



SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)


February 21st, 2018 Crescent Beach Options
Selection



Crescent Beach

PROJECT BACKGROUND

Climate Change & Coastal Floods

An aerial photograph showing a coastal area. On the left, there's a body of water with a sandy beach. A river or canal flows from the top right towards the center. To the right of the river, there are green agricultural fields. In the center-right, there's a residential or small industrial area with several buildings, some of which appear to be partially submerged or surrounded by water. The overall scene illustrates the vulnerability of coastal infrastructure and agriculture to rising sea levels.

- Coastal cities around the world are facing same challenges of sea level rise
- Province directed municipalities to plan for at least 1 m sea level rise by 2100
- In Surrey and Metro Vancouver most drainage systems not designed for projected changes

Study area @ a glance

COMMUNITIES AND PEOPLE



Many residential areas and neighbourhoods
Semiahmoo First Nation
2,500+ residents
Approximately 20% of Surrey's land area

PARKS AND ENVIRONMENT



Destination regional and City parks
Beaches and recreation areas
Critical foreshore, coastal, and riparian areas

LOCAL AND REGIONAL ECONOMY



3,500+ jobs
Over \$100M in annual farm gate revenue
Over \$1B in assessed property value
Almost \$25B annual truck and rail freight traffic

INFRASTRUCTURE



Over 10km of Provincial Highways
Over 200,000 vehicle trips a day
Over 30km of railway (freight, passenger)

CRESCENT BEACH



~ 0.7% of Surrey's gross property value (2016)
~ 0.5% of Surrey's population (1,150 residents)
~ 0.2% of Surrey's residential flood space

What is at Risk?



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

TODAY

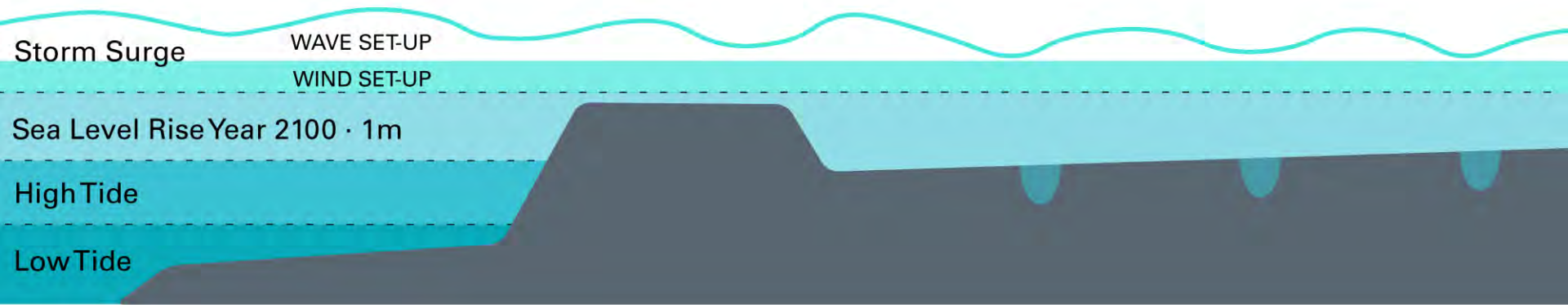
An Evolving Future

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.

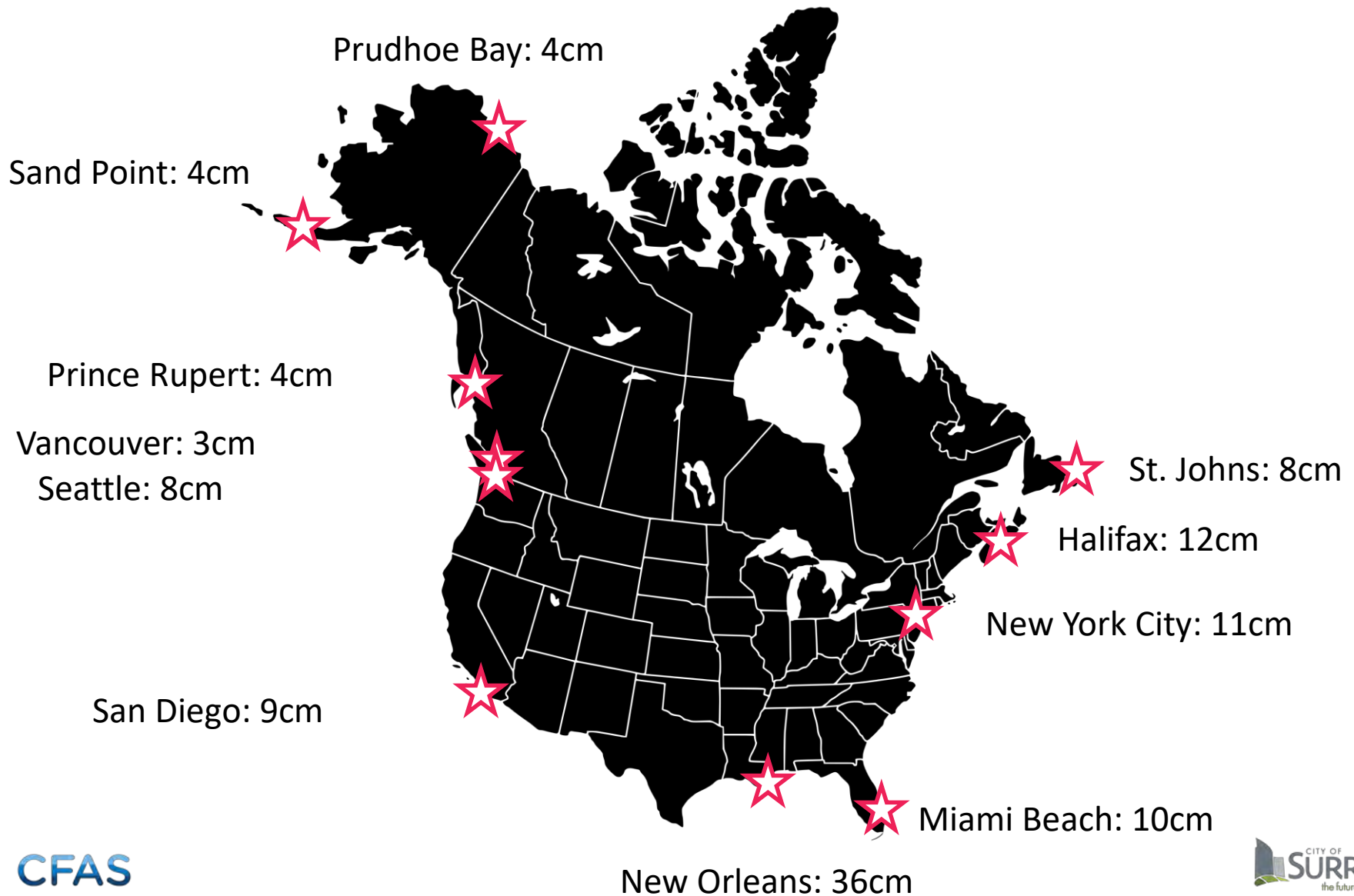
The Province has directed municipalities to plan for at least 1m sea level rise by 2100. In Surrey, and elsewhere in the Lower Mainland, most drainage systems are not designed for projected changes.



Sea level rise 1 metre by 2100



Approximate sea level rise since 1972



Extreme Floods

- Climate change is affecting intensity and frequency of storms and flood events
- Extreme floods of today become more frequent in the future

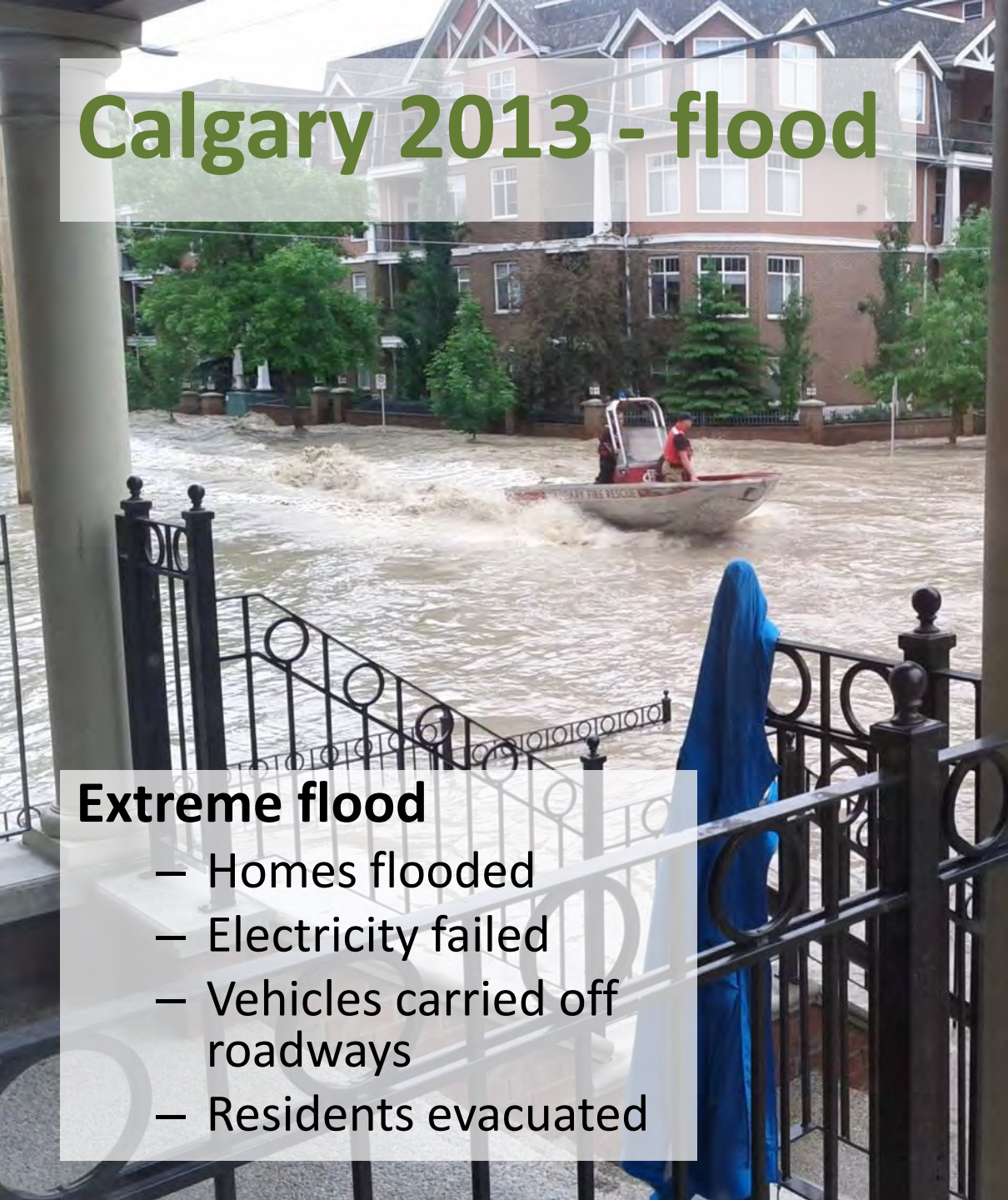


Extreme Flood Events

- Flood of 1948
 - +1 metre depth
 - flowing water



Calgary 2013 - flood



Extreme flood

- Homes flooded
- Electricity failed
- Vehicles carried off roadways
- Residents evacuated



England 2016 - flooding



Extreme flood

- Homes flooded
- Electricity failed
- Vehicles carried off roadways
- Residents evacuated

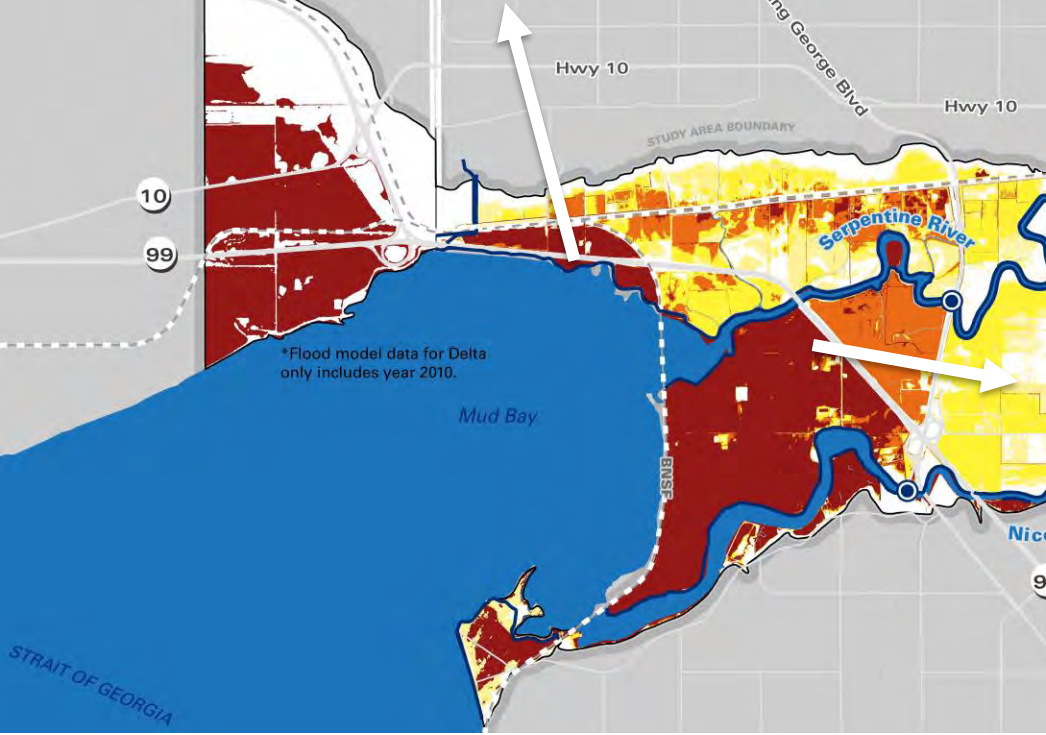
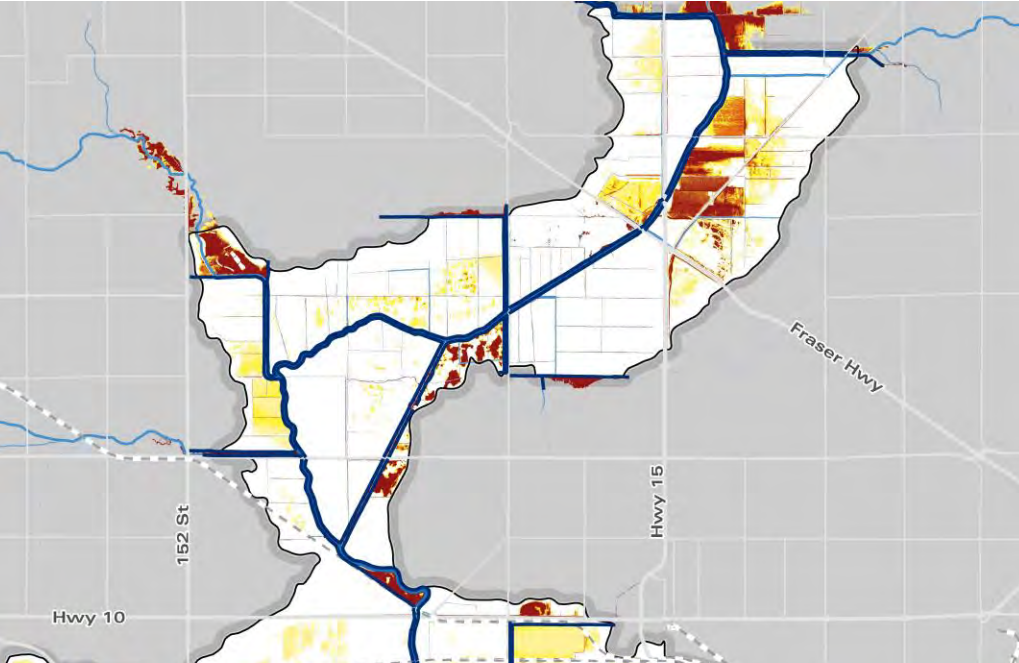


Houston 2017 - flooding

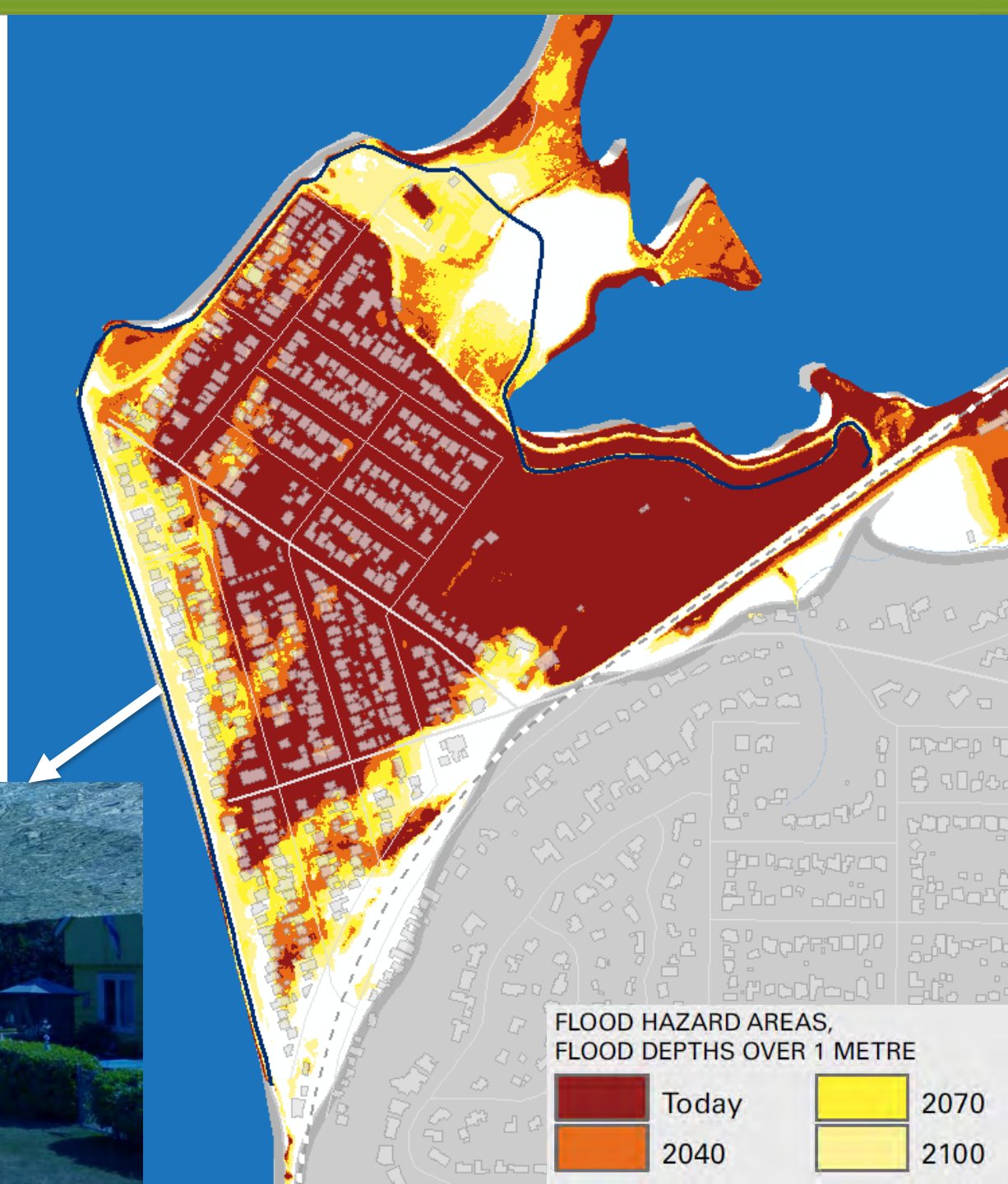


Extreme flood

- Homes flooded
- Electricity failed
- Vehicles carried off roadways
- Residents evacuated



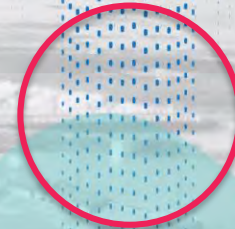
Flood Depth Over 1 metre



Flood Frequency

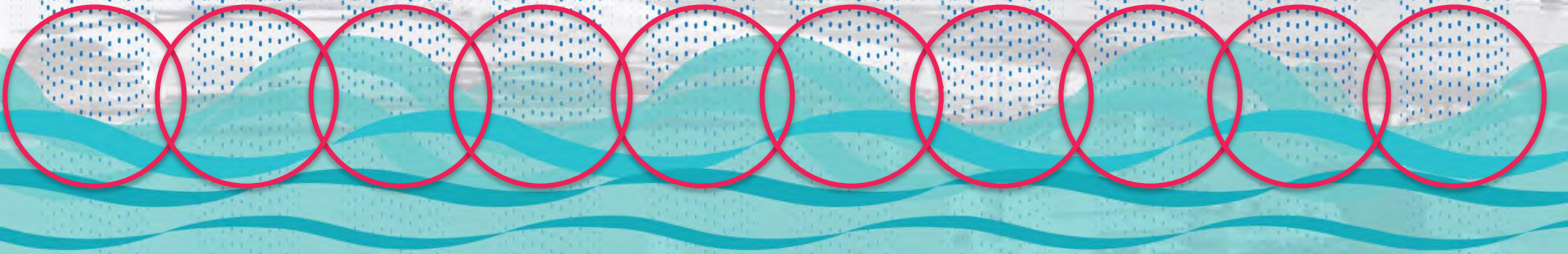
0.5%

chance of an
extreme
flood today



Flood Frequency

50%
chance of an
extreme
flood in
2100



Hazards and Impacts



Agriculture



Community and Residential



Environment and Recreation

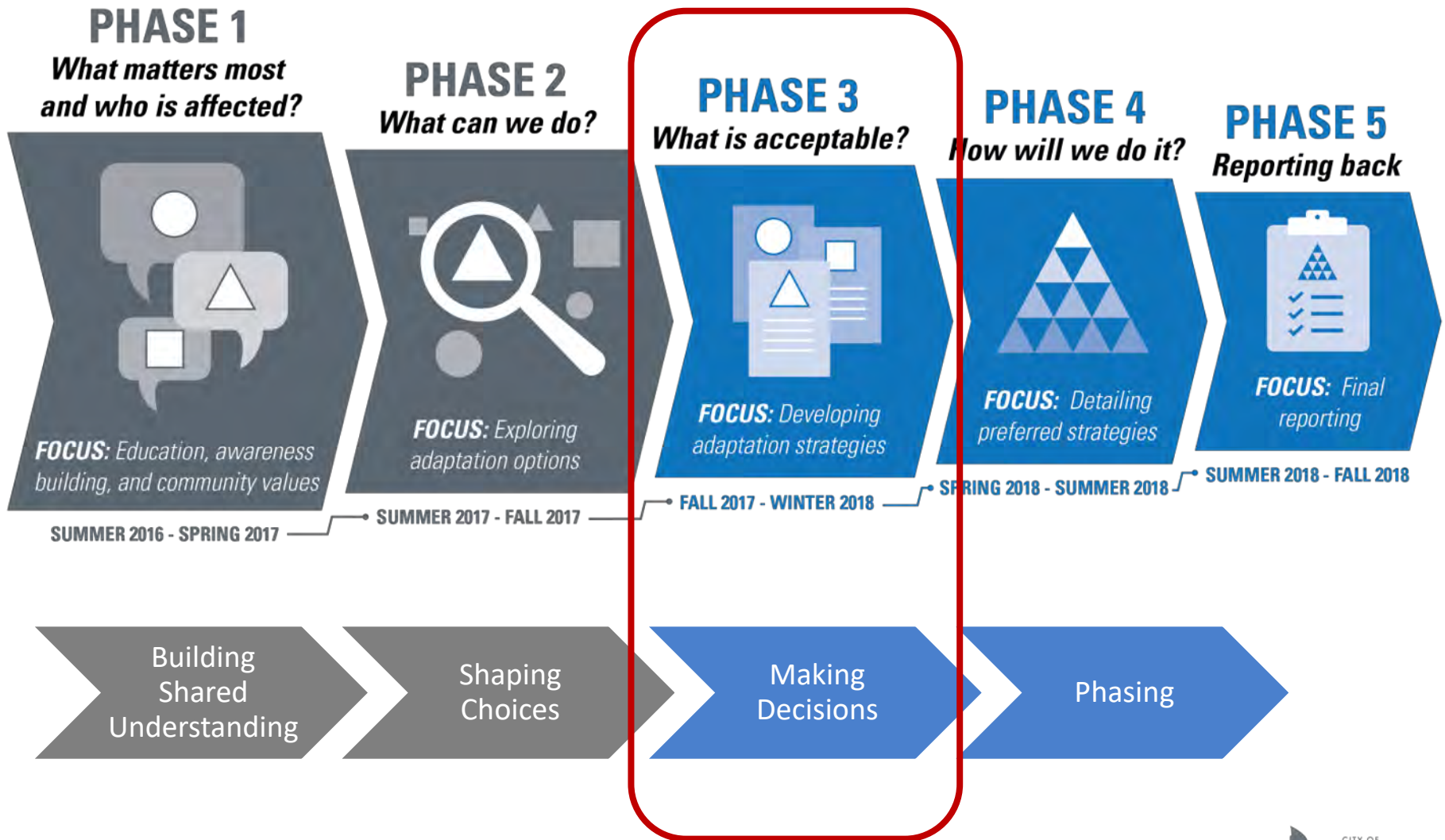


Transportation and Infrastructure



Local and Regional Economy

Surrey CFAS Process



CFAS Phase 1 Video

What Matters Most?



Crescent Beach

Engagement and Outcomes

Engagement

THREE CRESCENT BEACH COMMUNITY MEETINGS

- May to September, 2016
- 60+ Participants

THREE FOCUS GROUPS

- February to March, 2017
- 60+ participants
- Agriculture & Farming
- Community & Residential
- Environment & Recreation

OPEN HOUSE PHASE 1

- April 26, 2017
- Participants: 30+

SEMIAHMOO FIRST NATION

- Field visit and 4 meetings

TECHNICAL WORKSHOPS

- Nov 2016 to Dec, 2017
- 150+ participants
- 2 Green Shores™ Shoreline Design
- 2 PIEVC™ Infrastructure
- Coastal Design with Dutch & UBC
- Coastal Regulators
- Coastal Stewards
- Agriculture Land Commission

OPTIONS ASSESSMENT

- July to December, 2017
- 100+ participants
- Advisory Group Workshop
- Crescent Beach Workshop
- Semiahmoo Bay Workshop

Surveys

- Three public surveys

Communications & Outreach

COMMUNICATIONS

- Website
- Surveys
- Interactive “Story Maps”
- E-newsletters
- Social Media #SurreyCoastal
- Print materials
- Media

OUTREACH

- Presentations to Council Committees
- Community events
- City and civic spaces
- School outreach
- Conference presentations
- Study tours
- Pop up events

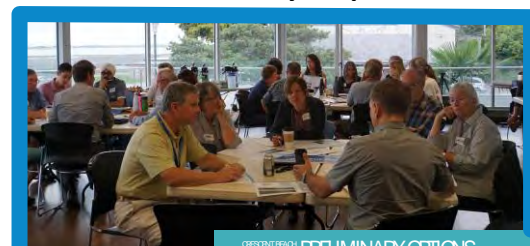
Options Development – What can we do?

Preliminary Options Development with Community and Professionals

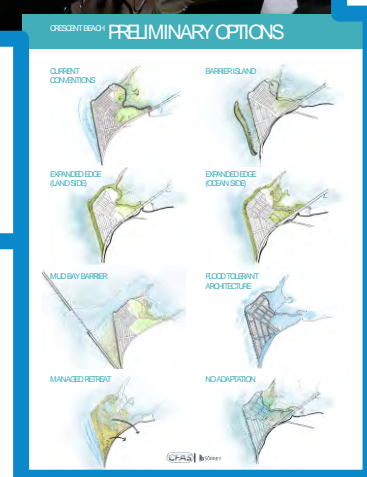


HIGH-LEVEL
FEASIBILITY ANALYSIS

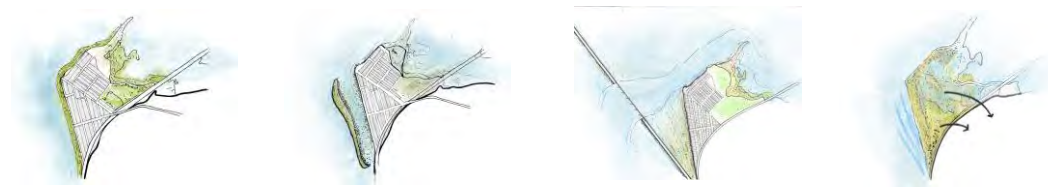
Community Review of
Preliminary Options



REFINEMENT &
TECHNICAL ANALYSIS



Shortlisted Options



Crescent Beach

Purpose of Workshop

Today's Tasks

- Crescent Beach Focus
 - Review and discussion of shortlisted options
 - Review and discussion of risks
 - Ranking and discussion of priority options



Crescent Beach Ground Rules

- Group discussion is important; and everyone should get a chance to speak
- Provide honest, open opinions
- Agree to disagree; consensus may not always be achieved

Activity #1

- In tables, please share the main reason for wanting to be part of today's workshop



Crescent Beach

Shortlisted Options

Shortlisted Options for Crescent Beach

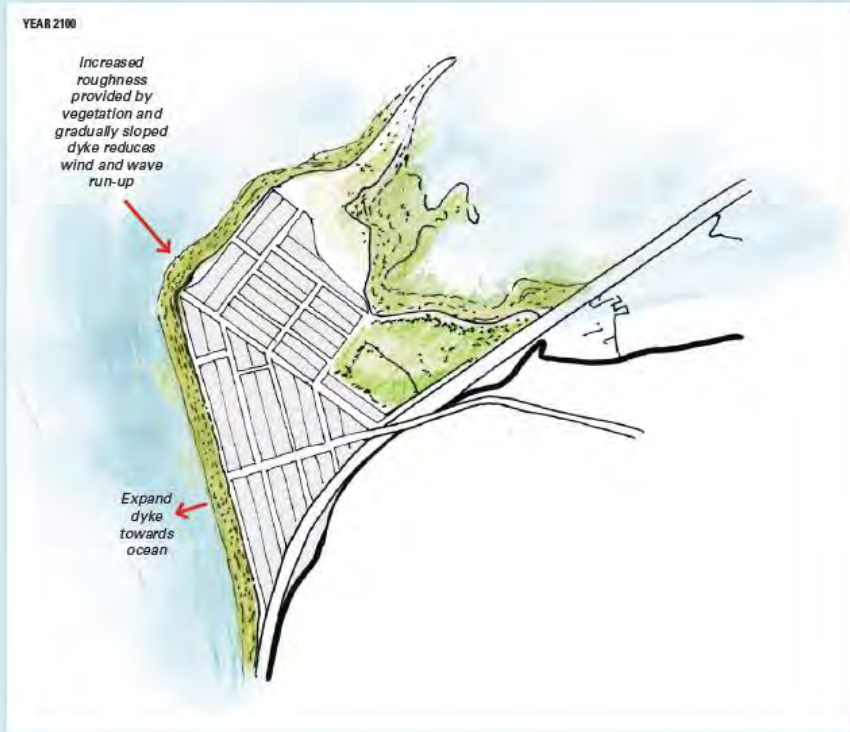
1. Expanded Edge
2. Barrier Island/Spit
3. Mud Bay Barrier
4. Managed Retreat



Option Overview

CHAPTER 2: CRESCENT BEACH

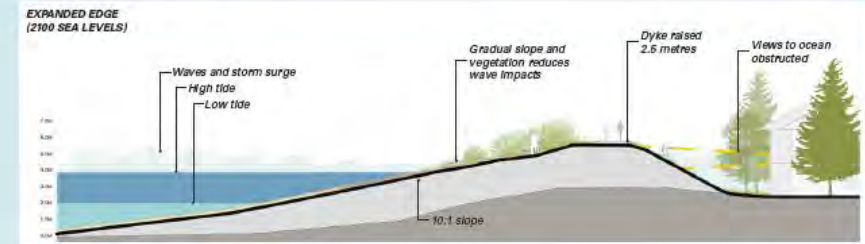
OPTION 1: EXPANDED EDGE



OPTION DESCRIPTION

This option proposes building the beach out in front of the existing shoreline to reduce the slope of the foreshore and, in turn, reduce wave run-up. By 2100, the dyke would be on average 2.5 metres higher than today with ocean front views severely impacted. The raised and expanded dyke will provide protection against overtopping and erosion. However, this option is considered high risk because of the high likelihood of failure of the dykes and potential detrimental impacts from flooding. Furthermore, given the sandy ground, seepage issues will accelerate with sea level rise. To help manage some seepage issues, perforated piping will need to be added over time to pump groundwater into the ocean. In addition, all homes and roadways will need to be raised by about 1 metre by the year 2100. The option would be phased over time, however, continuing to adapt to higher sea levels beyond the year 2100 may be challenging from a seepage perspective.

WHAT THIS COULD LOOK LIKE



Section of expanded edge and raised dyke



Raised dyke protects from storm surge and accommodates trails and other uses



Vegetated dykes reduce wind and wave run up

INFRASTRUCTURE, EARTHQUAKE & LANDUSE CHANGES & DESIGN

Reduction in dyking: None.

New dykes: None. Existing dykes would be raised by 2.5 metres and the edge expanded towards the ocean with a 10:1 slope ratio.

Earthquake design: None.

Re-purposed land: Raising of roads lanes will require additional land on the sides of existing roads as the footprint of a raised road is greater.

Relocated roads/rail lines: None. However, 14 km of road lanes in Crescent Beach need to be raised by 1 metre or more to remain usable due to high degree of ground seepage.

Values Criteria



RESIDENTS:

Are people permanently displaced?



ENVIRONMENT:

Are there impacts (positive & negative) to wetland habitats, freshwater fish habitat & riparian areas?



INFRASTRUCTURE:

Is service/transportation infrastructure made vulnerable?



ECONOMY:

Is there a permanent loss of business?



RECREATION:

Is there a diversity of recreational activities (positive & negative)?



CULTURE:

Are there Semiahmoo First Nation cultural impacts that could be expected?

Values Ranking:



WORSE ← NO CHANGE → BETTER

Values Criteria

VALUES CRITERIA

FAR WORSE ← NO CHANGE → FAR BETTER

RESIDENTS



No residents are relocated. Views of oceanfront properties would be impacted by raising current on-shore dykes by 2.5 metres. All housing is raised by about 1 metre due to seepage issues.

Indicator: People permanently displaced



SLIGHTLY WORSE

ENVIRONMENT



Even though shoreline habitats could be improved using a Green Shores approach, building out into the ocean would disrupt coastal processes and critical habitat areas, including eelgrass beds.

Indicator: Impacts to wetland habitats, freshwater fish habitat & riparian areas



SLIGHTLY WORSE

INFRASTRUCTURE



All roads and utilities adapt by raising or floodproofing and residents do not experience any change in infrastructure services.

Indicator: Percent of service/transportation infrastructure made vulnerable



NO CHANGE

ECONOMY



Local businesses would likely not be impacted, and furthermore, the expanded beach area might encourage more tourists to visit the area.

Indicator: Revenue



SLIGHTLY BETTER

RECREATION



Coastal recreation opportunities could be improved through a trail network, lookouts, and an expanded shoreline for recreation and enhanced accessibility using a more gradual slope.

Indicator: Diversity of recreational opportunities



MODERATELY BETTER

CULTURE



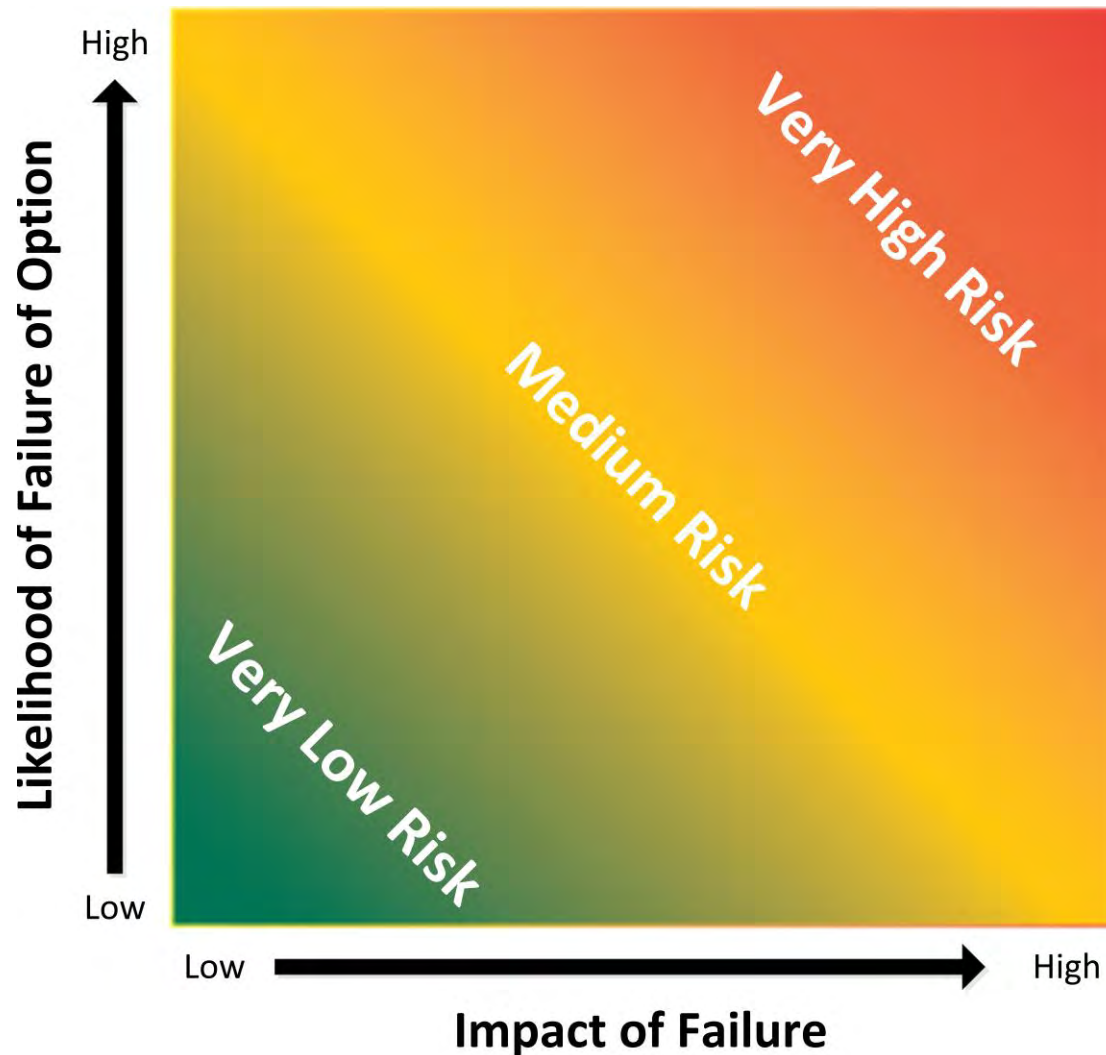
Construction could disturb archaeological artifacts and human remains.

Indicator: Opportunities for traditional practices





























SLIGHTLY WORSE

Risk: Likelihood & Impact of Failure



Risk Evaluation

IMPACT & RISK OF FAILURE		Impact of Failure on Value	x	Likelihood of Failure of Option	=	Risk
 RESIDENTS	Although the dykes would be raised and widened, a breach would affect all housing in Crescent Beach, likely leading to some loss of life.					
 ENVIRONMENT	Contamination from debris and garbage. Recoverable without permanent harm to species.					
 INFRASTRUCTURE	The entire area is cutoff. Roads inundated and potentially severely eroded. Other services, such as sewer, water, gas, cable, hydro, etc. will also be impacted.					
 ECONOMY	Extensive direct and indirect losses.					
 RECREATION	Temporary disruption to recreation amenities (shoreline trails, boat park, tennis courts, and parks), but recoverable.					
 CULTURE	A dyke breach and flood event would have low archeological impacts.					
					 Overall Risk:	

Cost Criteria



COST CRITERIA



CAPITAL COST

\$\$__



OPERATION & MAINTENANCE COST

\$\$_



INFRASTRUCTURE MARGINAL COST

\$\$_



COST TO FUTURE GENERATIONS

\$\$__

COST CRITERIA NOTES:

Budget bins for capital costs and future generation's costs: **S** - less than \$100M; **SS** - \$100M–\$1B; **SSS** - \$1B–\$4B; **SSSS** - more than \$4B

Approximate incremental infrastructure costs: **S** - less than \$10M; **SS** - \$10M–\$100M; **SSS** - more than \$100M

Annual operation and maintenance costs: **S** - less than \$1M; **SS** - \$1M–\$10M; **SSS** - more than \$10M

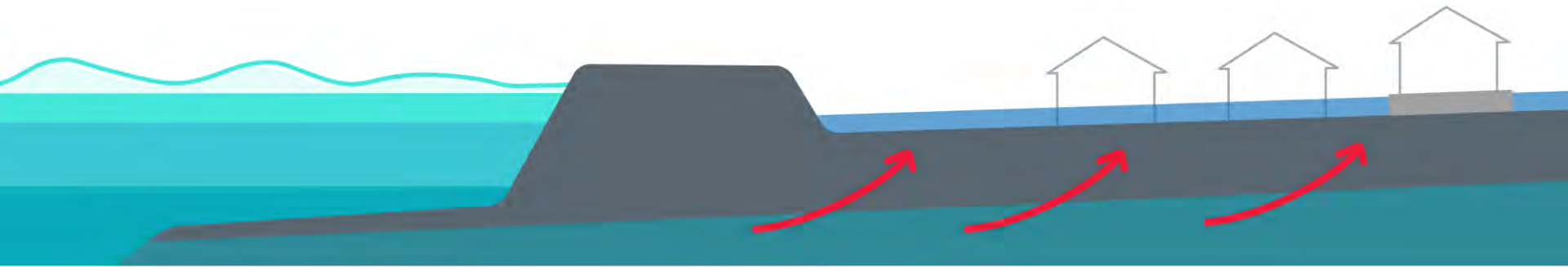
An aerial photograph of a coastal area, likely a beach or dune system, with a blue overlay. The image shows a wide, flat expanse of land with some darker, possibly vegetated areas. A prominent feature is a large, dark, irregularly shaped area in the lower right quadrant, which could be a pond or a large shadow. The overall scene is captured from a high angle, showing the intricate patterns of the terrain.

Crescent Beach

Expanded Edge

Video

Seepage/Groundwater



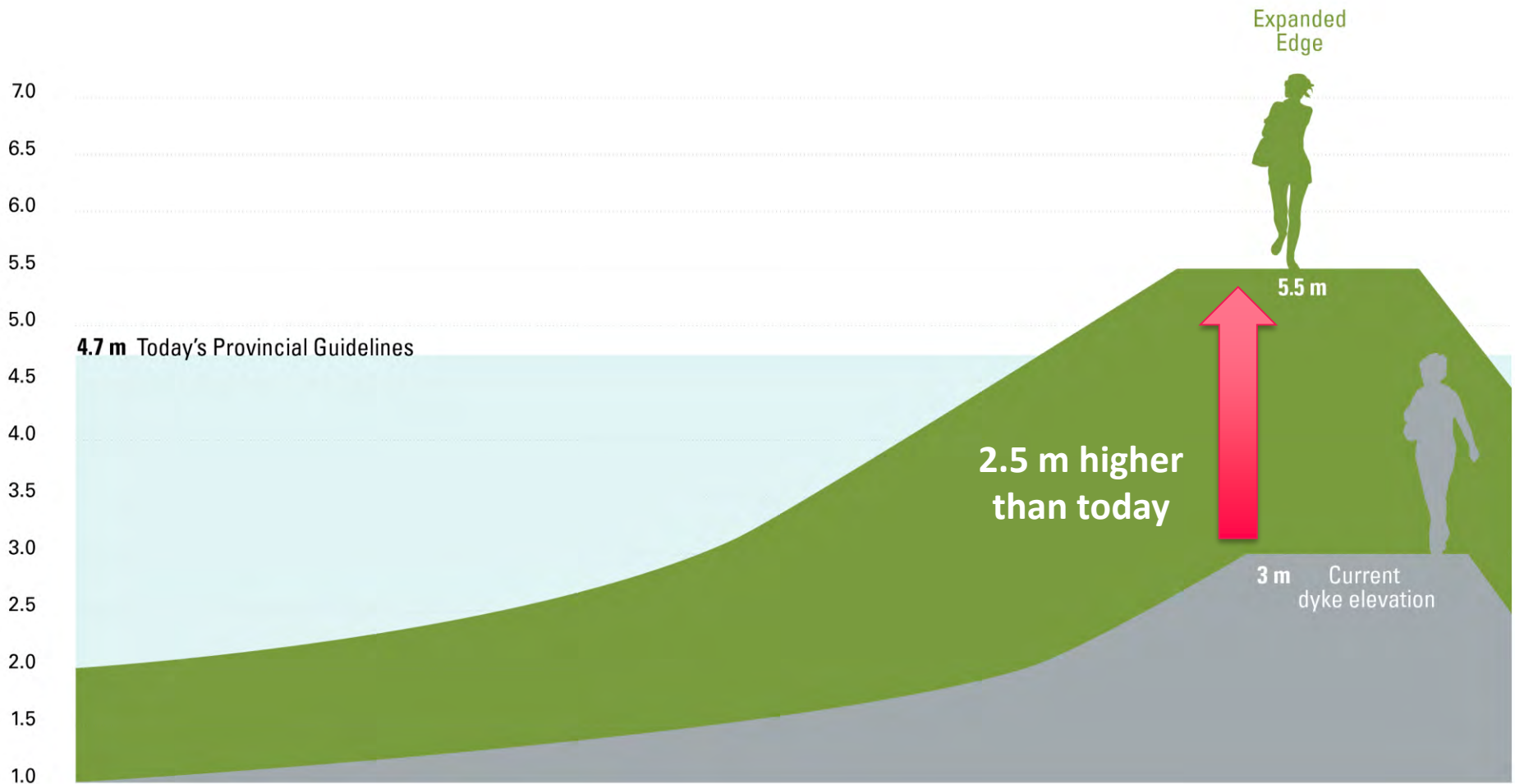
Seepage/Groundwater

Expanded Edge

- Raise homes and roads by at least 1 metre by 2100

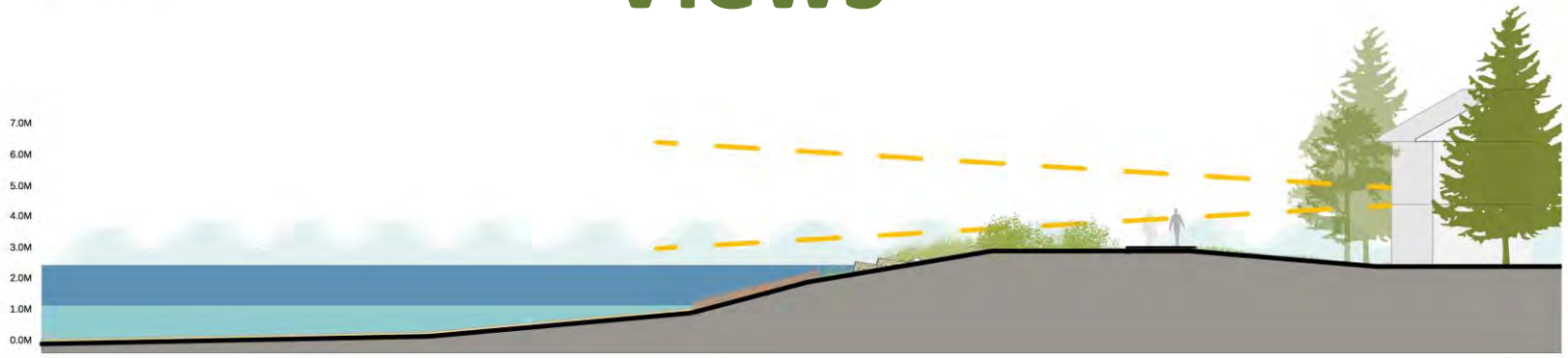


Crescent Beach Dyke Elevations



CURRENT CONDITIONS

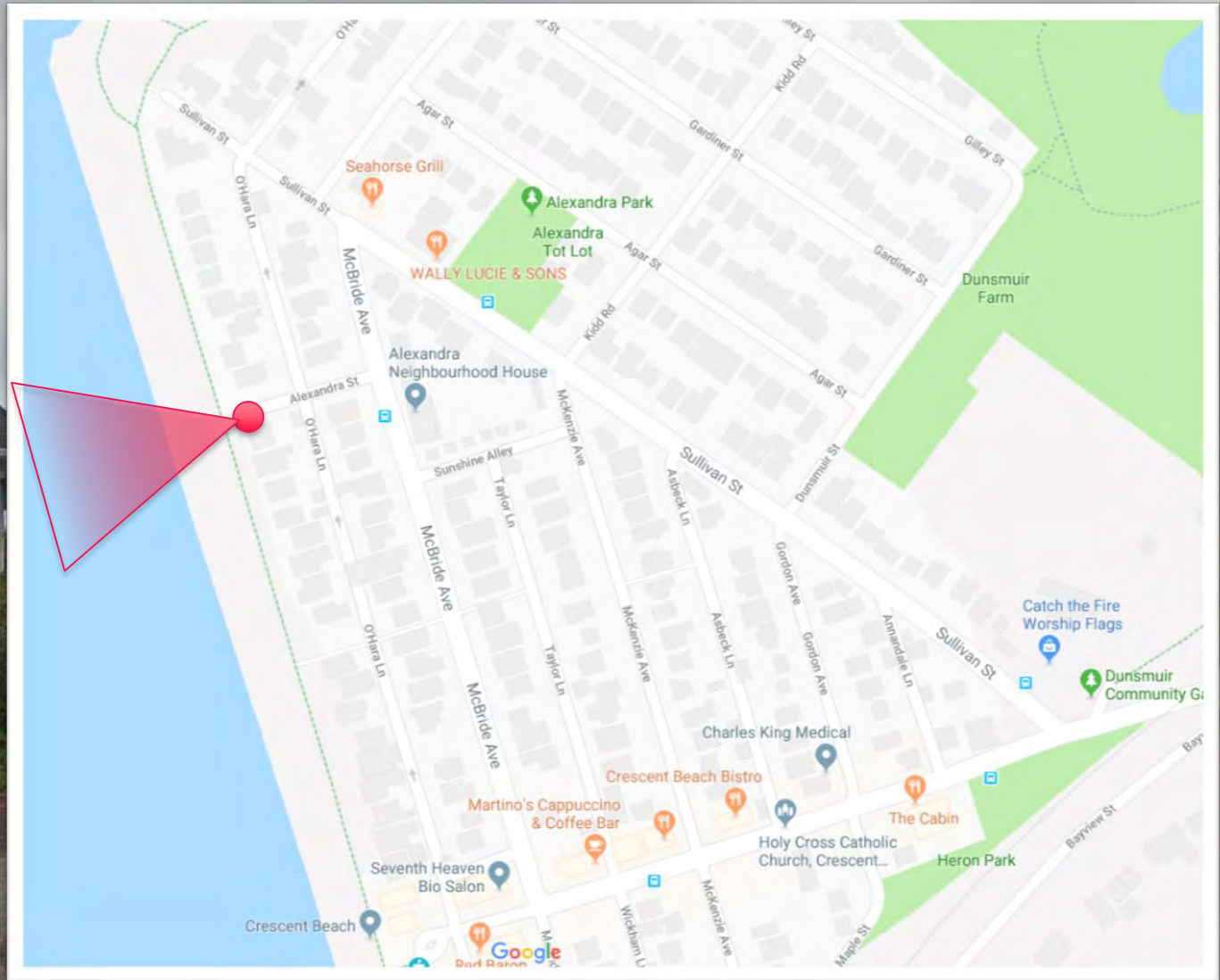
Views



Expanded Edge 2100



Expanded Edge



Earthquake

- No flood protection option is earthquake proof
- 20% chance of large earthquake by 2070









Liquefaction in Christchurch 2011 earthquake

**BASELINE -
NO ADAPTATION**

**EXPANDED
EDGE**






VALUES CRITERIA

	RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	FAR WORSE	SLIGHTLY WORSE
	INFRASTRUCTURE <i>Percent of service/ transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE
	ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY BETTER
	RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	MODERATELY BETTER
	CULTURE <i>Opportunities for traditional practices</i>	MODERATELY WORSE	SLIGHTLY WORSE

IMPACT & RISK OF FAILURE

	OVERALL RISK	VERY HIGH	HIGH
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COST CRITERIA

	 CAPITAL COST	---	\$\$
	OPERATION & MAINTENANCE COST	\$\$\$	\$\$
	INFRASTRUCTURE MARGINAL COST	\$\$\$	\$\$
	COST TO FUTURE GENERATIONS	\$\$\$\$	\$\$

An aerial photograph of a coastal landscape, showing a wide, flat area with intricate patterns of sand and water, likely a beach or dune system. The image is overlaid with a semi-transparent blue filter. The text is positioned in the lower-left quadrant of the image.

Crescent Beach

Barrier Island/Spit

Video

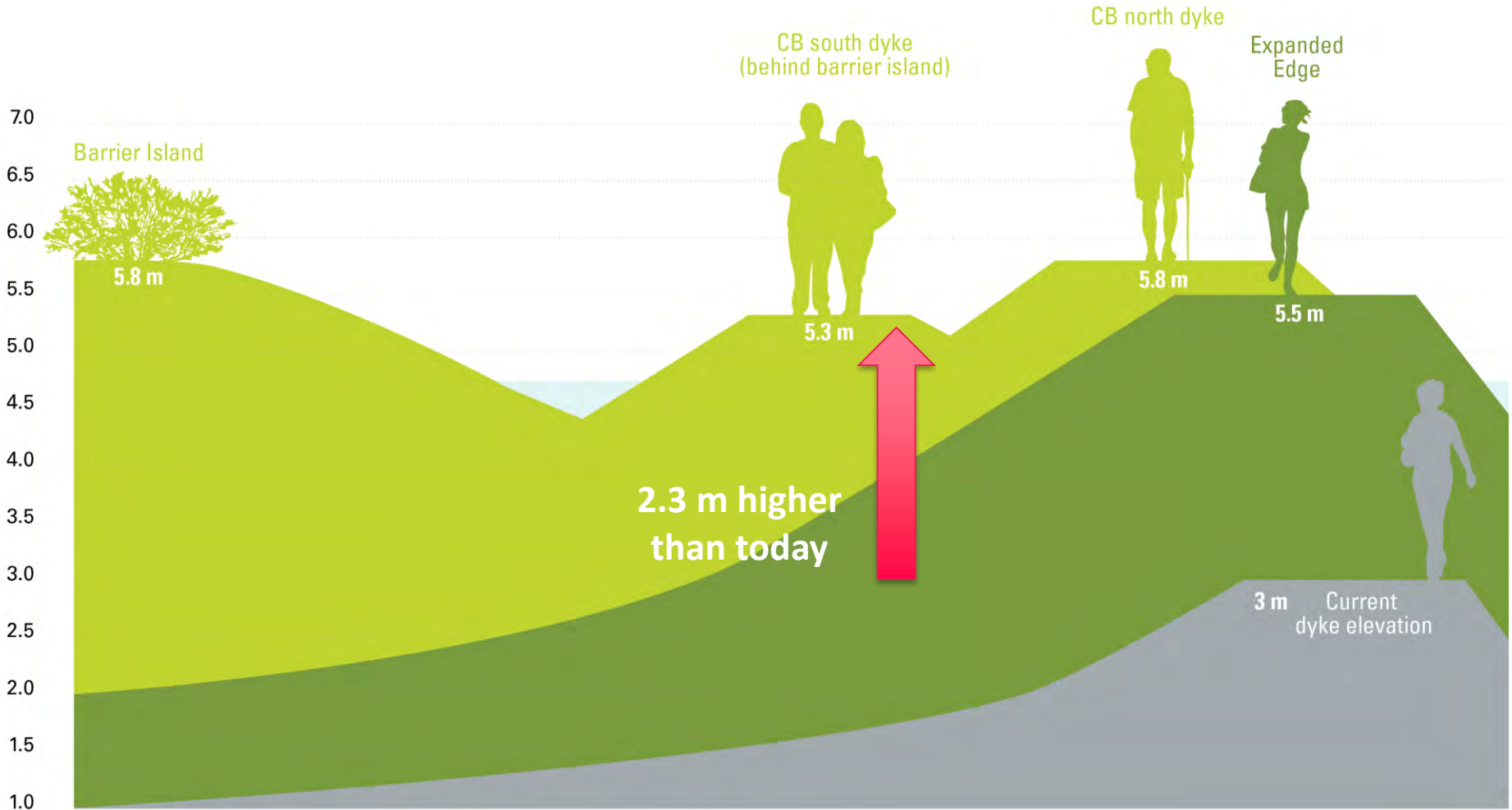
Seepage/Groundwater

Expanded Edge and Barrier Island/Spit

- Raise homes and roads by at least 1m by 2100

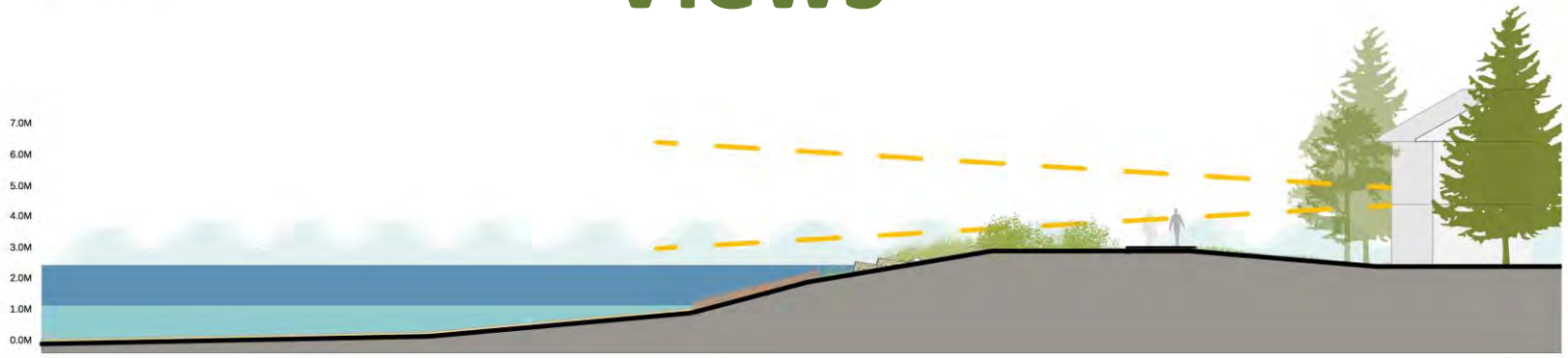


Crescent Beach Dyke Elevations

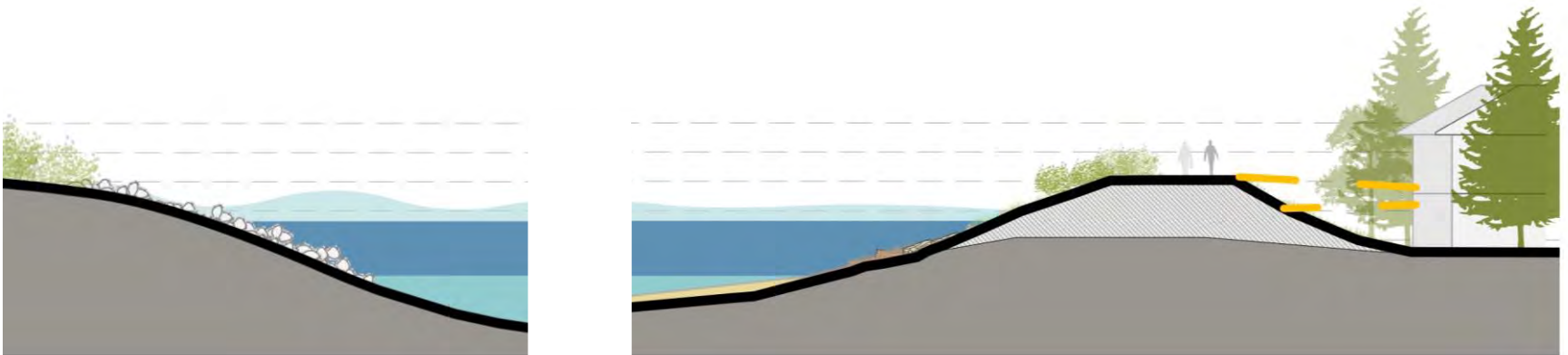


CURRENT CONDITIONS

Views










Barrier Island/Spit 2100



Barrier Island/Spit

~2.3 metre raised dyke



		BASELINE - NO ADAPTATION	EXPANDED EDGE	BARRIER ISLAND/ SPIT
VALUES CRITERIA				
	RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE	MODERATELY WORSE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	FAR WORSE	SLIGHTLY WORSE	MODERATELY WORSE
	INFRASTRUCTURE <i>Percent of service/ transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE	NO CHANGE
	ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY BETTER	NO CHANGE
	RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	MODERATELY BETTER	SLIGHTLY BETTER
	CULTURE <i>Opportunities for traditional practices</i>	MODERATELY WORSE	SLIGHTLY WORSE	SLIGHTLY WORSE

IMPACT & RISK OF FAILURE

	OVERALL RISK	VERY HIGH	HIGH	VERY HIGH
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COST CRITERIA

	 CAPITAL COST	---	\$\$	\$\$\$
	OPERATION & MAINTENANCE COST	\$\$\$	\$\$	\$\$
	INFRASTRUCTURE MARGINAL COST	\$\$\$	\$\$	\$\$
	COST TO FUTURE GENERATIONS	\$\$\$\$	\$\$	\$\$\$

An aerial photograph of a coastal area, likely a bay or estuary, showing a prominent barrier or dike. The water is a deep blue, and the land is a lighter blue. The barrier runs across the middle of the image, separating the bay from the open sea. The text "Crescent Beach" and "Mud Bay Barrier" is overlaid on the image in white.

Crescent Beach

Mud Bay Barrier

Video

Seepage/Groundwater

Expanded Edge and Barrier Island/Spit

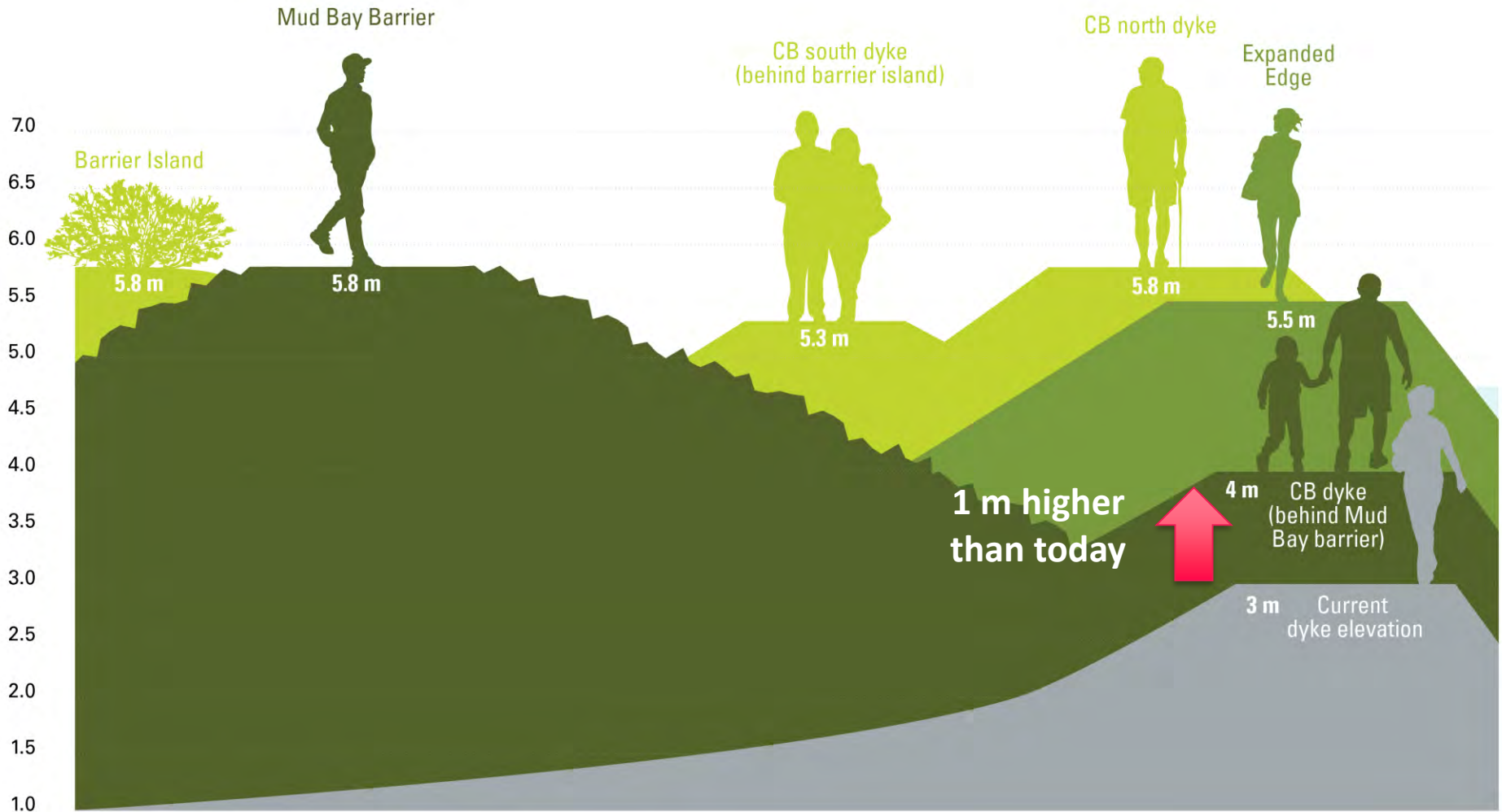
- Raise homes and roads by at least 1m by 2100

Mud Bay Barrier

- Raise home and roads, height to be determined by modelling

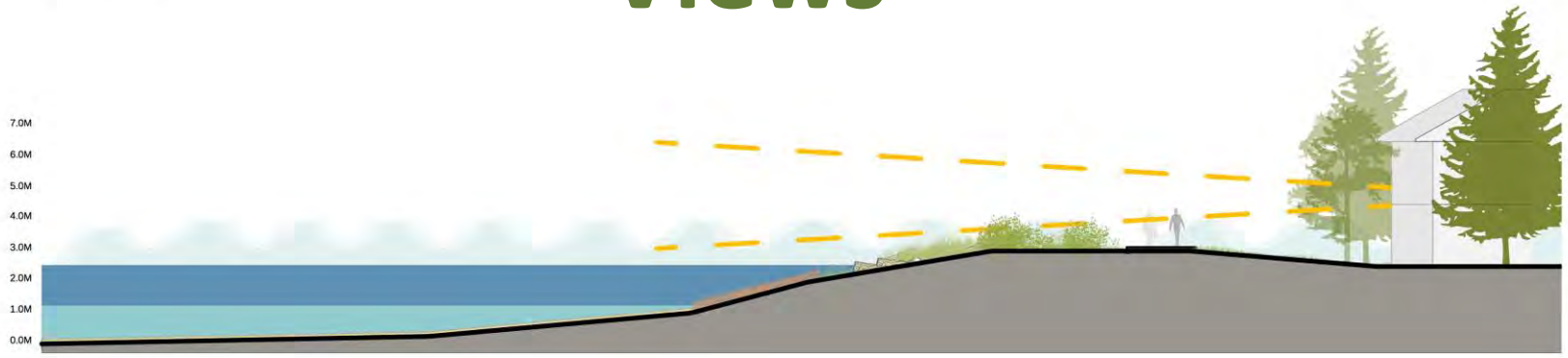


Crescent Beach Dyke Elevations

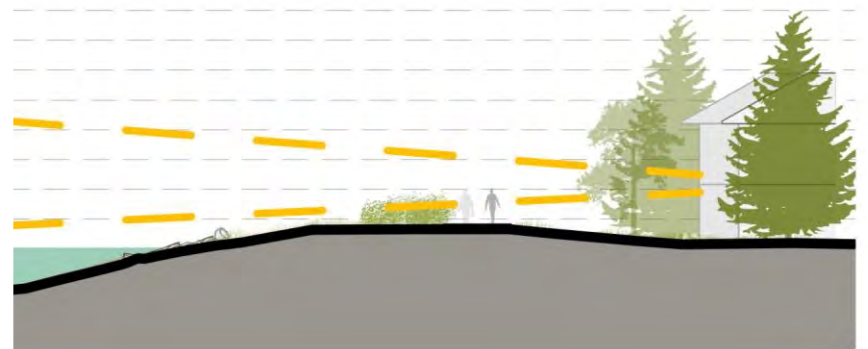
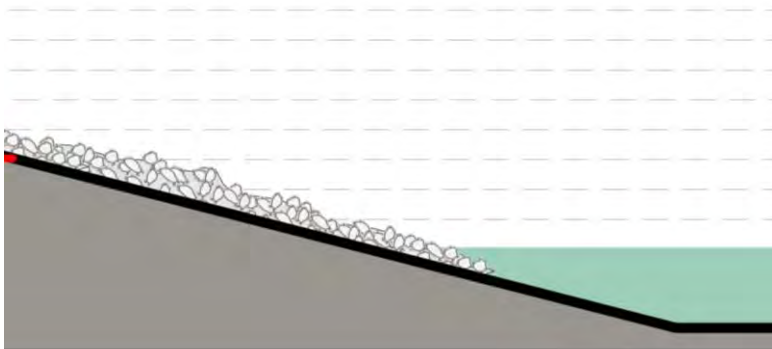


CURRENT CONDITIONS

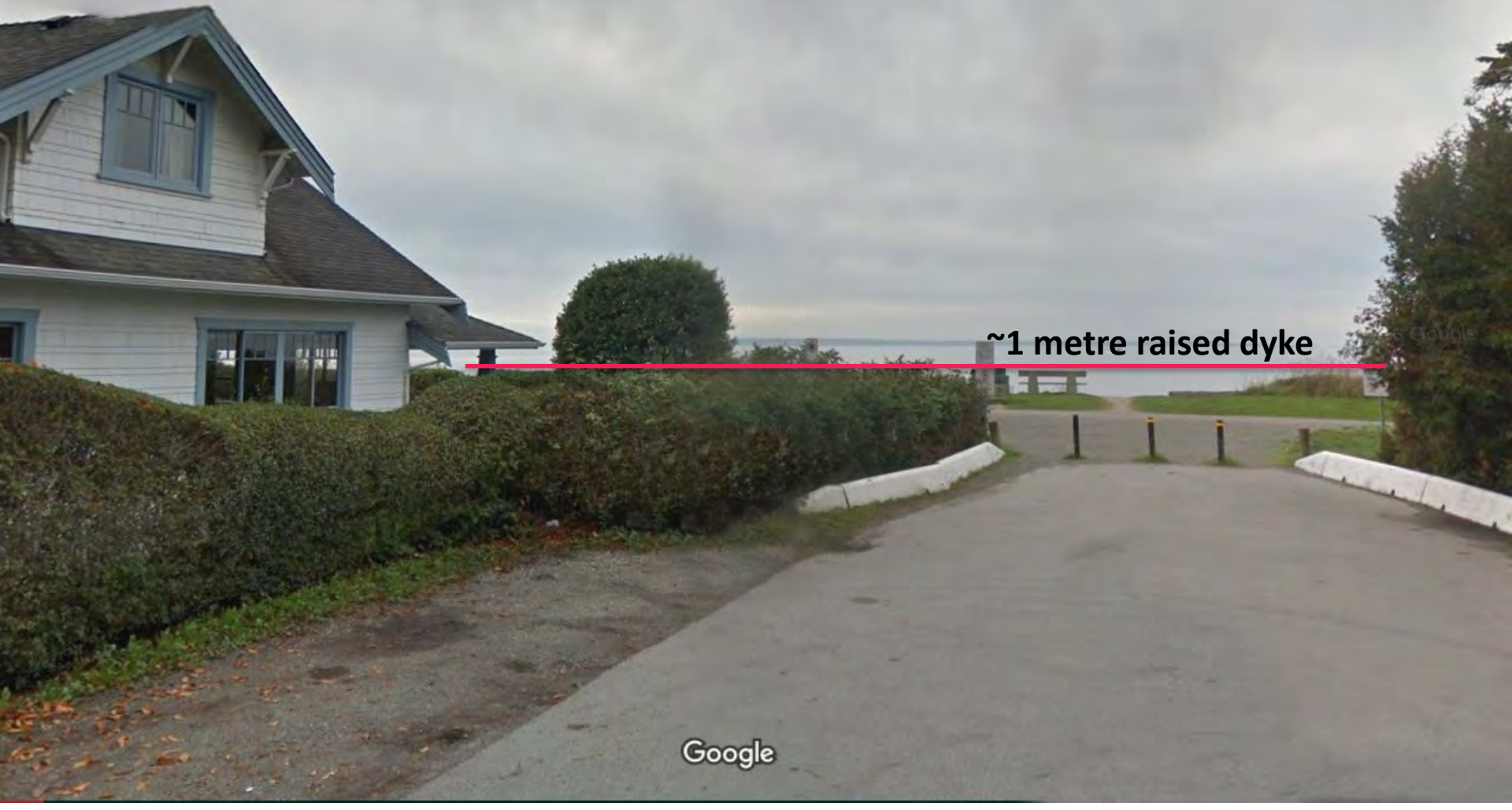
Views









Mud Bay Barrier 2100



Mud Bay Barrier








~1 metre raised dyke

		BASELINE - NO ADAPTATION	EXPANDED EDGE	BARRIER ISLAND/ SPIT	MUD BAY BARRIER
VALUES CRITERIA					
	RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE	MODERATELY WORSE	MODERATELY WORSE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	FAR WORSE	SLIGHTLY WORSE	MODERATELY WORSE	FAR WORSE
	INFRASTRUCTURE <i>Percent of service/ transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE	NO CHANGE	NO CHANGE
	ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY BETTER	NO CHANGE	SLIGHTLY WORSE
	RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	MODERATELY BETTER	SLIGHTLY BETTER	SLIGHTLY WORSE
	CULTURE <i>Opportunities for traditional practices</i>	MODERATELY WORSE	SLIGHTLY WORSE	SLIGHTLY WORSE	MODERATELY WORSE

IMPACT & RISK OF FAILURE

	OVERALL RISK	VERY HIGH	HIGH	VERY HIGH	VERY HIGH
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COST CRITERIA

	 CAPITAL COST	—	\$\$	\$\$\$	\$\$\$\$
	OPERATION & MAINTENANCE COST	\$\$\$	\$\$	\$\$	\$\$
	INFRASTRUCTURE MARGINAL COST	\$\$\$	\$\$	\$\$	\$
	COST TO FUTURE GENERATIONS	\$\$\$\$	\$\$	\$\$\$	\$\$\$

An aerial photograph of a coastal area, likely a beach or dune system, with a blue overlay. The image shows a wide, flat expanse of land with some darker, possibly vegetated areas. A road or path is visible on the left side. The overall scene is a coastal landscape.

Crescent Beach

Managed Retreat







Video

Crescent Beach Dyke Elevations



Managed Retreat



		BASELINE - NO ADAPTATION	EXPANDED EDGE	BARRIER ISLAND/ SPIT	MUD BAY BARRIER	MANAGED RETREAT
VALUES CRITERIA						
	RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE	MODERATELY WORSE	MODERATELY WORSE	FAR WORSE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	FAR WORSE	SLIGHTLY WORSE	MODERATELY WORSE	FAR WORSE	FAR BETTER
	INFRASTRUCTURE <i>Percent of service/ transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE	NO CHANGE	NO CHANGE	NO CHANGE
	ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY BETTER	NO CHANGE	SLIGHTLY WORSE	MODERATELY WORSE
	RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	MODERATELY BETTER	SLIGHTLY BETTER	SLIGHTLY WORSE	FAR BETTER
	CULTURE <i>Opportunities for traditional practices</i>	MODERATELY WORSE	SLIGHTLY WORSE	SLIGHTLY WORSE	MODERATELY WORSE	MODERATELY WORSE

IMPACT & RISK OF FAILURE

	OVERALL RISK	VERY HIGH	HIGH	VERY HIGH	VERY HIGH	VERY LOW
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COST CRITERIA

	 CAPITAL COST	---	\$\$	\$\$\$	\$\$\$\$	\$\$\$
	OPERATION & MAINTENANCE COST	\$\$\$	\$\$	\$\$	\$\$	---
	INFRASTRUCTURE MARGINAL COST	\$\$\$	\$\$	\$\$	\$	\$
	COST TO FUTURE GENERATIONS	\$\$\$\$	\$\$	\$\$\$	\$\$\$	---



Crescent Beach

Key Concerns

Activity #2

- In tables, please review each option and discuss:
 - Do you understand the options and the evaluation for each?
 - Are there any concerns you have that have not been captured in the evaluation?
 - Are there any options that you think are missing?



Crescent Beach

Risk

Crescent Beach Risk Heat Map

		IMPACT				
		Very Low	Low	Medium	High	Very High
LIKELIHOOD	Very High				BARRIER ISLAND / SPIT	
	High				EXPANDED EDGE	MUD BAY BARRIER
	Medium					
	Low					
	Very Low	MANAGED RETREAT				

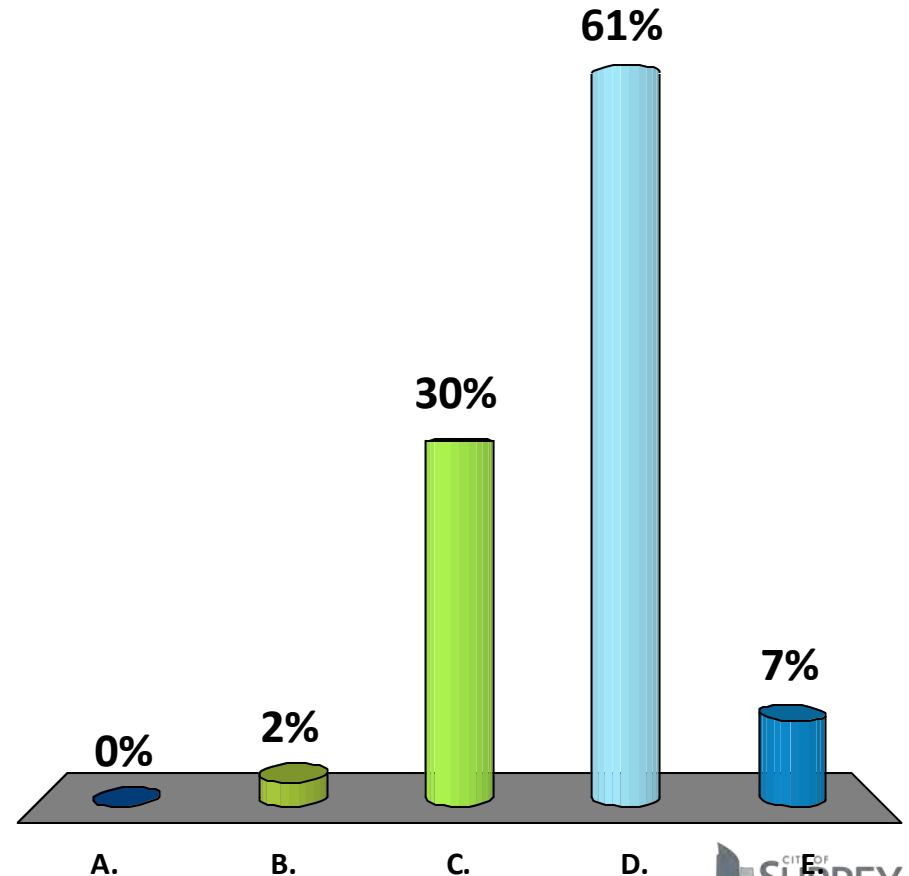
Audience polling devices (aka clickers)

TEST

- Press any key A through J and green light should show

How old are you?

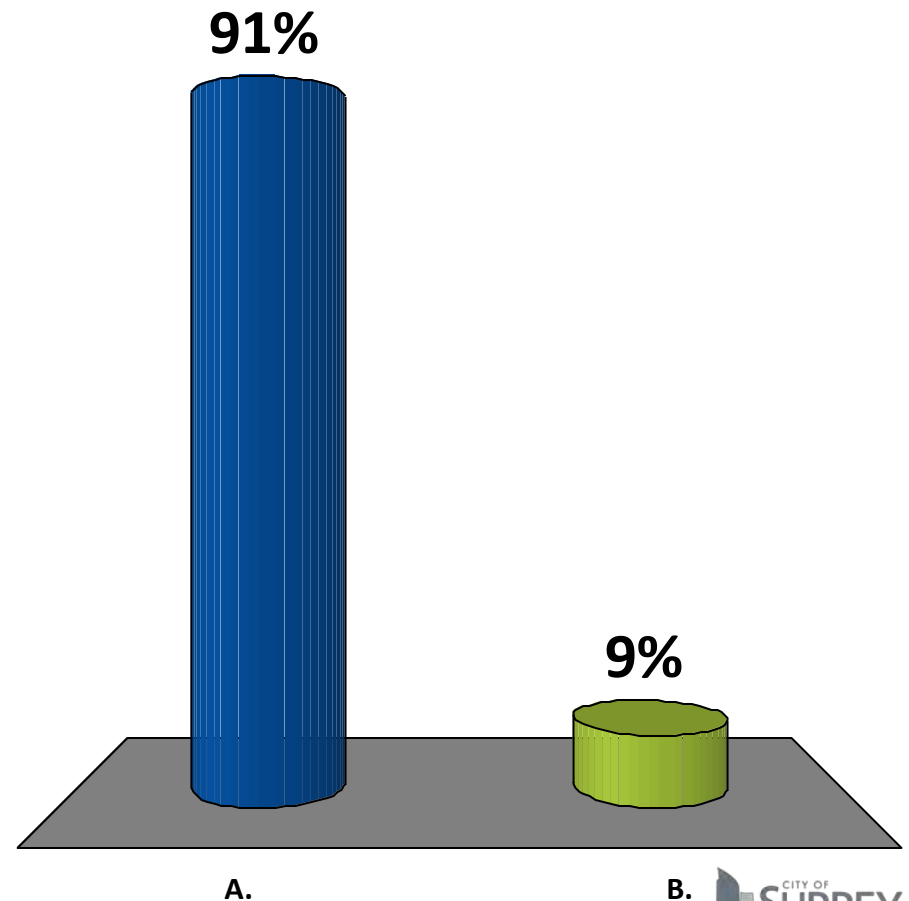
- A. Under 25
- B. 26-40
- C. 41-60
- D. 61-80
- E. 80+



Do you live in Surrey?

A. Yes

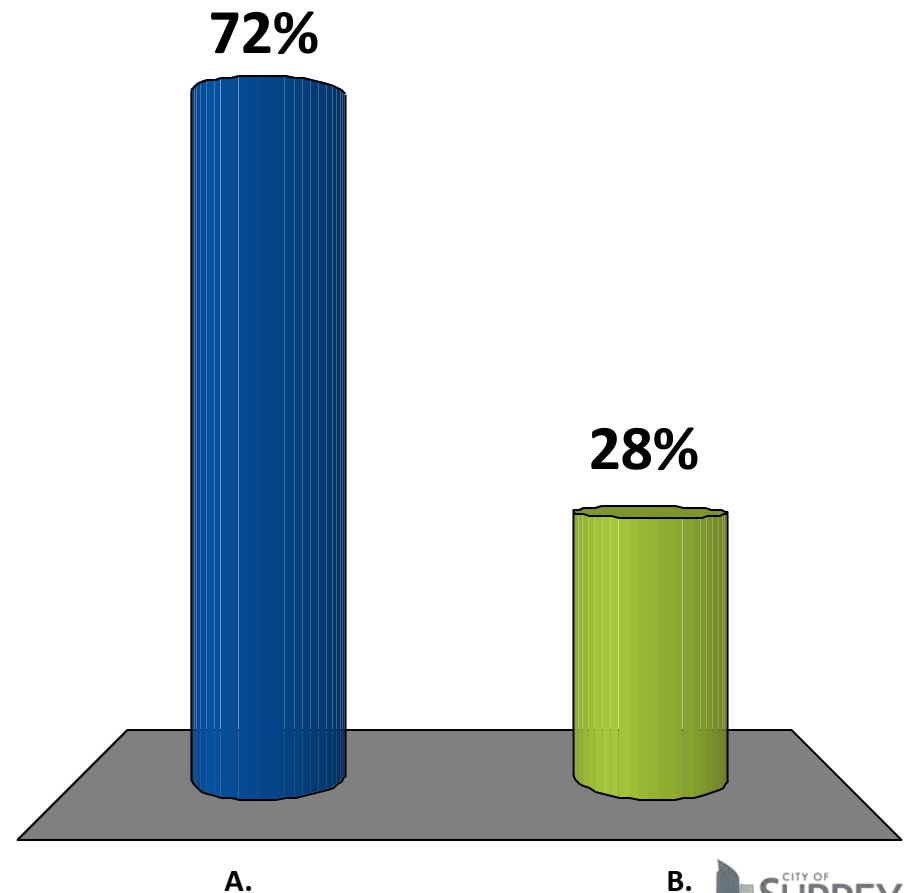
B. No



Do you live or work in Crescent Beach?

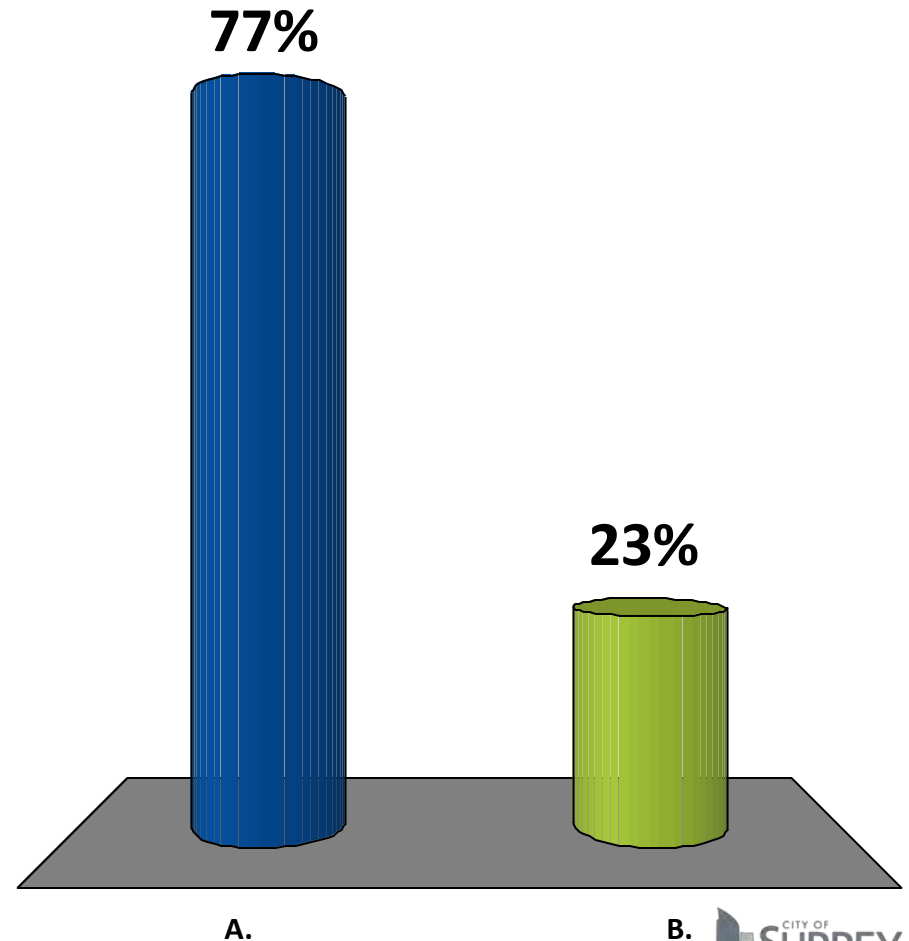
A. Yes

B. No



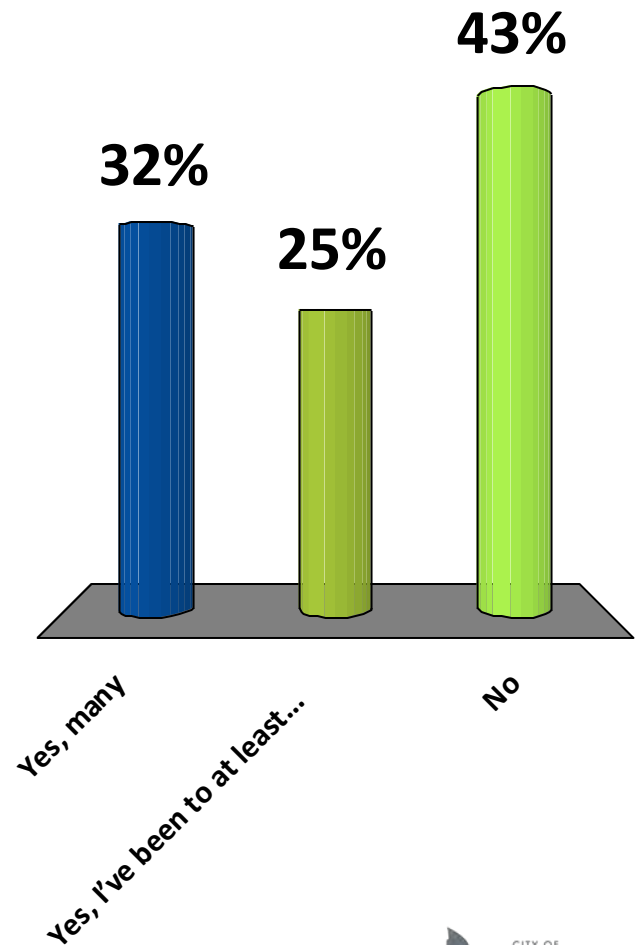
Do you own property in Crescent Beach?

- A. Yes
- B. No



Have you participated in other CFAS events?

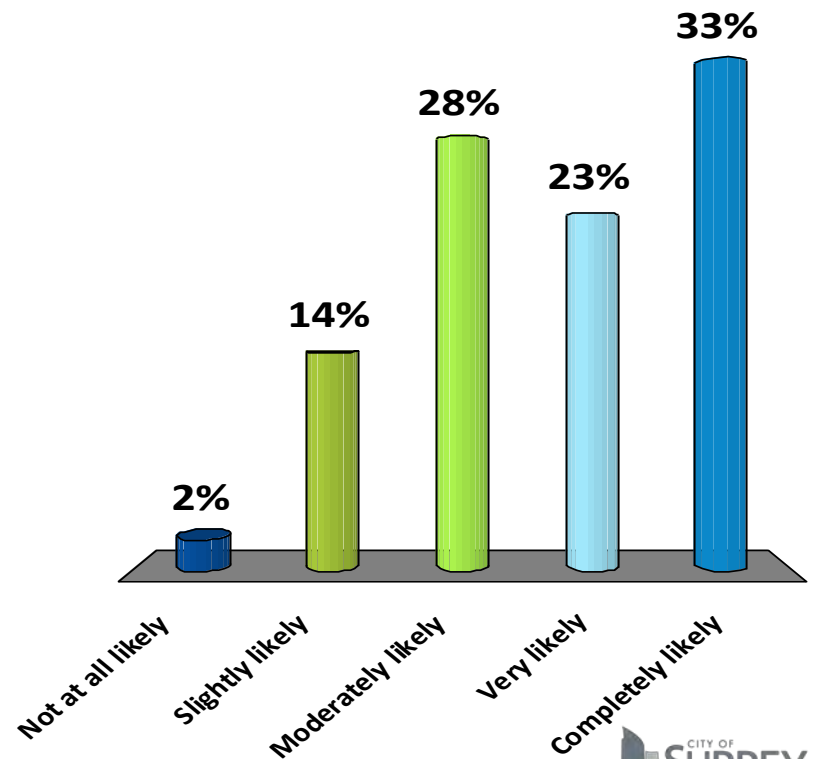
- A. Yes, many
- B. Yes, I've been to at least one event
- C. No



Risk Perception

How likely do you think that the area will experience an extreme flood before 2100?

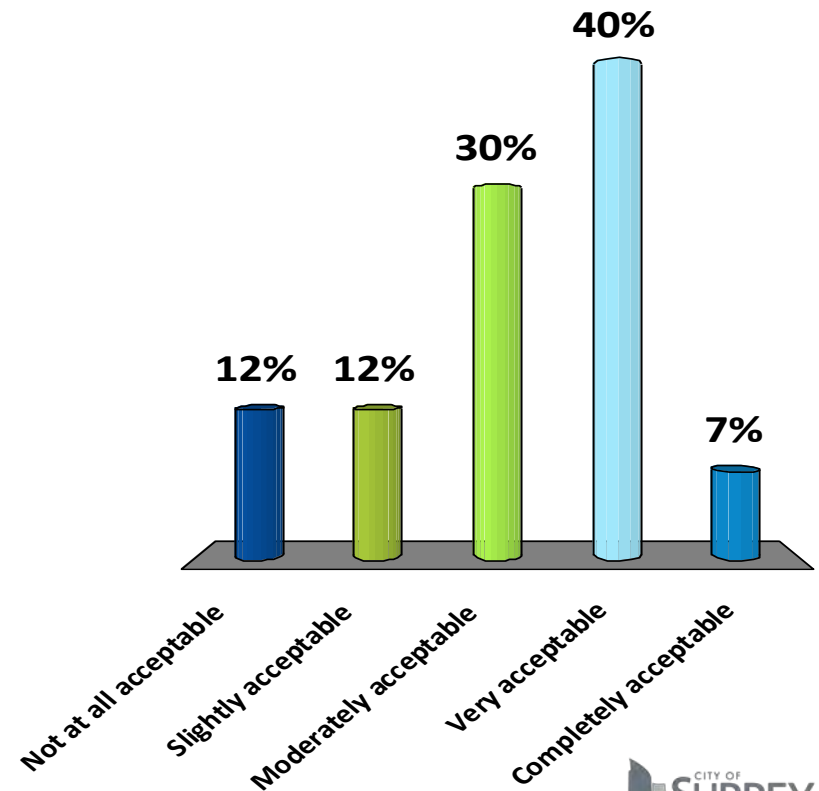
- A. Not at all likely
- B. Slightly likely
- C. Moderately likely
- D. Very likely
- E. Completely likely



Risk Acceptance

How acceptable is it to you to continue living in Crescent Beach given the high and very high risks of flooding?

- A. Not at all acceptable
- B. Slightly acceptable
- C. Moderately acceptable
- D. Very acceptable
- E. Completely acceptable

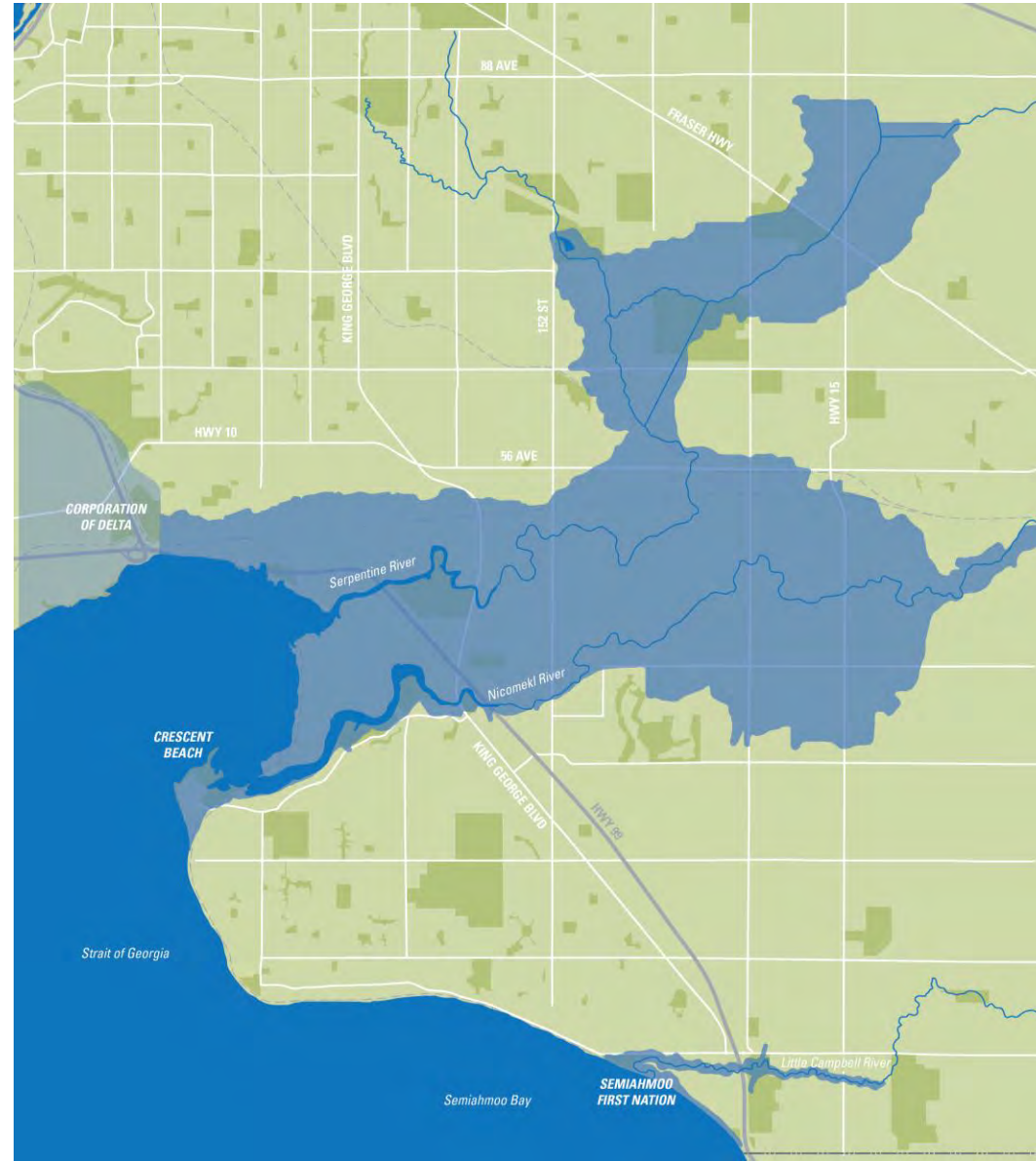


Crescent Beach

Financing adaptation options

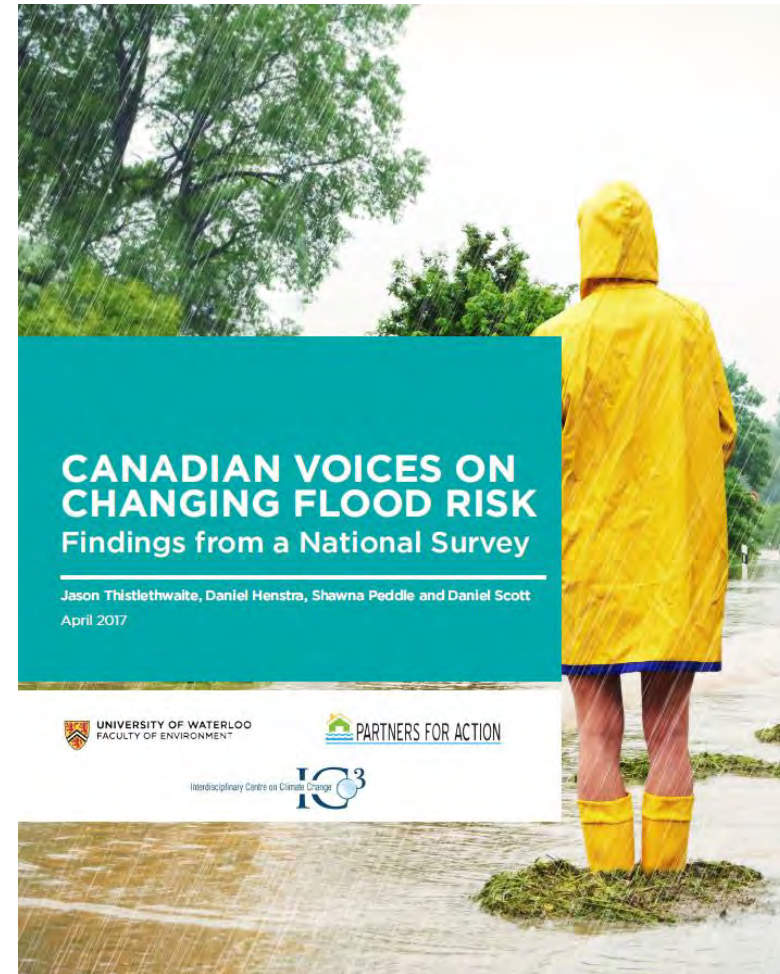
Options Bundling

- Three study areas
- 10 shortlisted options
- Three budget bins
 - \$: less than \$100M
 - \$\$: \$100M to \$1B
 - \$\$\$: More than \$1B



National Survey on Flood Risks

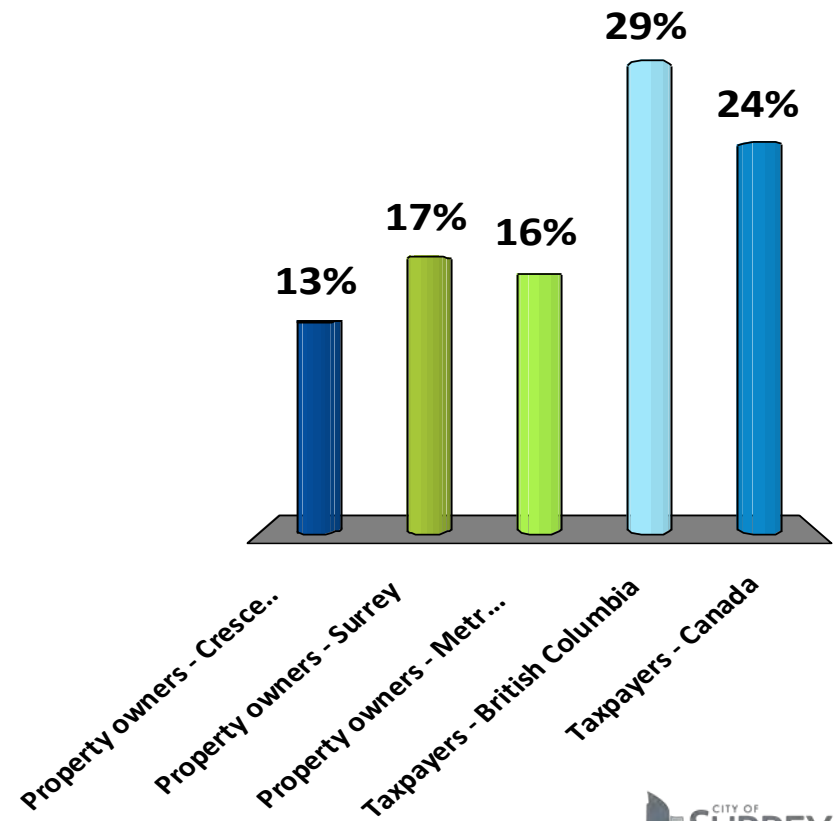
- 6% of Canadians' know they live in a designated flood risk area
- 21% believe that the risk of flooding will increase over the next 25 years
- 83% of Canadians' believe that homeowners are responsible for personal protection



Who should pay?

Who should pay the most to help Crescent Beach adapt to sea level rise (rank)?

- A. Property owners - Crescent Beach
- B. Property owners - Surrey
- C. Property owners - Metro Vancouver
- D. Taxpayers - British Columbia
- E. Taxpayers - Canada














Crescent Beach

Priority Options

Summary Key Concerns

- Seepage
- Views
- Extreme flood
- Earthquake
- Burden to future generations

		EXPANDED EDGE	BARRIER ISLAND/ SPIT	MUD BAY BARRIER	MANAGED RETREAT
VALUES CRITERIA					
	RESIDENTS <i>People permanently displaced</i>	SLIGHTLY WORSE	MODERATELY WORSE	MODERATELY WORSE	FAR WORSE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	SLIGHTLY WORSE	MODERATELY WORSE	FAR WORSE	FAR BETTER
	INFRASTRUCTURE <i>Percent of service/ transportation infrastructure made vulnerable</i>	NO CHANGE	NO CHANGE	NO CHANGE	NO CHANGE
	ECONOMY <i>Revenue</i>	SLIGHTLY BETTER	NO CHANGE	SLIGHTLY WORSE	MODERATELY WORSE
	RECREATION <i>Diversity of recreational opportunities</i>	MODERATELY BETTER	SLIGHTLY BETTER	SLIGHTLY WORSE	FAR BETTER
	CULTURE <i>Opportunities for traditional practices</i>	SLIGHTLY WORSE	SLIGHTLY WORSE	MODERATELY WORSE	MODERATELY WORSE
IMPACT & RISK OF FAILURE					
	OVERALL RISK	HIGH	VERY HIGH	VERY HIGH	VERY LOW
COST CRITERIA					
	CAPITAL COST	\$\$	\$\$\$	\$\$\$\$	\$\$\$
	OPERATION & MAINTENANCE COST	\$\$	\$\$	\$\$	—
	INFRASTRUCTURE MARGINAL COST	\$\$	\$\$	\$	\$
	COST TO FUTURE GENERATIONS	\$\$	\$\$\$	\$\$\$	—

Worksheet

CHAPTER 2: CRESCENT BEACH

RANKING WORKSHEET



	A	B	C	D	E	RANK CRITERIA
VALUES CRITERIA						
RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE	MODERATELY WORSE	MODERATELY WORSE	FAR WORSE	
ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	FAR WORSE	SLIGHTLY WORSE	MODERATELY WORSE	FAR WORSE	FAR BETTER	
INFRASTRUCTURE <i>Percent of service/transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE	NO CHANGE	NO CHANGE	NO CHANGE	
ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY BETTER	NO CHANGE	SLIGHTLY WORSE	MODERATELY WORSE	
RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	MODERATELY BETTER	SLIGHTLY BETTER	SLIGHTLY WORSE	FAR BETTER	
CULTURE <i>Opportunities for traditional practices</i>	MODERATELY WORSE	SLIGHTLY WORSE	SLIGHTLY WORSE	MODERATELY WORSE	MODERATELY WORSE	
IMPACT & RISK OF FAILURE						
OVERALL RISK	VERY HIGH	HIGH	VERY HIGH	VERY HIGH	VERY LOW	
COST CRITERIA						
CAPITAL COST	---	\$\$	\$\$\$	\$\$\$\$	\$\$\$	
OPERATION & MAINTENANCE COST	\$\$\$	\$\$	\$\$	\$\$	---	
INFRASTRUCTURE MARGINAL COST	\$\$\$	\$\$	\$\$	\$	\$	
COST TO FUTURE GENERATIONS	\$\$\$\$	\$\$	\$\$\$	\$\$\$	---	

COST CRITERIA NOTES:
 Budget bins for capital costs and future generation's costs: \$ - less than \$10M, \$\$ - \$10M-\$1B, \$\$\$ - \$1B-\$4B, \$\$\$\$ - more than \$4B
 Approximate incremental infrastructure costs: \$ - less than \$10M, \$\$ - \$10M-\$100M, \$\$\$ - more than \$100M
 Annual operation and maintenance costs: \$ - less than \$1M, \$\$ - \$1M-\$10M, \$\$\$ - more than \$10M

RANK OPTIONS (letters A through E)

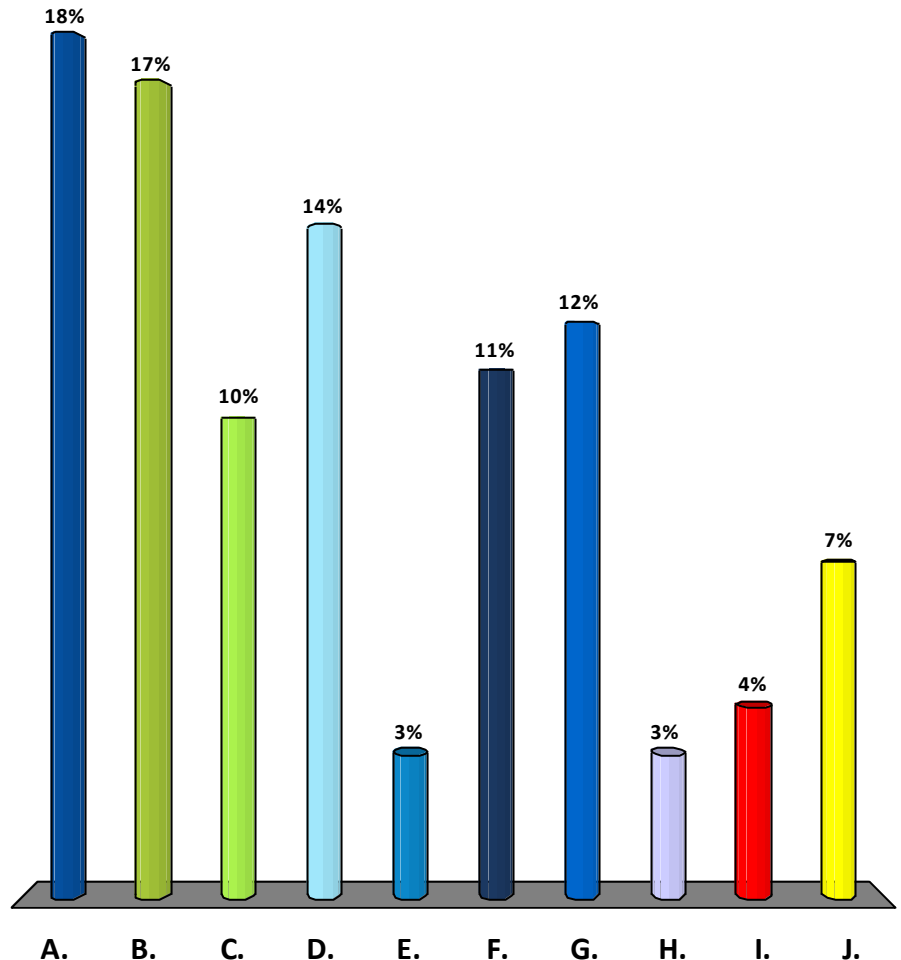
1. _____
2. _____
3. _____
4. _____
5. _____

Activity #3

- Individually:
 1. Rank top 5 criteria
 2. Rank all options
- In tables, discuss:
 - Does your top option perform well on the criteria you care most about?

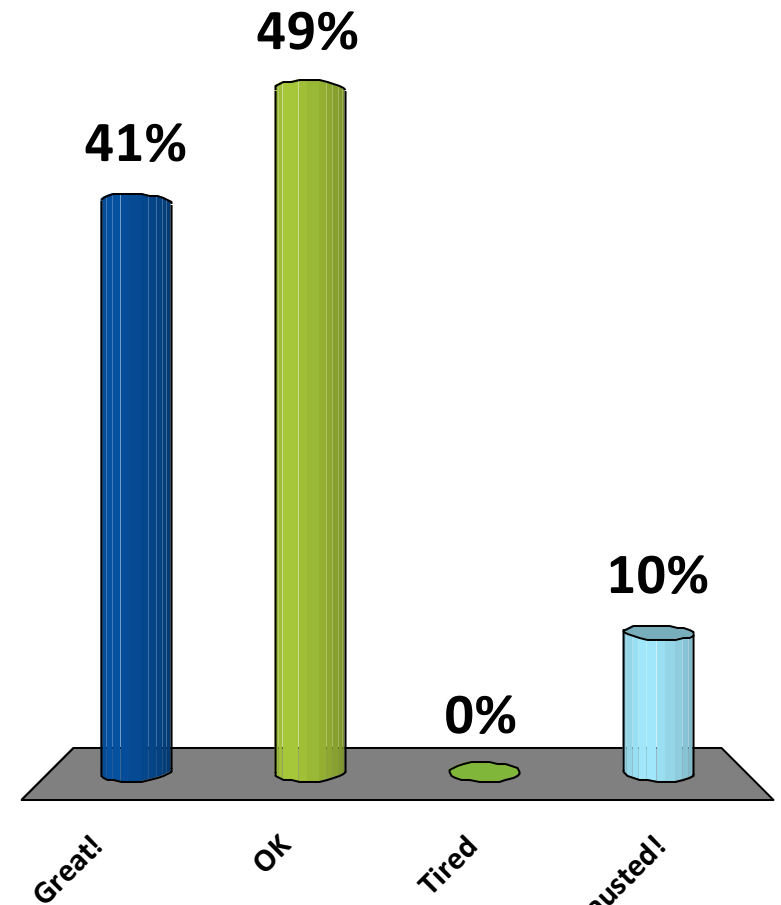
Criteria importance (rank top 5)

- A. Residents
- B. Environment
- C. Economy
- D. Recreation
- E. Culture
- F. Overall Risk
- G. Capital Cost
- H. O&M Cost
- I. Infrastructure Marginal Cost
- J. Cost to Future Generations



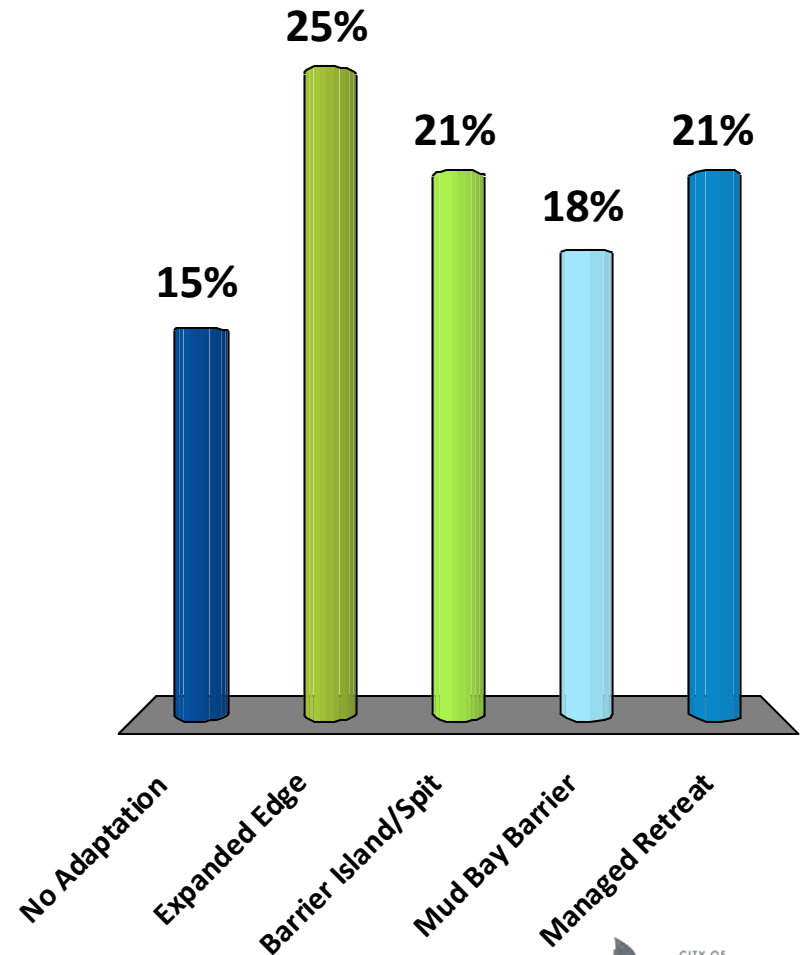
How are you feeling?

- A. Great!
- B. OK
- C. Tired
- D. Exhausted!



Option preference by 2100 (rank)

- A. No Adaptation
- B. Expanded Edge
- C. Barrier Island/Spit
- D. Mud Bay Barrier
- E. Managed Retreat



Crescent Beach

Next Steps

Please do not take clickers home



They will not work with your TV!

Next Steps Phase 3

- Mud Bay Survey (live now)
- Crescent Beach Survey (TBD)
- Advisory Group (March 9th, 2018)
- Open house (April 10th, 2018)



More information?





SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

Thank you!

