses, community groups
  - Environmental and recreational groups
  - **Infrastructure operators, owners & emergency service providers**
  - Semiahmoo First Nation





4

**MEETINGS AND SITE VISITS**  
with Semiahmoo First Nation

3

**FOCUS GROUPS**  
(Agriculture & Farming, Community & Residential, Environment & Recreation)  
**60+ participants**

7  
**TECHNICAL WORKSHOPS**  
2 Greenshores™ Shoreline Design workshops, 2 PIEVC™ infrastructure operators workshops, 2 Design workshops with Dutch engineering design experts and UBC researchers, Coastal regulators, Coastal stewards

3

**CFAS ADVISORY GROUP WORKSHOPS**  
With project stakeholders and partners, including local governments, infrastructure operators, provincial agencies, organizations, residents and farmers

5

**CRESCENT BEACH COMMUNITY WORKSHOPS**  
**140+ attendees**



**BUS TOURS**  
Site tour and "walk-shops" around the CFAS study area  
**70+ participants**



**SURREY YOUTH ENGAGED**  
5 sessions with high school students, 2 youth events at City Hall, and 80 CFAS postcards completed by elementary school students



**COMMUNITY CONVERSATIONS**  
at Crescent Beach pop-up event hosted with 40+ University of the Fraser Valley Geography and Environment students



**POP-UP PROJECT OUTREACH STATIONS**  
Crescent Beach, Blackie Spit, SFU Surrey, Surrey Centre/Ocean Park/ Semiahmoo Public Libraries, Surrey City Hall, Alexandra House (Crescent Beach)



**WORKSHEETS COMPLETED**  
At various engagement events and workshops



**SOCIAL MEDIA IMPRESSIONS**  
Instagram & Twitter (200+ #SurreyCoastal mentions), Facebook (100+ CFAS comments), LinkedIn, YouTube (1,000+ hours of CFAS video views), CFAS website and StoryMaps (10,000+ views)



**1,000+**  
**COMMUNITY MEMBERS**  
directly involved to date

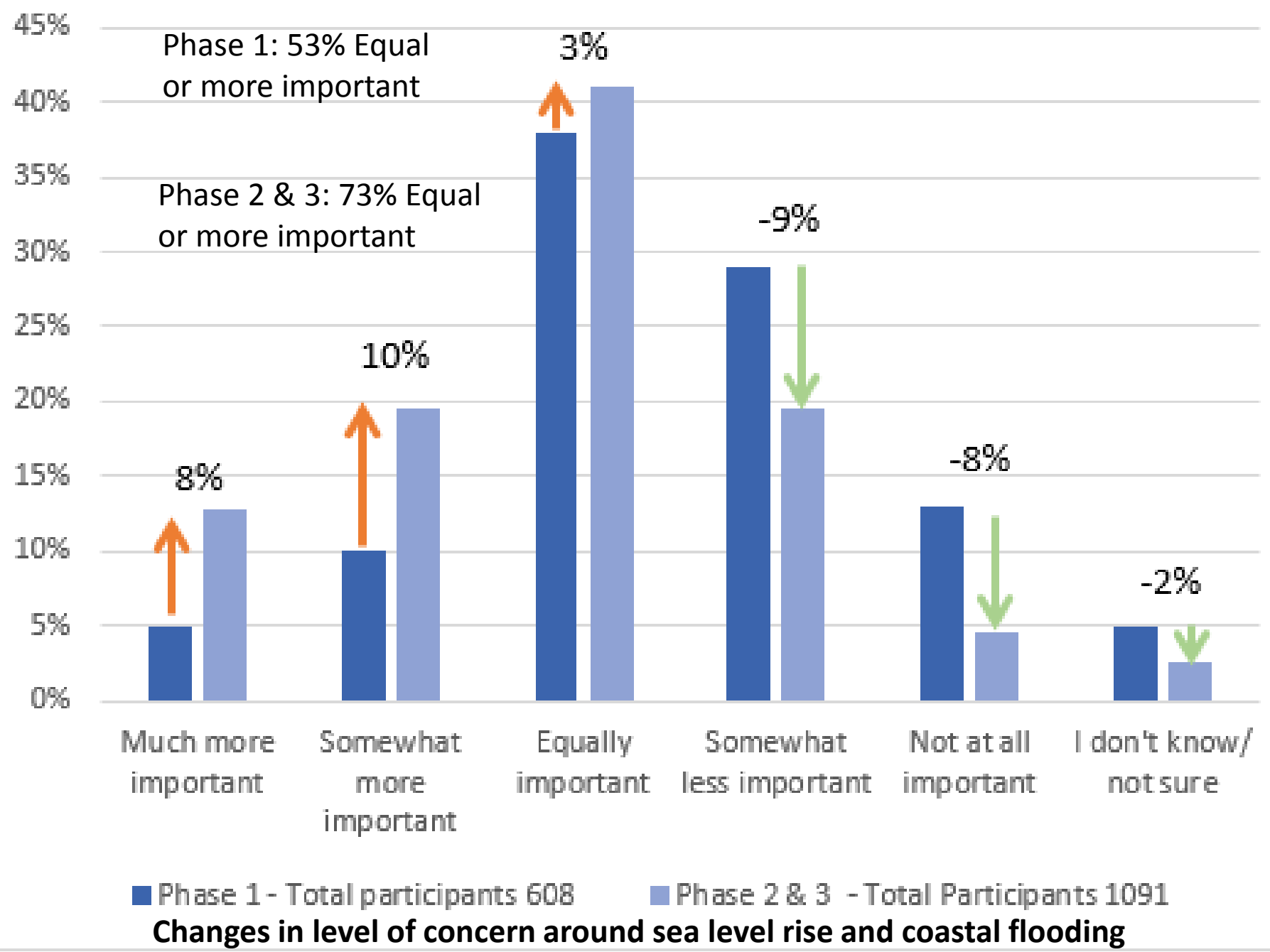


**#SURREYCOASTAL PHOTO CONTEST**  
200+ submissions on Facebook, Twitter, and Instagram with winners in three categories



**1,000+**  
**SURVEYS**  
Completed online, at CFAS workshops, at community events, and by CitySpeaks Members

By comparison to other issues Surrey is facing, how important is the issue of sea level rise and coastal flooding?

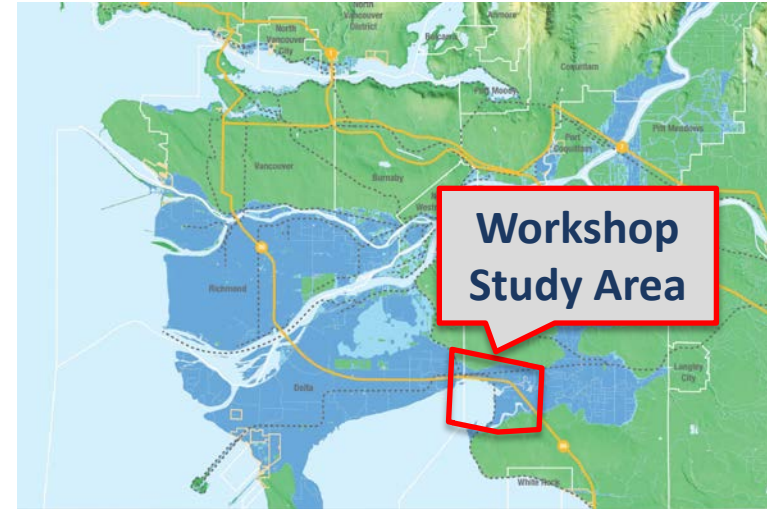




# PIEVC™ Vulnerability Assessment

## Workshop 1: March 28, 2017

- Mud Bay infrastructure operators, owners & emergency service providers participated in a one day workshop
- Workshop included 66 participants from 28 organizations
- Workshop utilized the PIEVC Protocol (<http://pievc.ca/>)
  - Developed by Engineers Canada and heavily used by Ministry of Transportation and Infrastructure



## Organizing Committee Established



Delta



# Workshop 1 Stakeholders

- Stakeholders in 3 sectors assessed their vulnerabilities:
  - Flood / Marine (2 groups)
  - Transportation (2 groups)
  - Utilities (2 groups)



## Workshop Attendee Organizations

Associated Engineering	Cowichan Valley Regional District	Ministry of Environment
BC Ambulance Service	Ducks Unlimited Canada	Ministry of Transportation and Infrastructure
BC Rail Consultant	Emergency Management BC	Mud Bay Dyking District
BC Hydro	Engineers Canada	Port of Vancouver
BNSF	FortisBC	Royal Canadian Mounted Police
Canadian Coast Guard	Metro Vancouver	SNC Lavalin
CFPS Consulting Team	Ministry of Agriculture	Southern Railway of BC
City of Surrey	Ministry of Community, Sport and Cultural Development	Surrey Operations
City of Vancouver		Telus/Shaw
Corporation of Delta		



# Risk Assessment Results

- Risk Summary: 43 assets assessed
  - Coastal Flood with Dyke Breach

- Created a shared understanding of coastal flooding impacts to infrastructure in Mud Bay
- Identified issues, concerns and vulnerabilities of Mud Bay infrastructure
- Obtained feedback on approaches for addressing coastal flood hazards

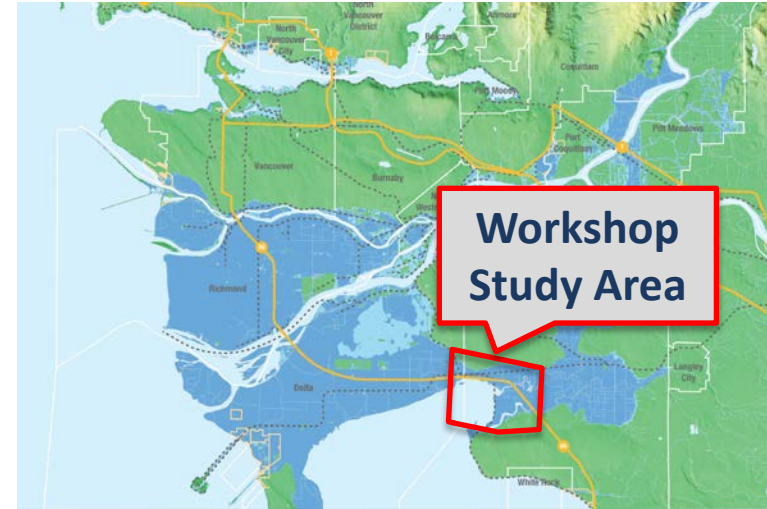
Flood Risk	Coastal Flood with Dyke Breach Current	Coastal Flood with Dyke Breach 2100
Low	20	6
Medium	21	15
High	2	22

53% of today's low and medium risk infrastructure is projected to become high risk by 2100

# PIEVC Adaptation Approaches

## Workshop 2: October 10, 2017

- To explore what impacts selected adaptation options may have on **vulnerable key infrastructure** and land-use located in the Study Area
- Workshop included 58 participants from 23 organizations
- Workshop utilized the PIEVC Protocol triple bottom line decision-making module
- Optional pre-workshop study tour September 25, 2017



### New stakeholders participating :

- Agricultural Land Reserve
- BC Agriculture and Food Climate Action Initiative
- Engineers and Geoscientists BC
- Fraser Basin Council
- Surrey Board of Trade
- University of British Columbia



# Triple Bottom Line Analysis

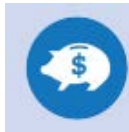
Helps to establish, in broad terms, environmental, social and economic factors to aid decision-makers in selecting appropriate adaptation actions and strategies.



Environmental



Social



Economic

Focus of  
Workshop 2



- 14 factors identified, each participant evaluated importance
- 11 factors stood out as high level of importance across multiple sectors

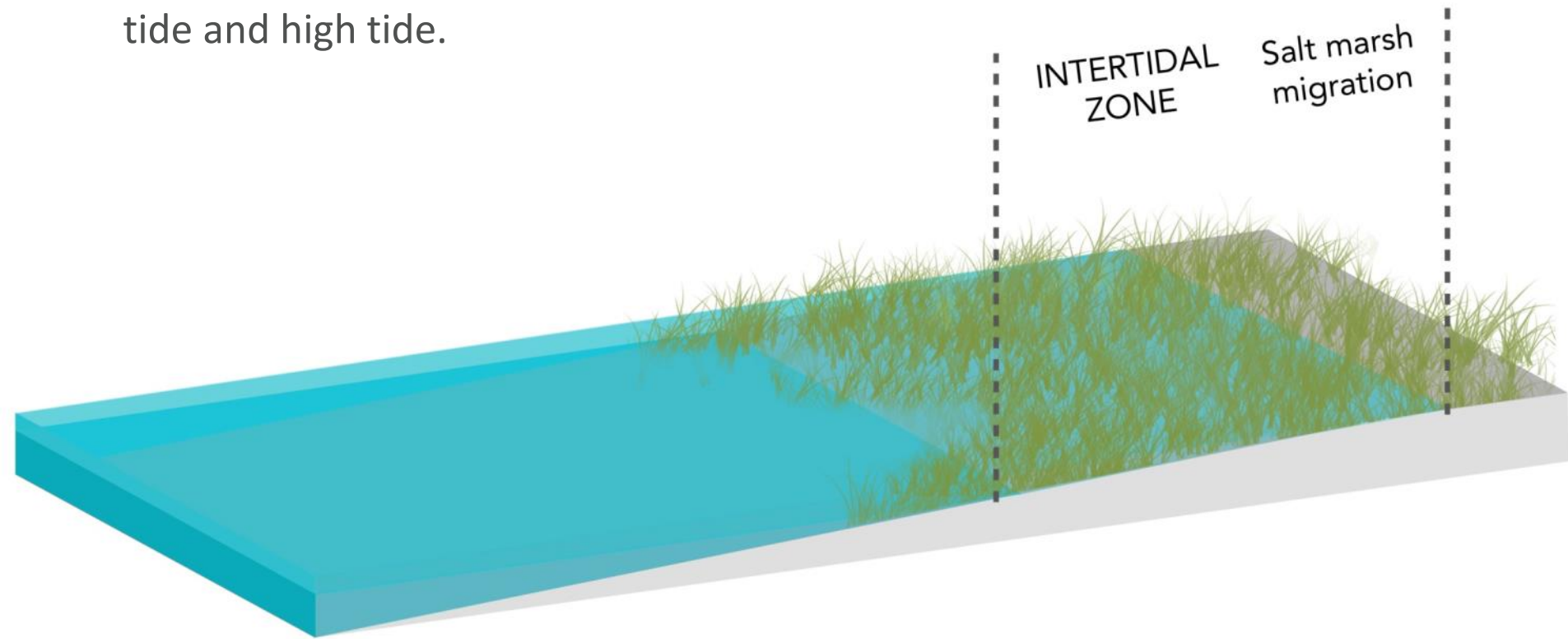
# Green Infrastructure

- Included in the Triple Bottom Line Assessment
- Important to have broad stakeholder base involved (ENGOS, City Parks, etc.)
- Significant data gaps need to be resolved
  - Follow up study *Prioritizing Infrastructure and Ecosystem Risk in Mud Bay* is underway



# Natural Shoreline (Green Infrastructure)

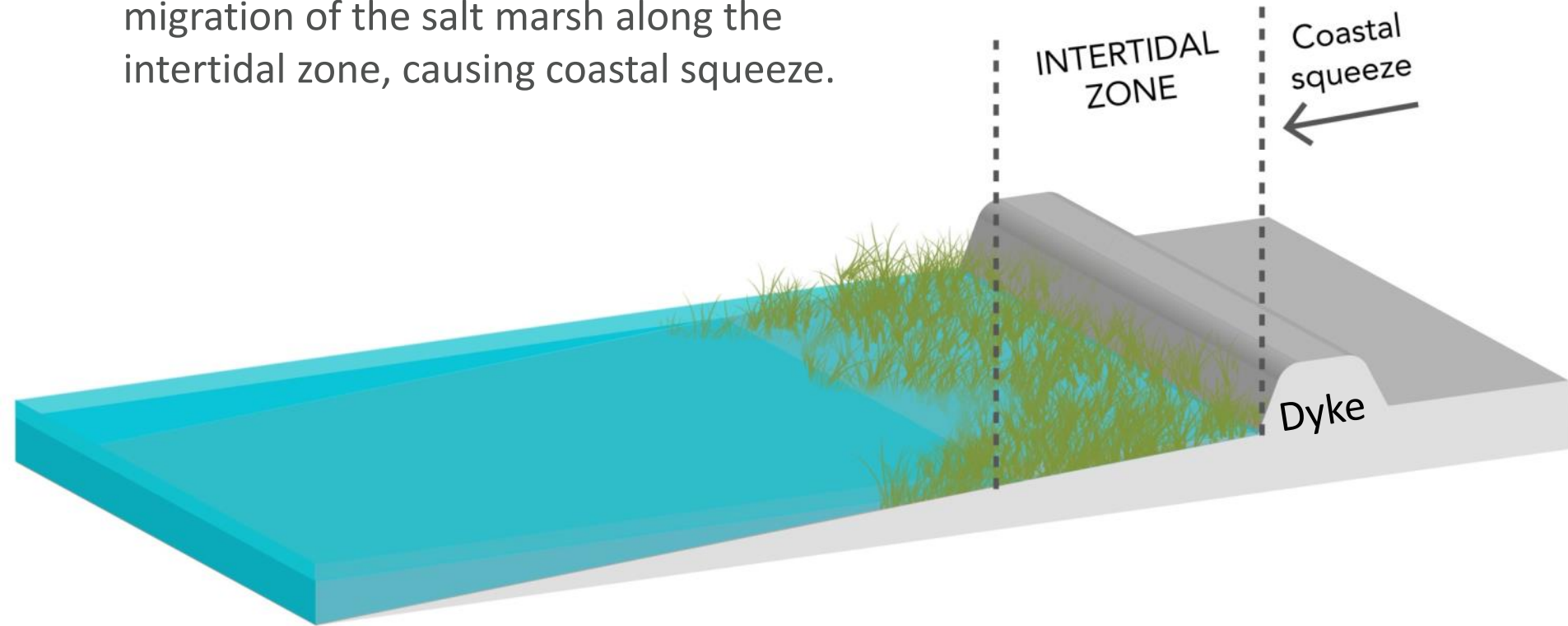
The Intertidal zone occurs between the low tide and high tide.





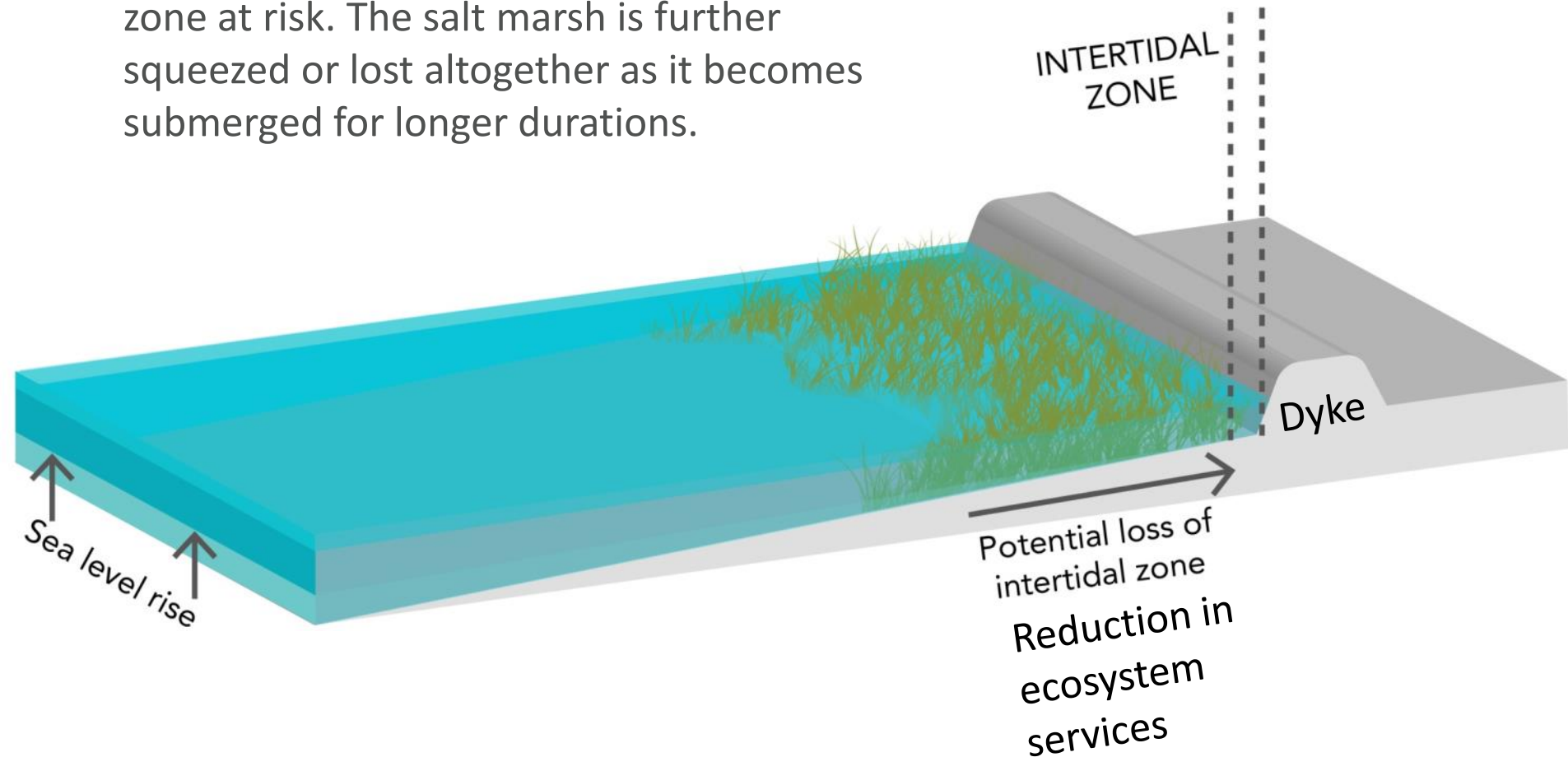
# Addition of Grey Infrastructure

The placement of a dyke prevents natural migration of the salt marsh along the intertidal zone, causing coastal squeeze.



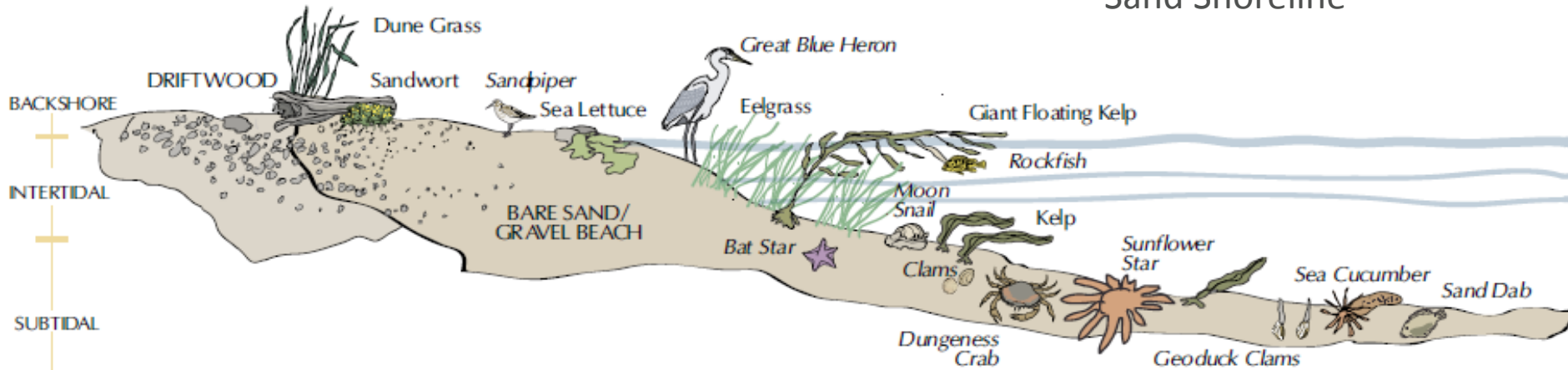
# Sea Level Rise

Sea level rise further places the intertidal zone at risk. The salt marsh is further squeezed or lost altogether as it becomes submerged for longer durations.



# What's at risk?

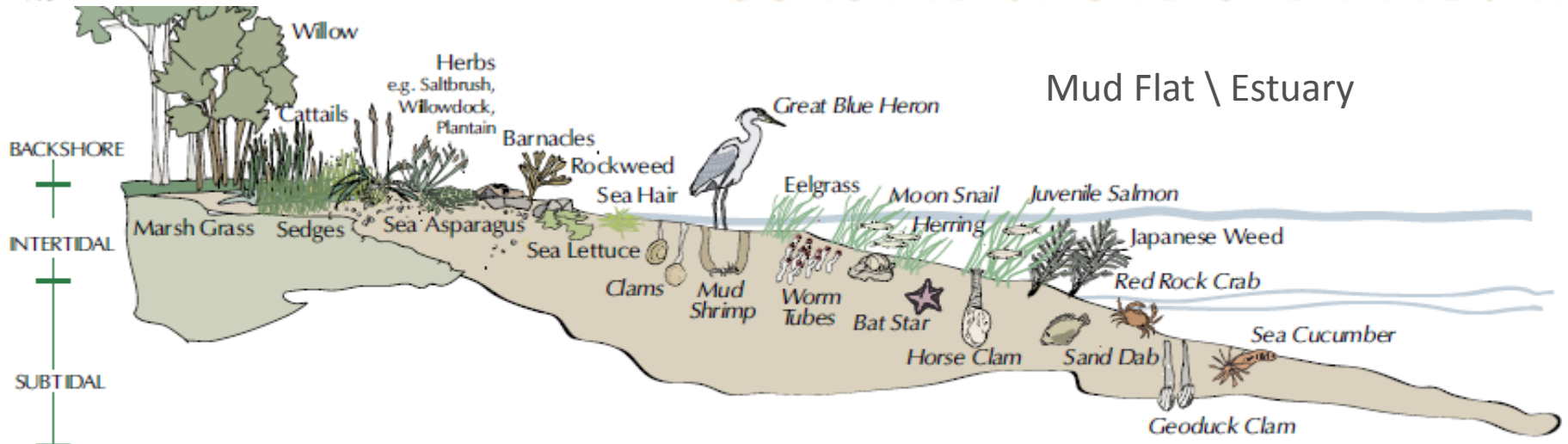
Sand Shoreline



*Adapted from a sketch by Archipelago Marine Research Ltd.*

COASTAL SHORE STEWARDSHIP

Mud Flat \ Estuary



*Adapted from a sketch by Archipelago Marine Research Ltd.*

COASTAL SHORE STEWARDSHIP



# Example Coastal Squeeze

Aug. 29 '08

Jan. 16 '09



Up to 1.8m lateral erosion in 16 months

# Example Coastal Squeeze



© Pictometry

- April 1, 2013



# Example Coastal Squeeze



Illustration 8-28

Barrie Sanford

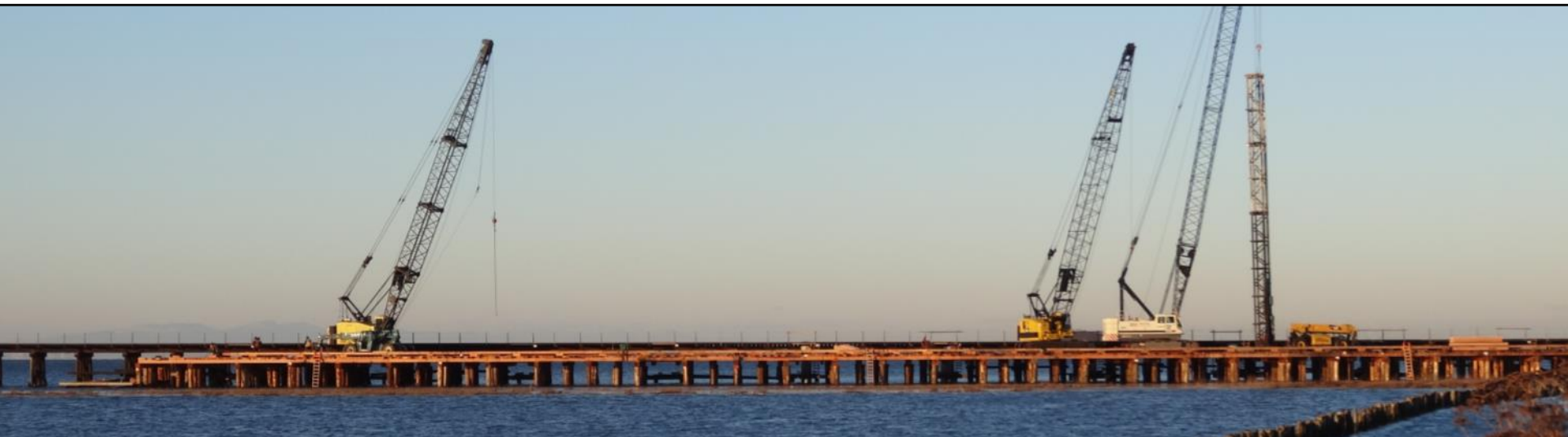
Source: Railway on the Bay, 2009



# Risk Assessment Findings

Flood Risk	No Adaptation 2100	Coastal Realignment to 152 St 2100	River Realignment 2100
Low	2	4	11
Medium	6	6	5
High	13	11	5

Improving Coastal Flood Adaptation Approaches



# Workshop 2 – General Comments

## 1) Cost-sharing and collaboration is a high priority

- Seek co-benefits
- Collaborative projects makes for better outcomes
- Necessary for community and political support

## 2) Considerations of shared utility corridors

- Reduces costs
- Can increase risk without extensive mitigation



# Insights for CFAS Decision Process

- 1) Key infrastructure is **adaptable**  
→ Options have the potential to minimize infrastructure risk
- 2) Infrastructure owners are mostly **reactive**  
→ Absence of specific adaptation plans
- 3) Flood infrastructure and transportation infrastructure are heavily **interconnected**  
→ Coordination is required





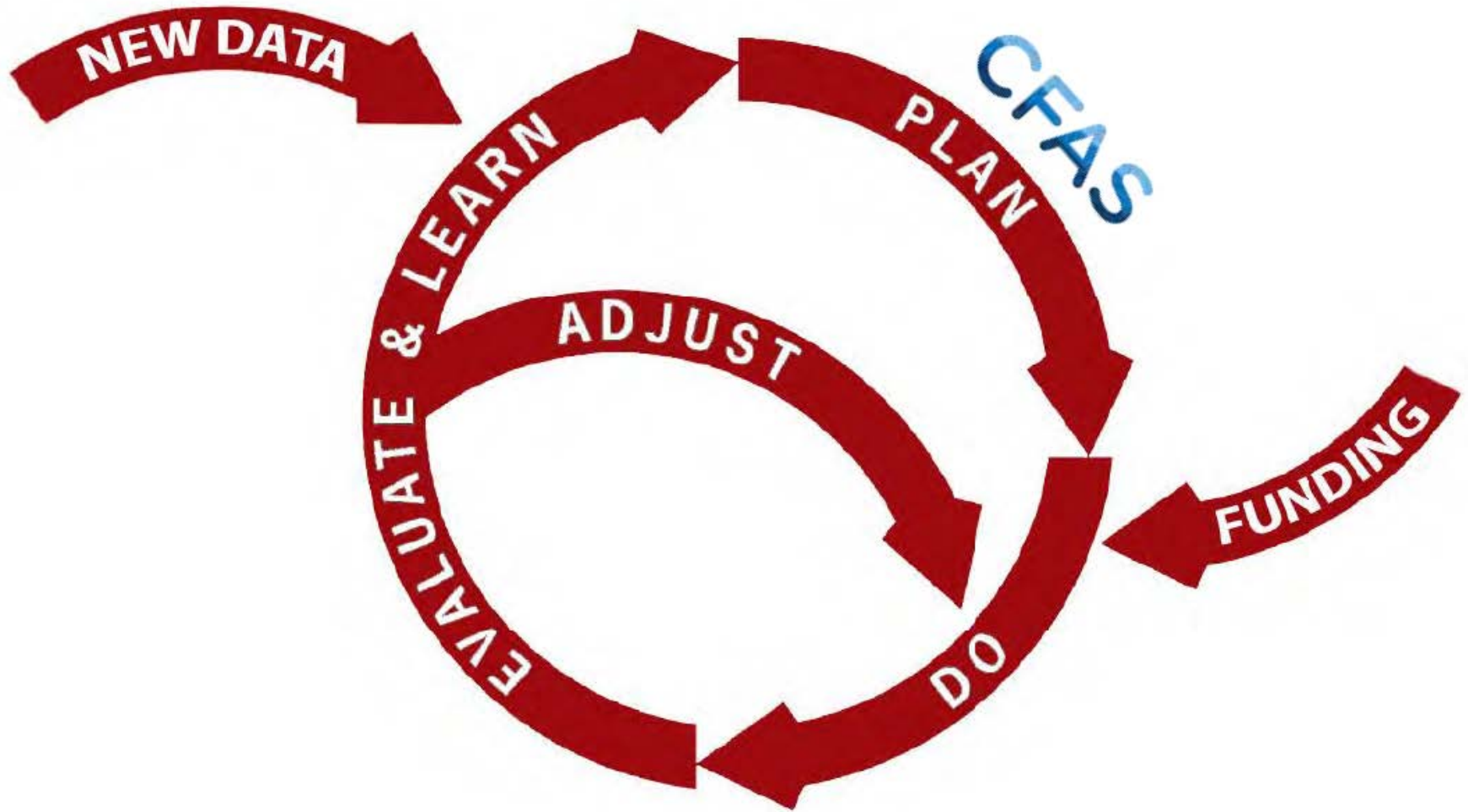
# Lessons Learned

- Staff level input at **WORKSHOPS** is key from all departments
  - Start the conversation while there is time
- PIEVC provided a **SYSTEMATIC** method to think through risk
  - Minimized gaps that may otherwise have formed in the broader public participation process
- Adaptation raises **BIG** issues
  - Private organizations **AND** government need to respond
- **INNOVATIVE** materials are needed
  - Online materials (Videos, interactive maps, resource libraries)
  - Custom designed graphics with stylized Primers and presentations
- Process is **ITERATIVE** and a **FRAMEWORK** is needed to coordinate long term adaptation actions across jurisdictions
- Funding opportunities provide **INCENTIVES** to collaborate

# Climate Adaptation Investments

- Provincial Cost Estimate for Surrey Adaptation Works \$1.5B
  - 1) City of Surrey Investment
    - Annual Budget \$500,000 for partnerships and studies
  - 2) Federal Funding Received \$450,000 (FCM MCIP)
    - Supporting Assessments and Plans
  - 3) Provincial-Federal Funding Requested \$900,000 (NDMP)
    - Proposed to build community partnerships
  - 4) Federal Funding Requested \$30+ M (DMAF)
    - Proposed to support implementation of capital works, integrated with asset renewal and extensive climate adaptation aspects and other co-benefits

# What's Next?







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- UBC CALP
- Engineers Canada
- Engineers & Geoscientists BC

Workshop materials online: [www.surrey.ca/coastal](http://www.surrey.ca/coastal)  
[#SurreyCoastal](https://twitter.com/SurreyCoastal)