Ecosystem Vulnerability Workshop

Surrey City Hall
13450 104 Avenue
First Floor - Committee Rooms A & B

Tuesday, November 27, 2018 9:00 AM - 12:00 PM

This workshop will convene Boundary Bay environmental partners, agency representatives and subject matter experts to provide an update on Surrey's Coastal Flood Adaptation Strategy (CFAS), and gather feedback on a framework for ecosystem risk assessment to prioritize issues for near term adaptation and communications materials.

CFAS

CITY OF SURREY
the future lives here.

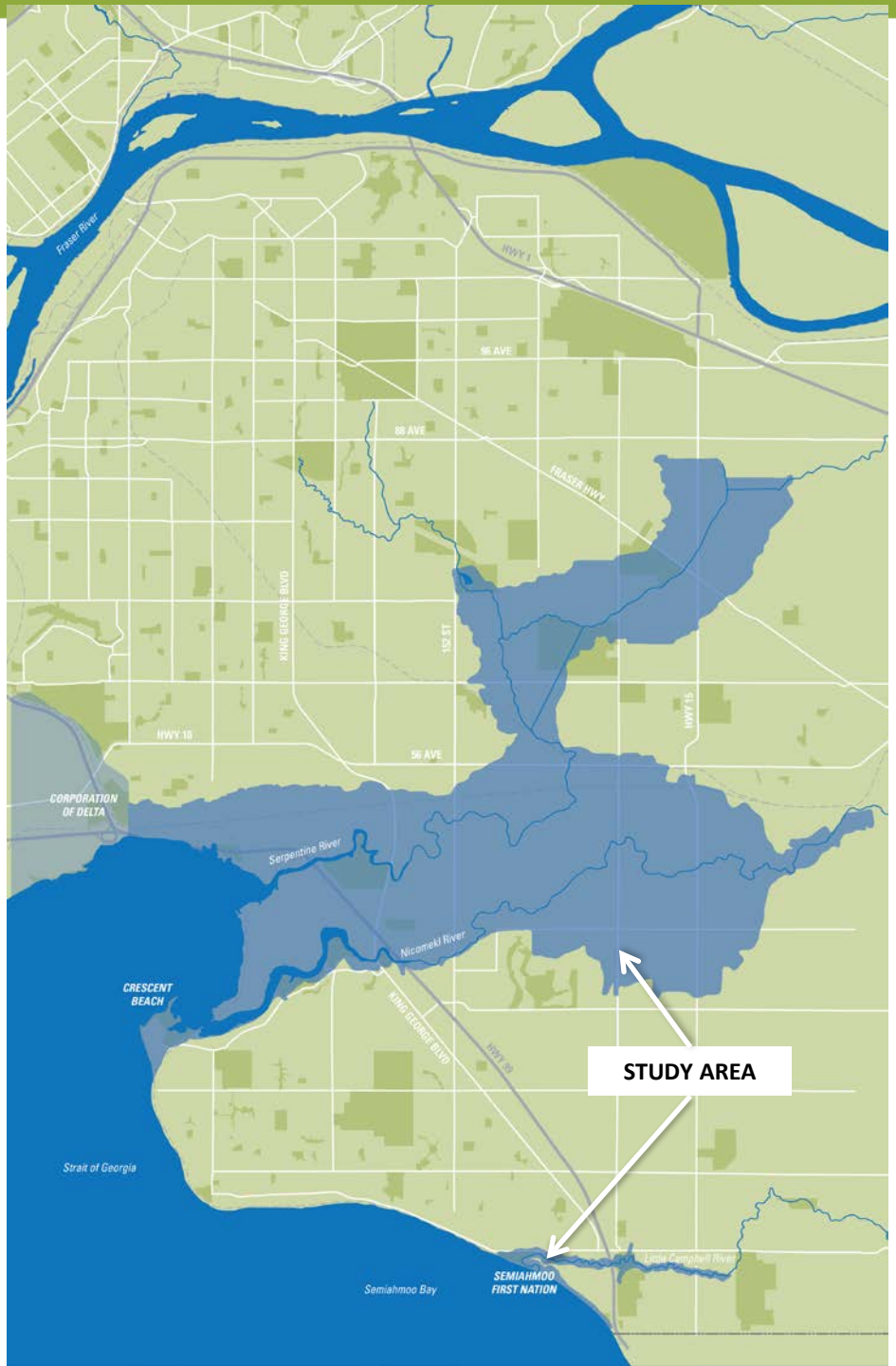
Agenda

- Introductions (10 min)
- Background to CFAS (10 min)
- Data collected/collated (30 min)
- Ecosystem Risk Framework (10 min)
- Table Exercises (30 min)
- Break (15 min)
- Plenary discussion (20 min)
- Communication work plan (20 min)
- Conclusion (15 min)

SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

November 27, 2018

Update



SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

- Mayor & Council adopted recommendations to develop a Coastal Strategy Feb 22, 2016 under Corporate Report No. R034;2016
  - Continuing commitment to participatory planning
- CFAS anticipated to be complete by end of 2018
- Large study area with many communities, stakeholders and partners

Study area @ a glance

What is at Risk?

COMMUNITIES AND PEOPLE

Many residential areas and neighbourhoods
Semiahmoo First Nation
1,500+ 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

700+ 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)

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

1.2 Metres

Metre

100 cm
80 cm
60 cm
40 cm
20 cm
0 cm

Sea Level Rise with Ground Subsidence

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

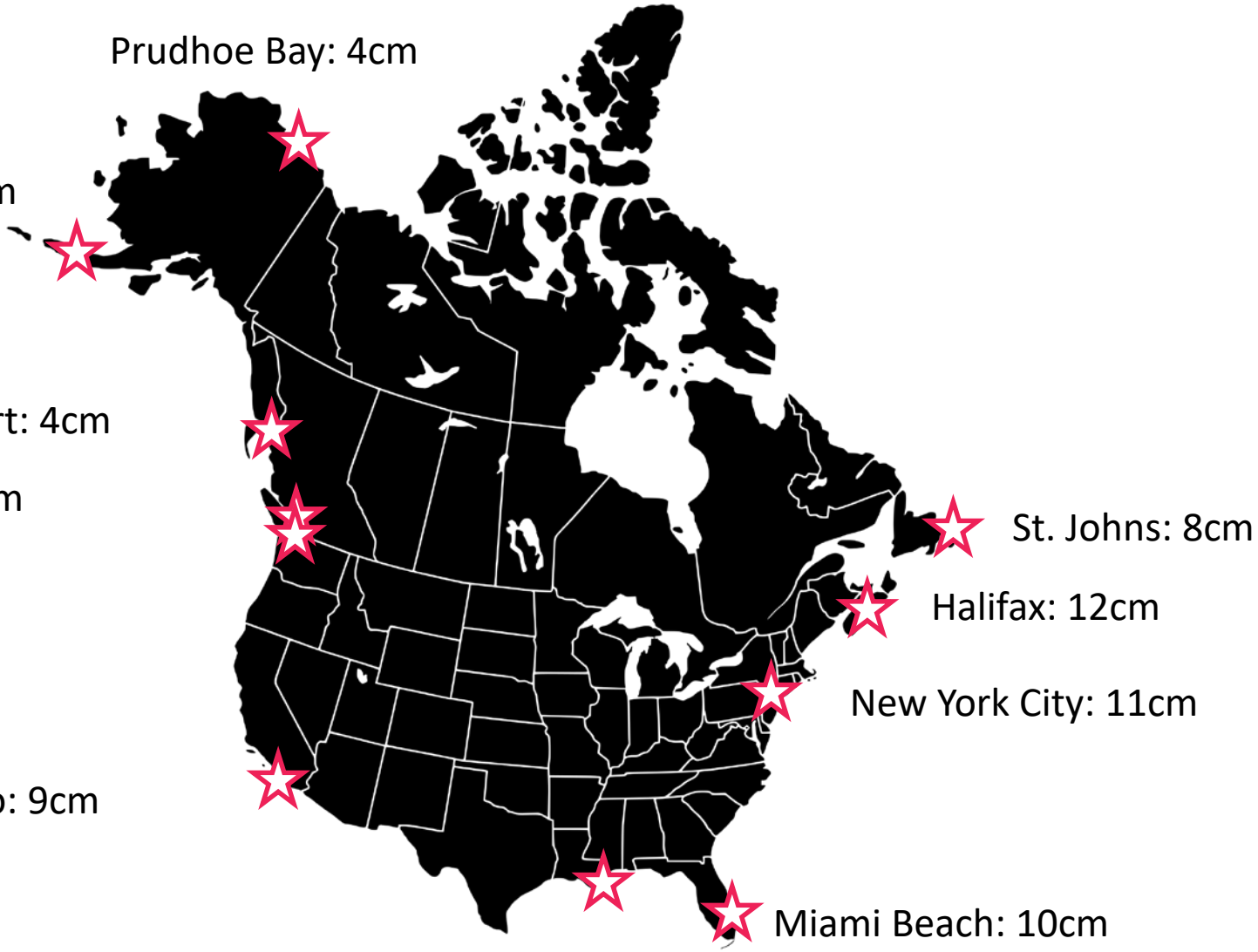
An Evolving Future

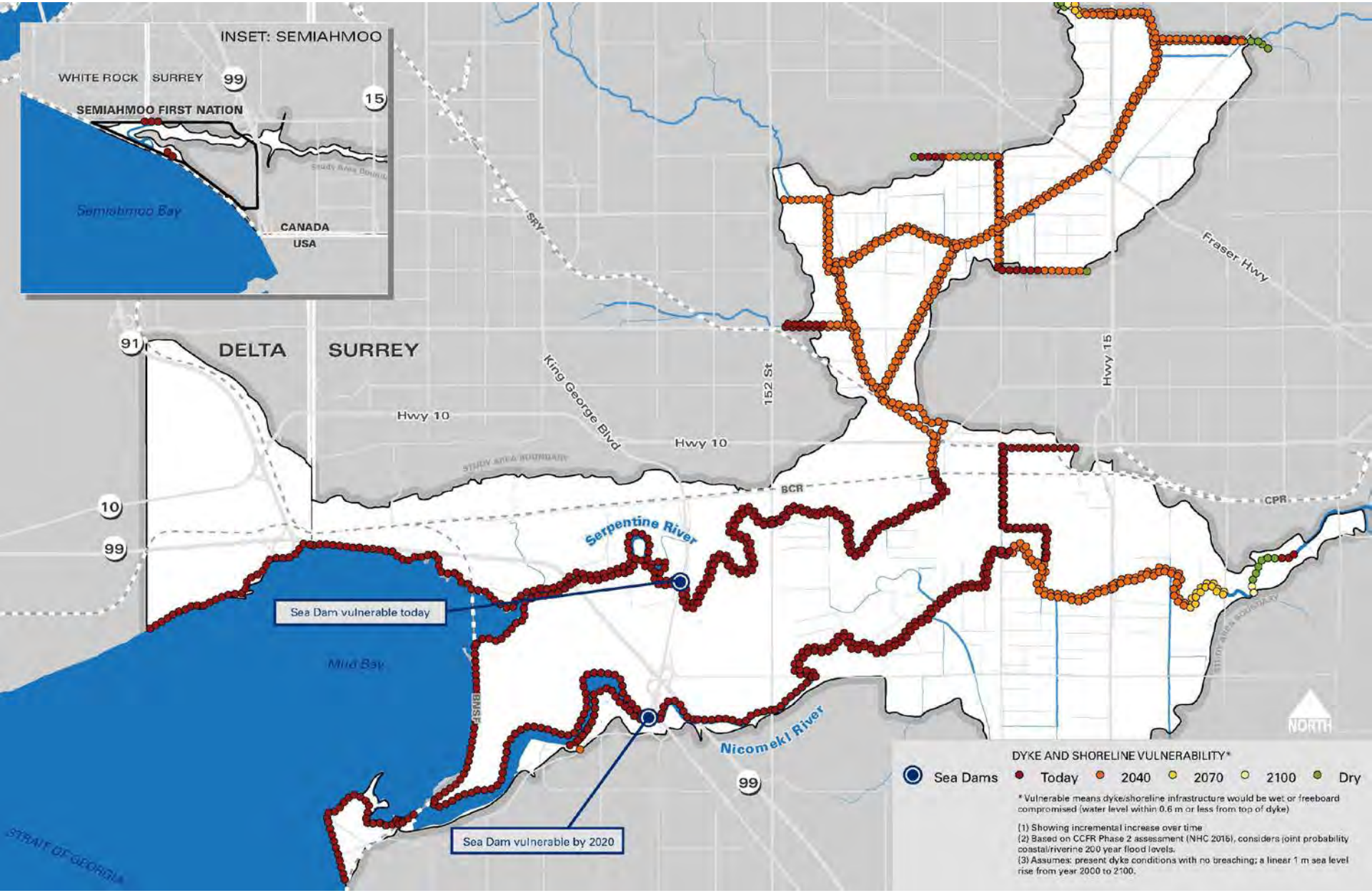
As our climate continues to change and sea levels continue to rise over the coming years, it is anticipated that the frequency and intensity of major coastal and river floods will also increase.

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.

Photos courtesy Surrey Archives and Museum

Approximate sea level rise since 1972




INSET: SEMIAHMOO
WHITE ROCK
SURREY
99
15
SEMIAHMOO FIRST NATION
Semiahmoo Bay
CANADA
USA
DELTA
SURREY
91
10
99
Hwy 10
King George Blvd
152 St
Hwy 15
Fraser Hwy
SRY
BCR
CPR
Serpentine River
Nicomekl River
Mud Bay
BNSF
Sea Dam vulnerable today
Sea Dam vulnerable by 2020
STRAIT OF GEORGIA
NORTH
DYKE AND SHORELINE VULNERABILITY*
Sea Dams
Today
2040
2070
2100
Dry
* Vulnerable means dyke/shoreline infrastructure would be wet or freeboard compromised (water level within 0.6 m or less from top of dyke)
(1) Showing incremental increase over time
(2) Based on CCFR Phase 2 assessment (NHC 2016), considers joint probability coastal/riverine 200 year flood levels.
(3) Assumes: present dyke conditions with no breaching; a linear 1 m sea level rise from year 2000 to 2100.

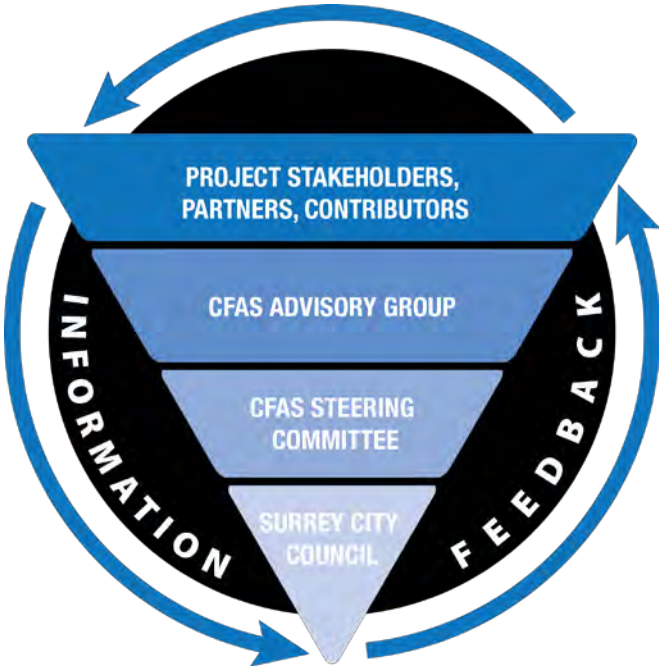
Coastal Vulnerabilities

Coastal Dyke Vulnerability

Location	Annual Exceedence Probability	
	Present	Future with 10 cm of sea level rise
BNSF Railway	14%	33%
Colebrook Dyke (Average of two locations)	5%	11% funding requested to bring to 0.5%
South Bank Serpentine River (Mud Bay)	4%	9%
Crescent Beach	3%	9%

Surrey CFAS Process

- Many stakeholders
  - Farmers and agricultural community
  - Residents, businesses, community groups
  - Environmental and recreational groups
  - Infrastructure operators and owners
  - Semiahmoo First Nation



CFAS

Surrey CFAS Process

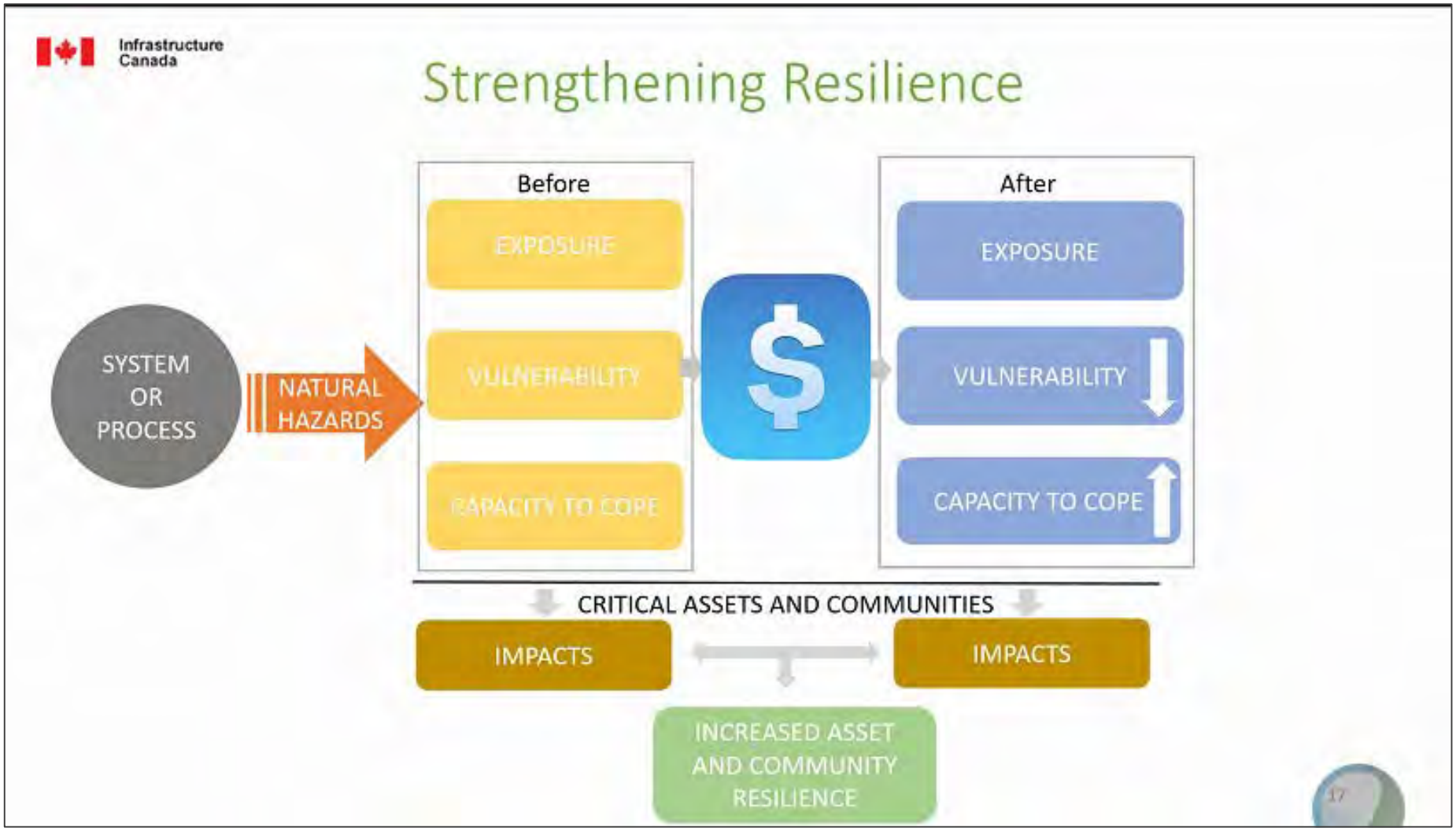
Environment & Recreation Focus Group March 8, 2017

July 11, 2017 Green Shores™

October 2017 Environmental Stewardship Meeting

November 17, 2017 Coastal Land Stewardship Workshop

DMAF Framework



Mud Bay Ecosystem and Infrastructure Prioritization project

- Commenced August 2017
- Literature Review
- Online materials
- High Level Environmental Assessment & Risk Assessment
- Estuary monitoring
  - Wind and wave data
  - 4 sites for accretion\erosion and subsidence measurements
  - Water quality and water salinity
  - Remote Sensing (mapping, video collection)
- Completion deadline August 2019

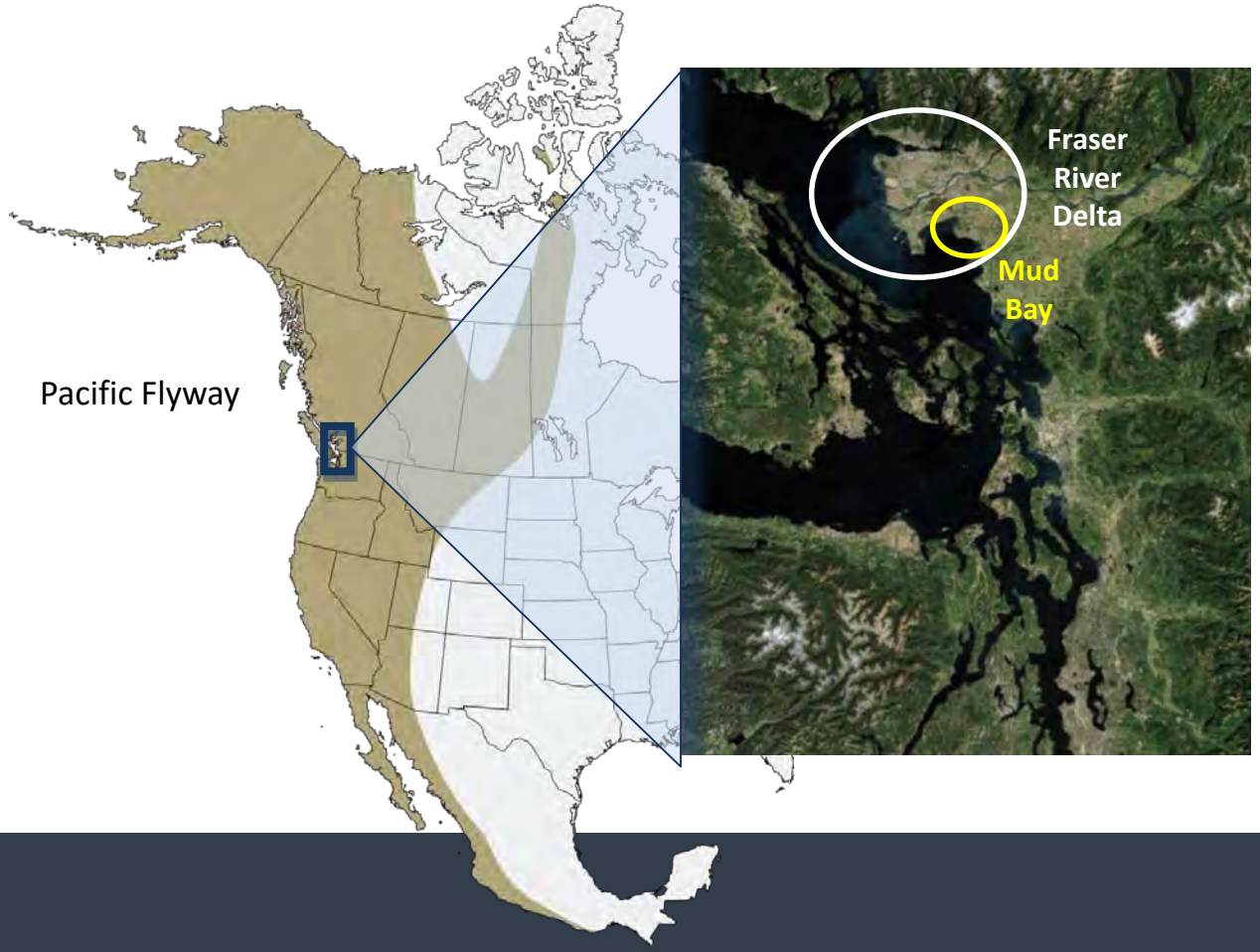
Conservation Context

The 200,000 hectare Delta is the most-used migratory staging area in BC.

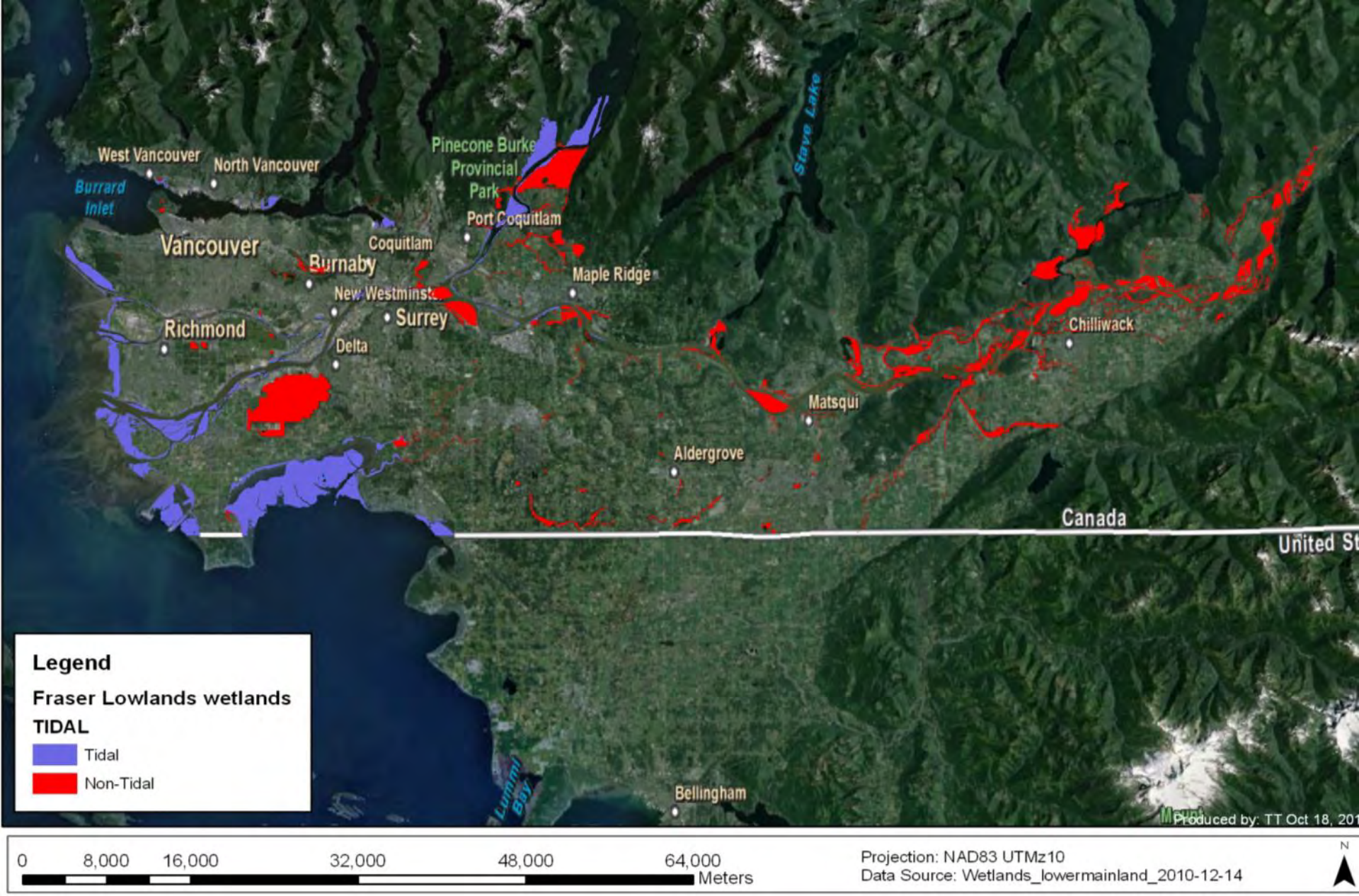
Largest estuary in BC (45% of BC mudflats)

Supports the highest density of wintering waterfowl in Canada.

Mostly used by **wintering and migrating waterfowl** (33 species; 90 million waterfowl use days) and these birds use the FD mostly for **food supply and refuge.**

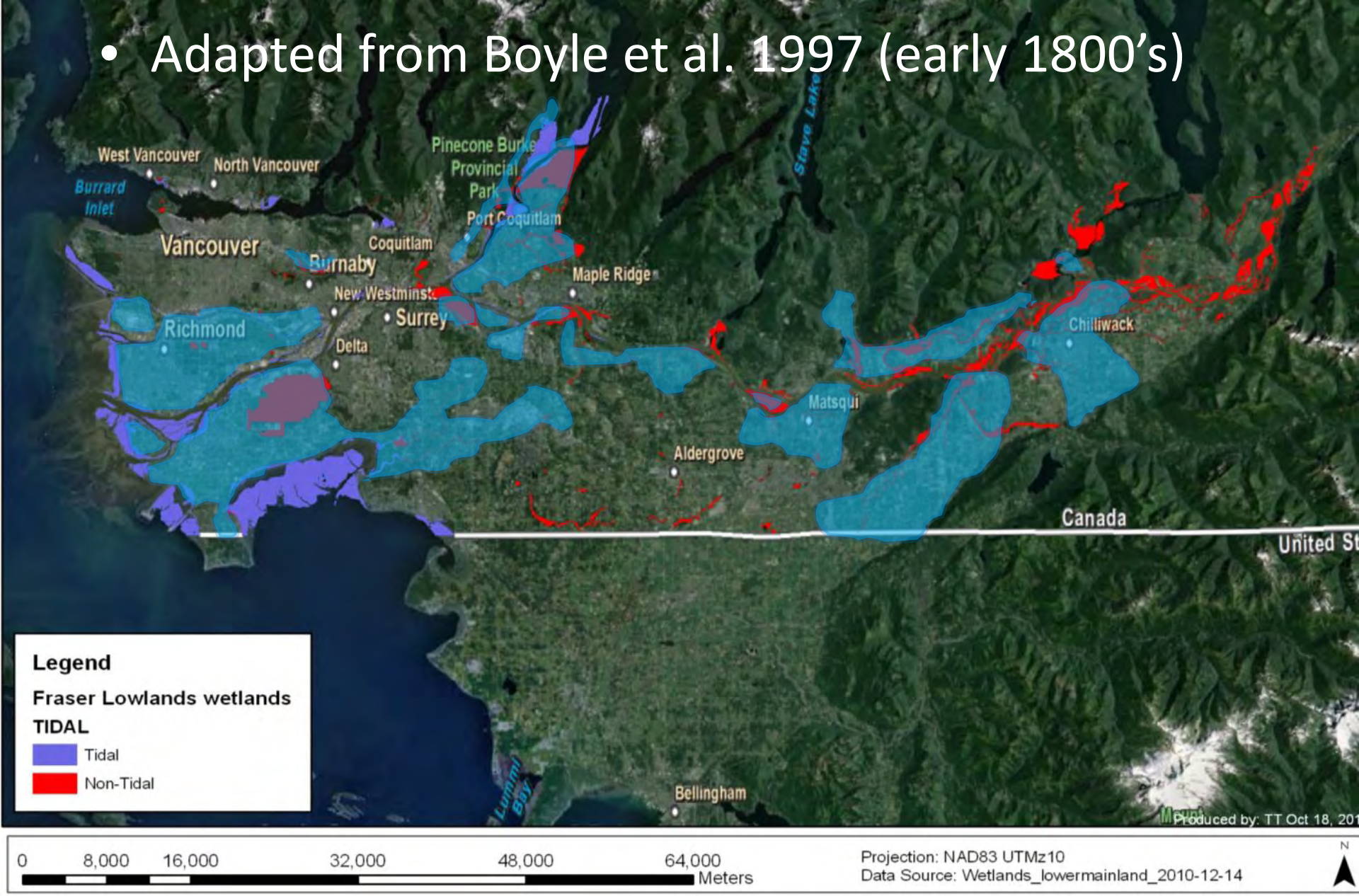


Ducks Unlimited Canada

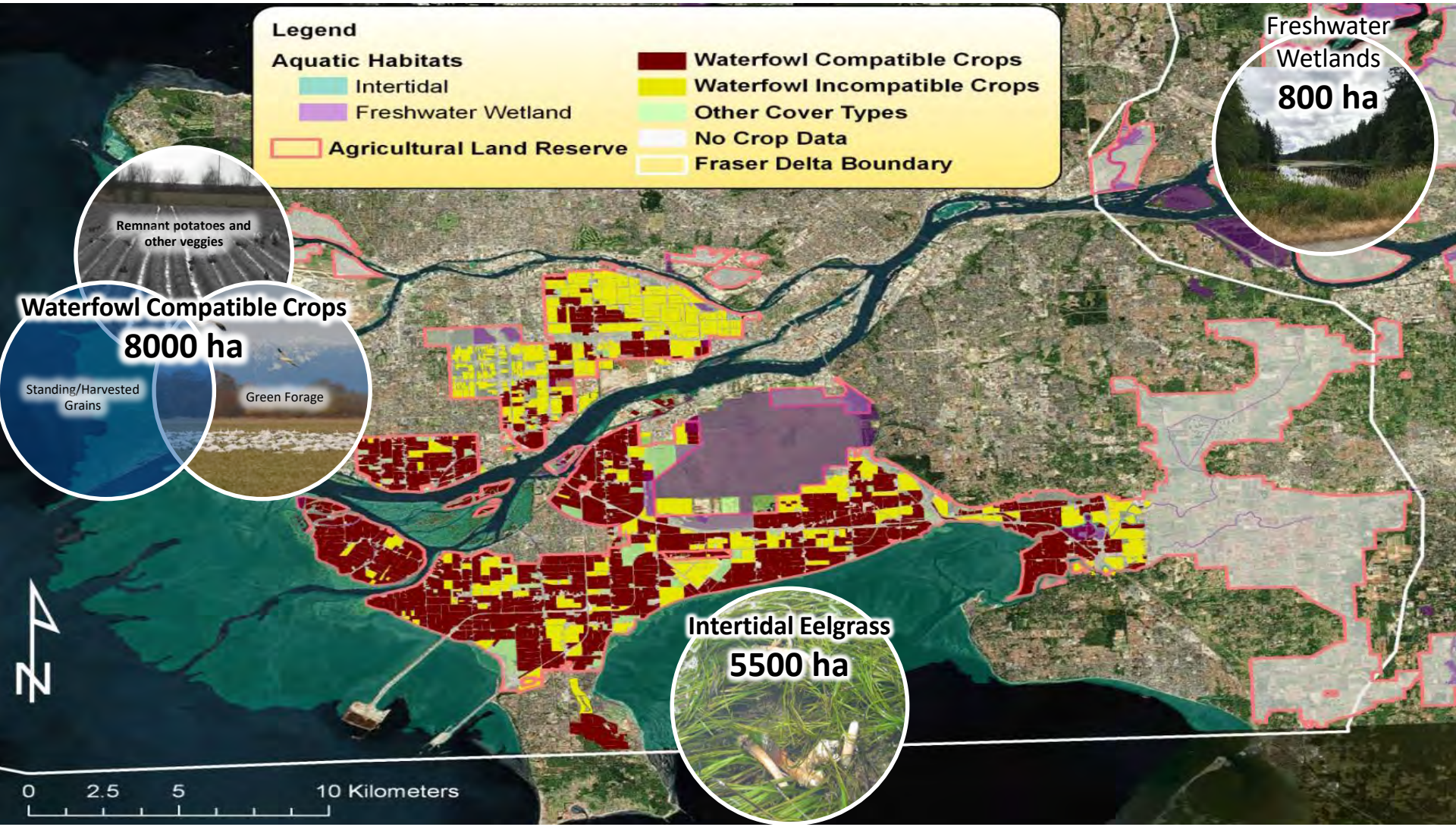


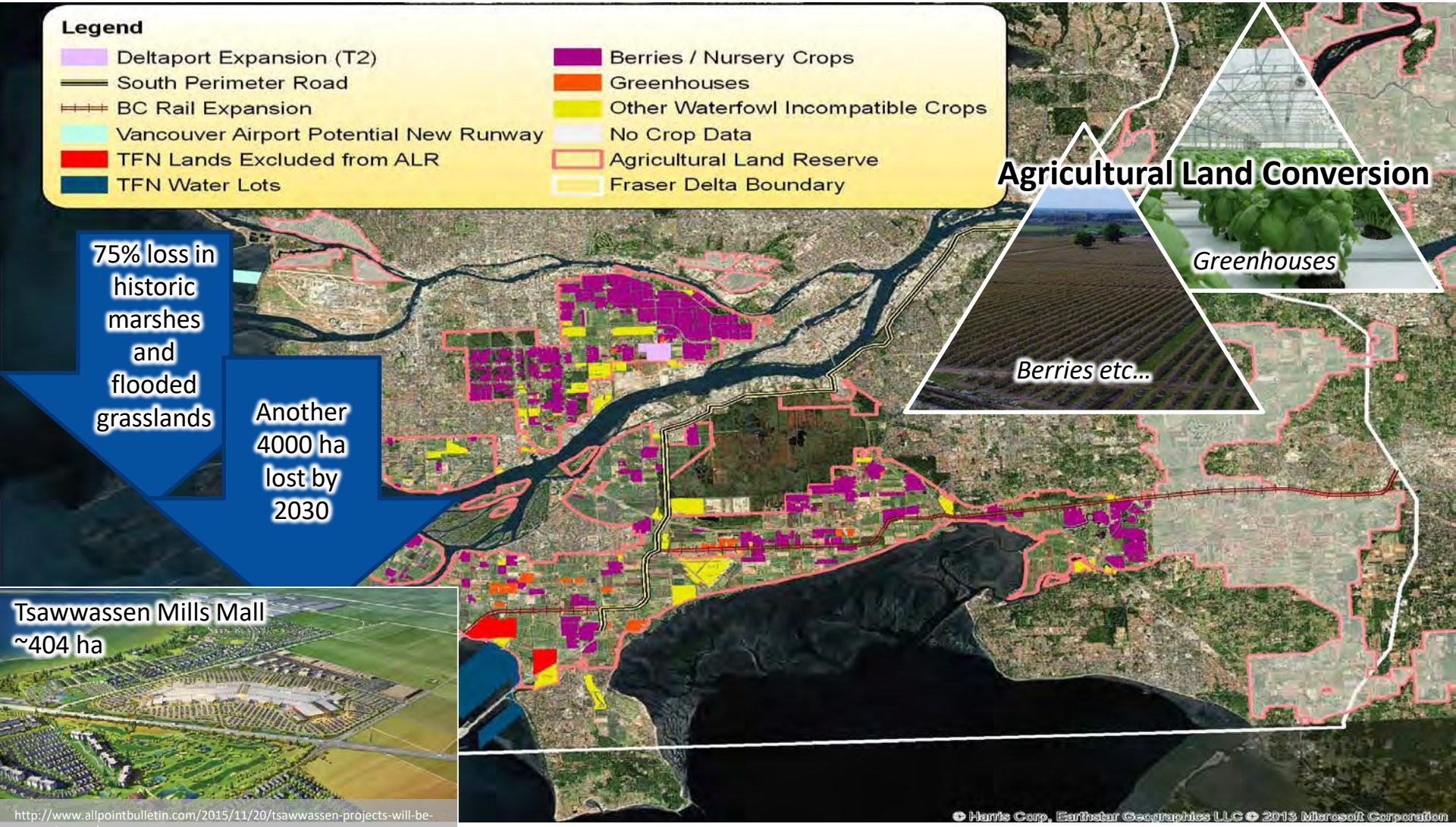
Current Wetlands in the Fraser Lowland

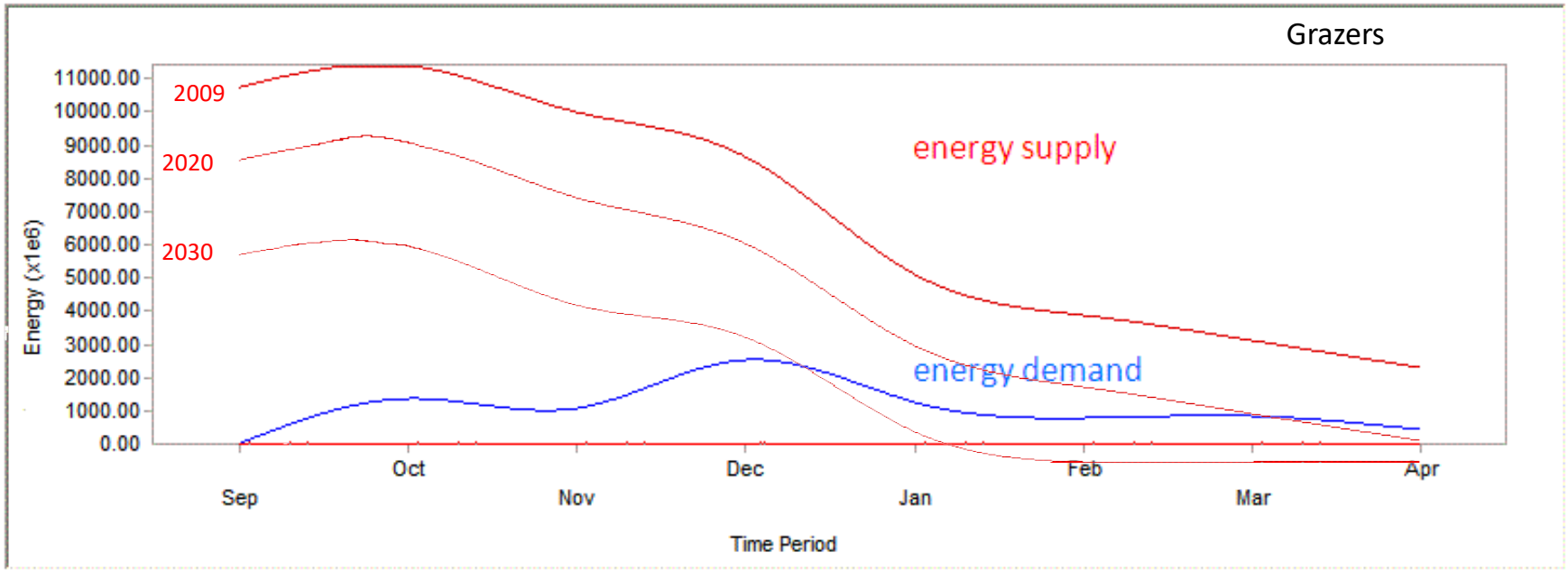
- Adapted from Boyle et al. 1997 (early 1800's)

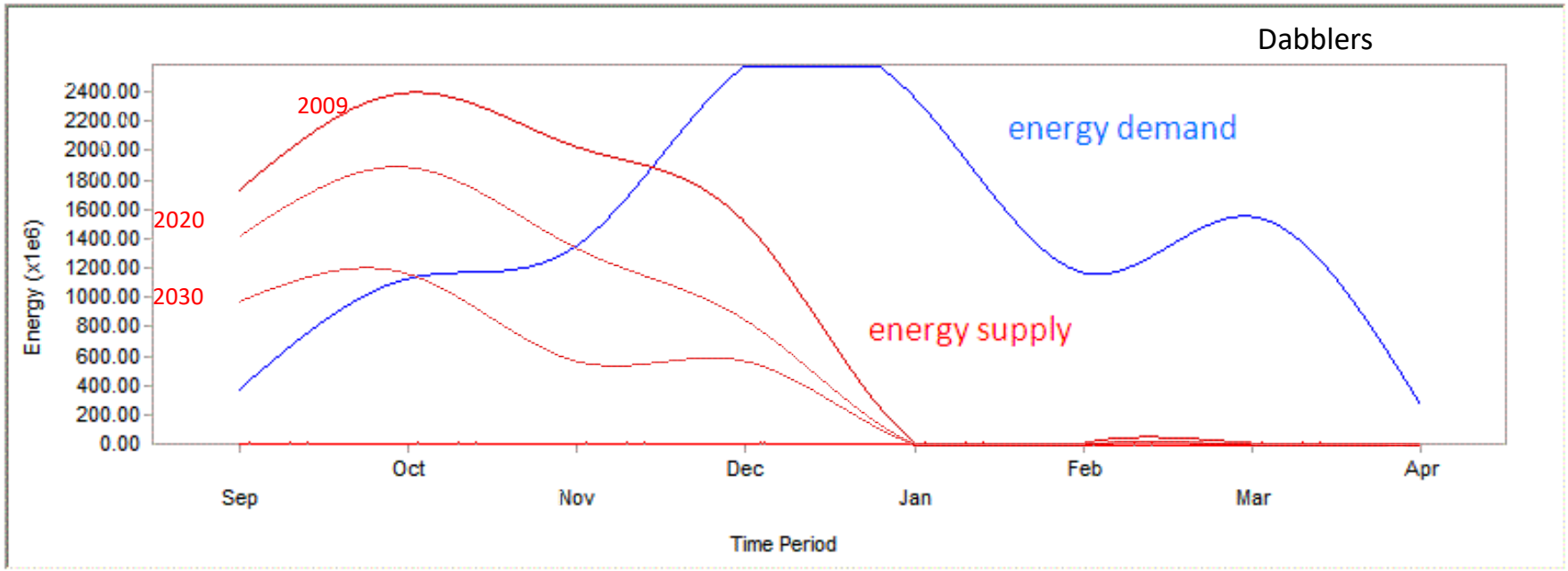


Historic Wetlands in the Fraser Lowland

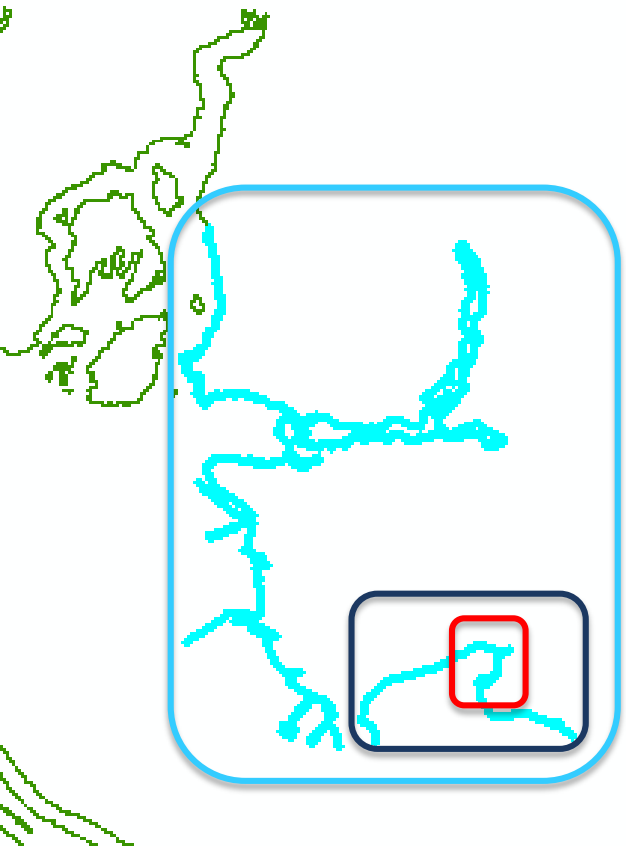

Legend
Aquatic Habitats
Intertidal
Freshwater Wetland
Agricultural Land Reserve
Waterfowl Compatible Crops
Waterfowl Incompatible Crops
Other Cover Types
No Crop Data
Fraser Delta Boundary
Freshwater Wetlands
800 ha
Remnant potatoes and other veggies
Waterfowl Compatible Crops
8000 ha
Standing/Harvested Grains
Green Forage
Intertidal Eelgrass
5500 ha
N
0
2.5
5
10 Kilometers


Legend
Deltaport Expansion (T2)
South Perimeter Road
BC Rail Expansion
Vancouver Airport Potential New Runway
TFN Lands Excluded from ALR
TFN Water Lots
Berries / Nursery Crops
Greenhouses
Other Waterfowl Incompatible Crops
No Crop Data
Agricultural Land Reserve
Fraser Delta Boundary
Agricultural Land Conversion
Greenhouses
Berries etc…
75% loss in historic marshes and flooded grasslands
Another 4000 ha lost by 2030
Tsawwassen Mills Mall
~404 ha
http://www.allpointbulletin.com/2015/11/20/tsawwassen-projects-will-be-game-changer/
© Harris Corp, Earthstar Geographics LLC © 2013 Microsoft Corporation


Grazers
11000.00
10000.00
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
Energy (x1e6)
2009
2020
2030
energy supply
energy demand
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
Time Period


Dabblers
2400.00
2200.00
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Energy (x1e6)
2009
2020
2030
energy demand
energy supply
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
Time Period

Regional Significance



Shoreline Classification	Mud Bay Total Length (m)	Relative to Boundary Bay	Relative to Lower Mainland	Relative to Province
Estuary (Organics/Fines)	11,137	44%	16%	<1%
Sand Beach, wide > 30m	2,326	23%	18%	<1%
Total	13,463	28%	3%	<0.1%

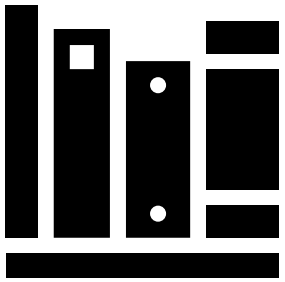
Shoreline Classification	Boundary Bay Total Length (m)	Relative to Lower Mainland	Relative to Province
Estuary (Organics/Fines)	25,509	37%	1.4%
Sand Beach, wide > 30m	10,215	79%	2.6%
Other	13,115	<1%	<0.1%
Total	48,839	13%	4.8%

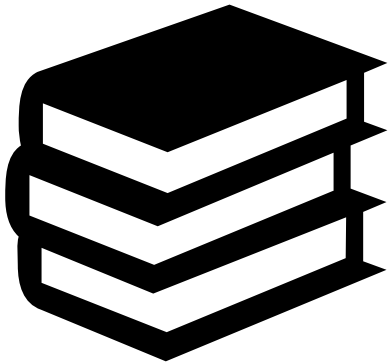
Shoreline Classification	Lower Mainland Total Length (m)	Relative to Province
Estuary (Organics/Fines)	68,619	3.8%
Sand Beach, wide > 30m	15,586	3.3%
Other	303,459	<1%
Total	387,664	1.1%

Source: Archipelago Marine Research, 2015. Note: Mapping excludes Nicomekl River and Serpentine River East of Hwy 99

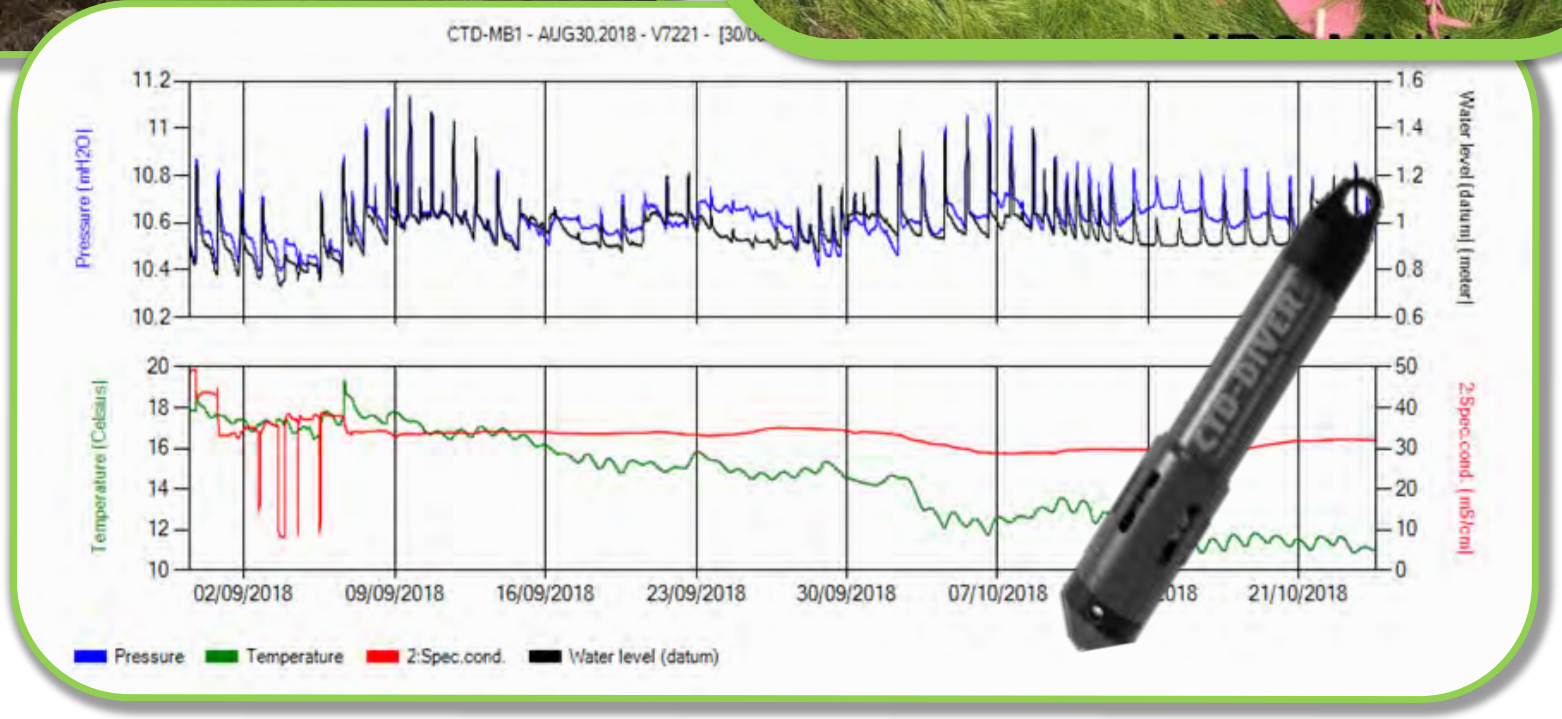
Literature Review

- > 77 pieces of literature reviewed and cited for Mud Bay
- Hydrology, sediment, vegetation, biofilm, invertebrates, fish, birds
- Spreadsheet of all articles and their relevance to CFAS



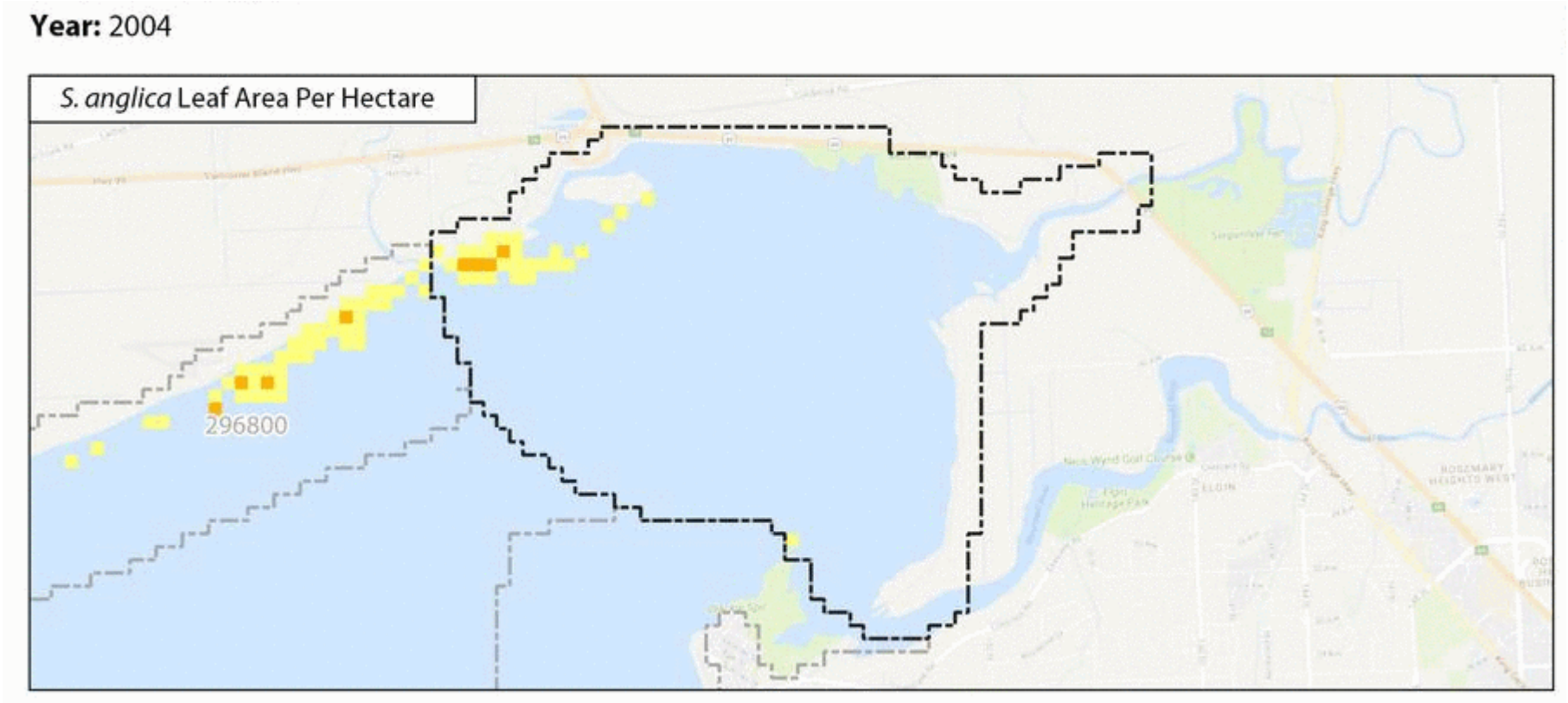


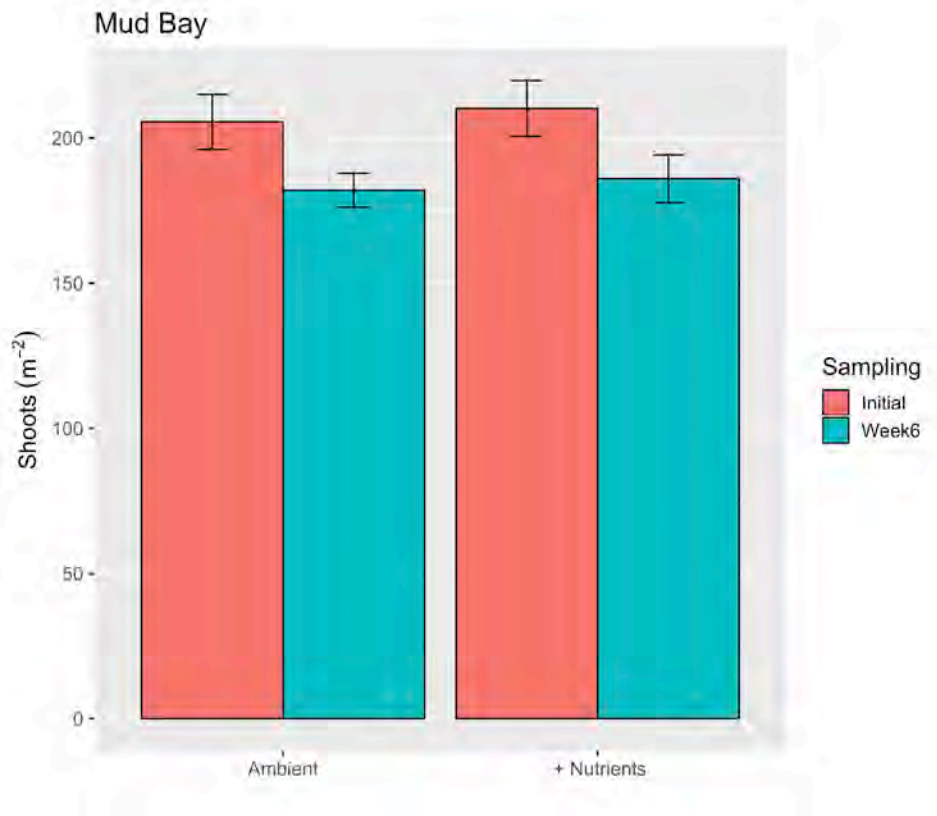

MB2-MH3
MB2
MB2-MH2

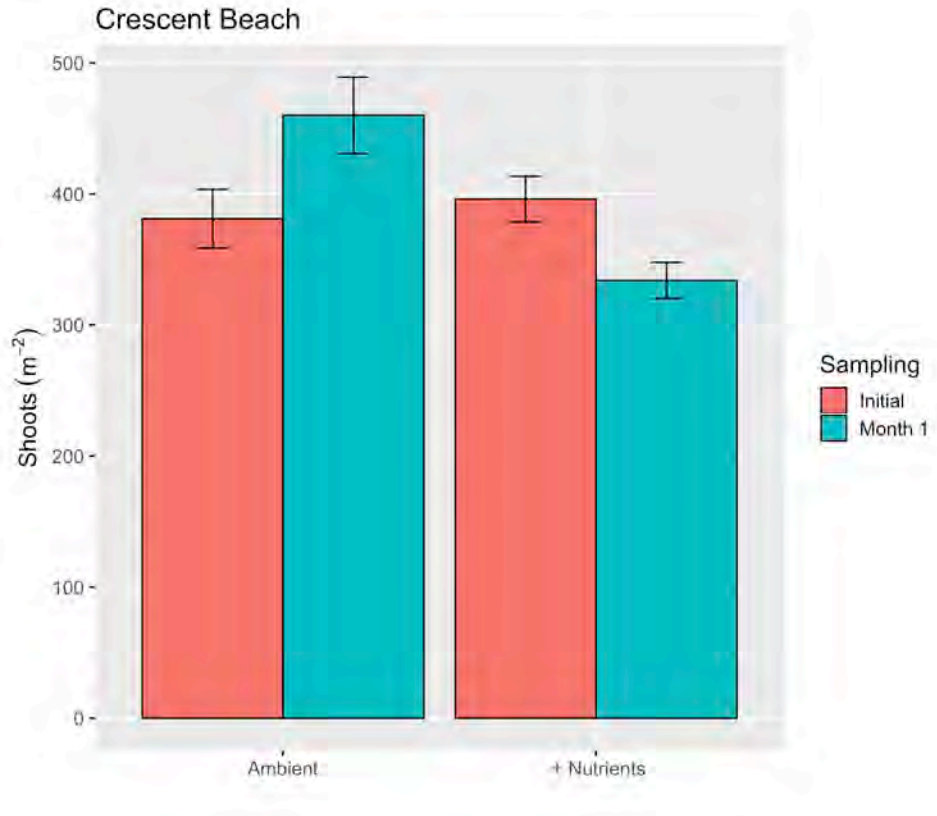

CTD-MB1 - AUG30.2018 - V7221 -
Pressure [mH2O]
Temperature [Celcius]
Water level [datum] [meter]
2:Spec.cond. [mS/cm]
02/09/2018
09/09/2018
16/09/2018
23/09/2018
30/09/2018
07/10/2018
21/10/2018
Pressure
Temperature
2:Spec.cond.
Water level (datum)
CTD-DIVER

 Songbirds	American Goldfinch American Robin Barn Swallow Violet Green Swallow White crowned sparrow	 Shorebirds	Greater Yellowlegs Killdeer Western Sandpiper Western Grebe Whimbrel
 Waterfowl	Mallard Northern Pintail Green-winged teal American Wigeon Snowgoose	 Raptors	Bald Eagle Northern Harrier Red-tailed hawk Peregrin Falcon Rough legged hawk

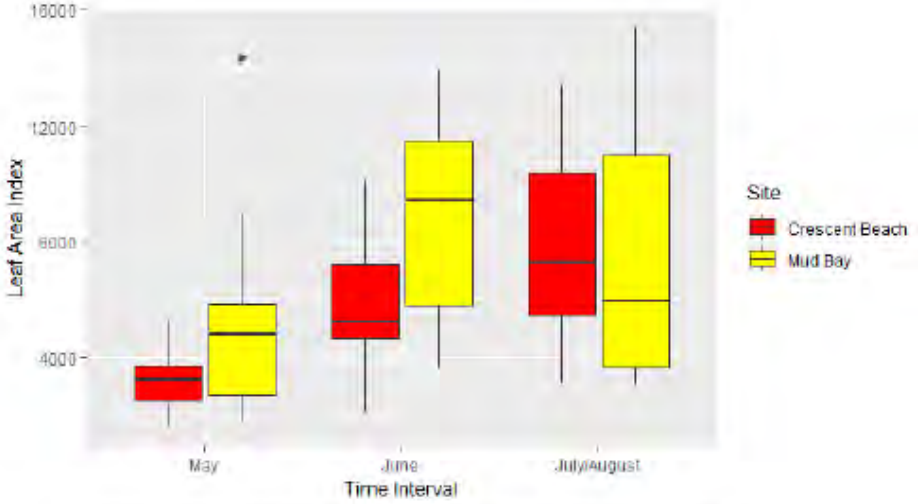
Invasive Spartina

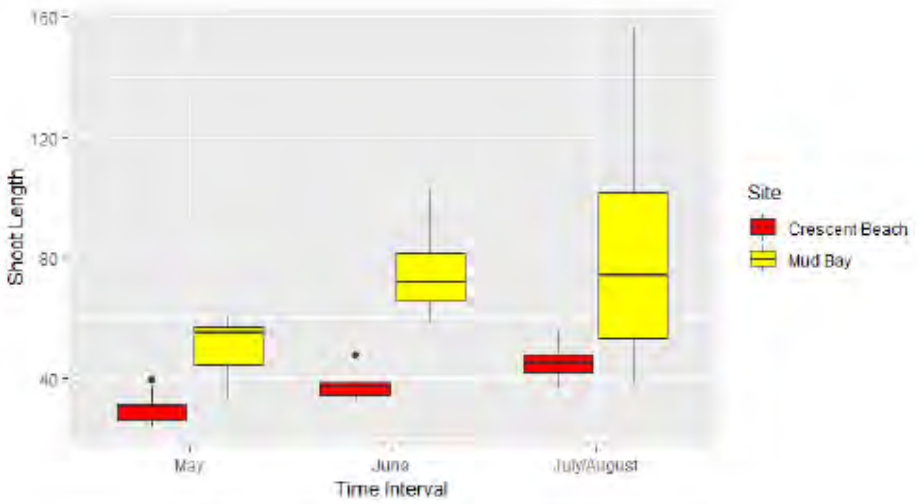


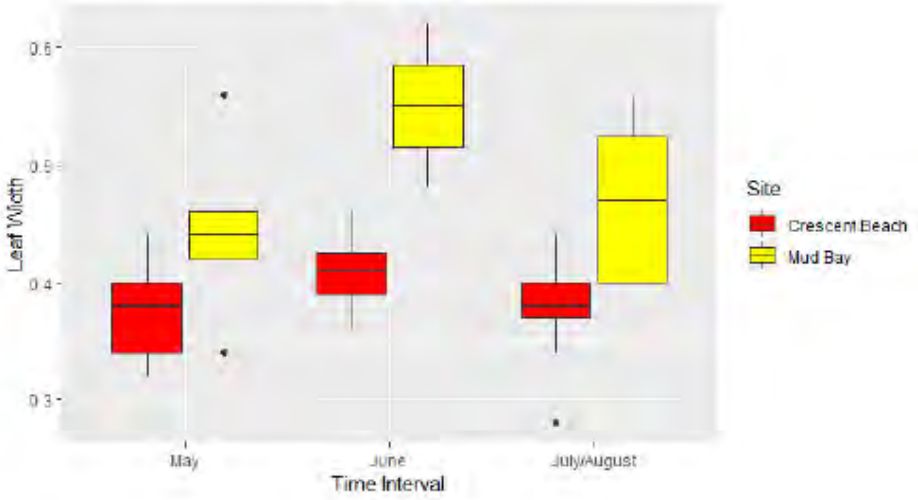


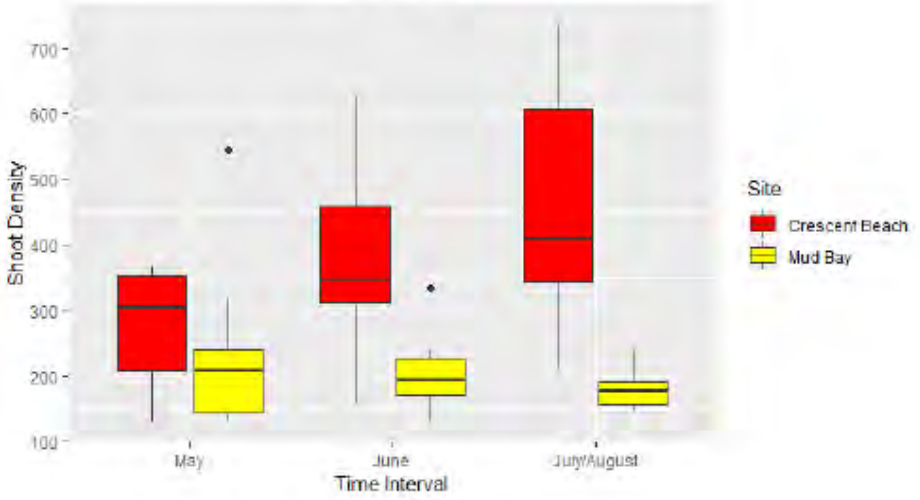


- Zostera marina shoot density (Shoots/m2) at Crescent Beach is double that of Mud Bay
- Increased nutrient loading causes a decline in seagrass shoot density, increase in macroalgal species, and increase in detrital material. These patterns are stronger at Crescent Beach than Mud Bay which suggests that Mud Bay is already highly enriched. Nutrient concentration in the water column and shifts in invertebrate diversity/feeding groups is forthcoming.

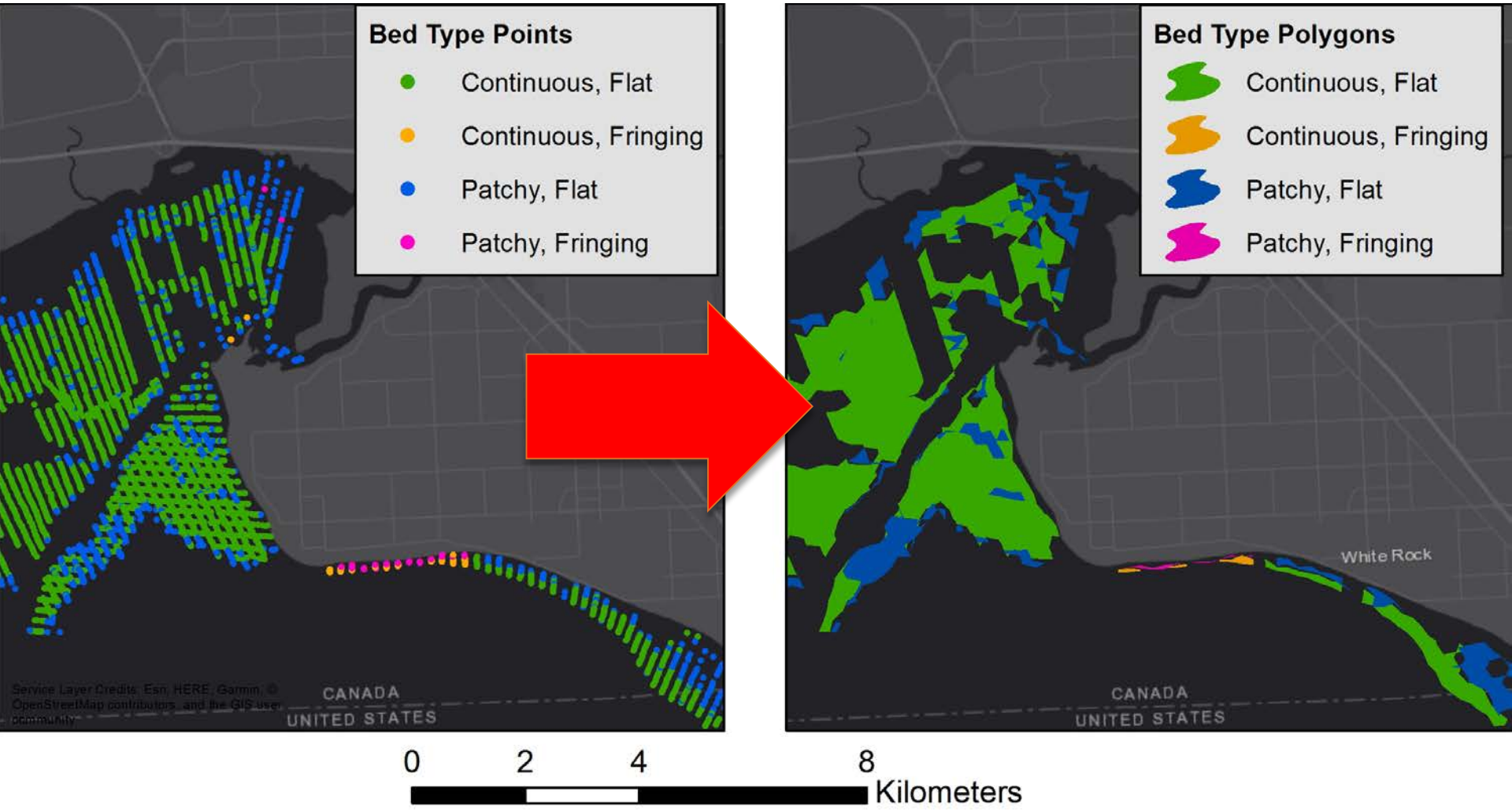

16000
12000
8000
4000
Leaf Area Index
May
June
July/August
Time Interval
Site
Crescent Beach
Mud Bay

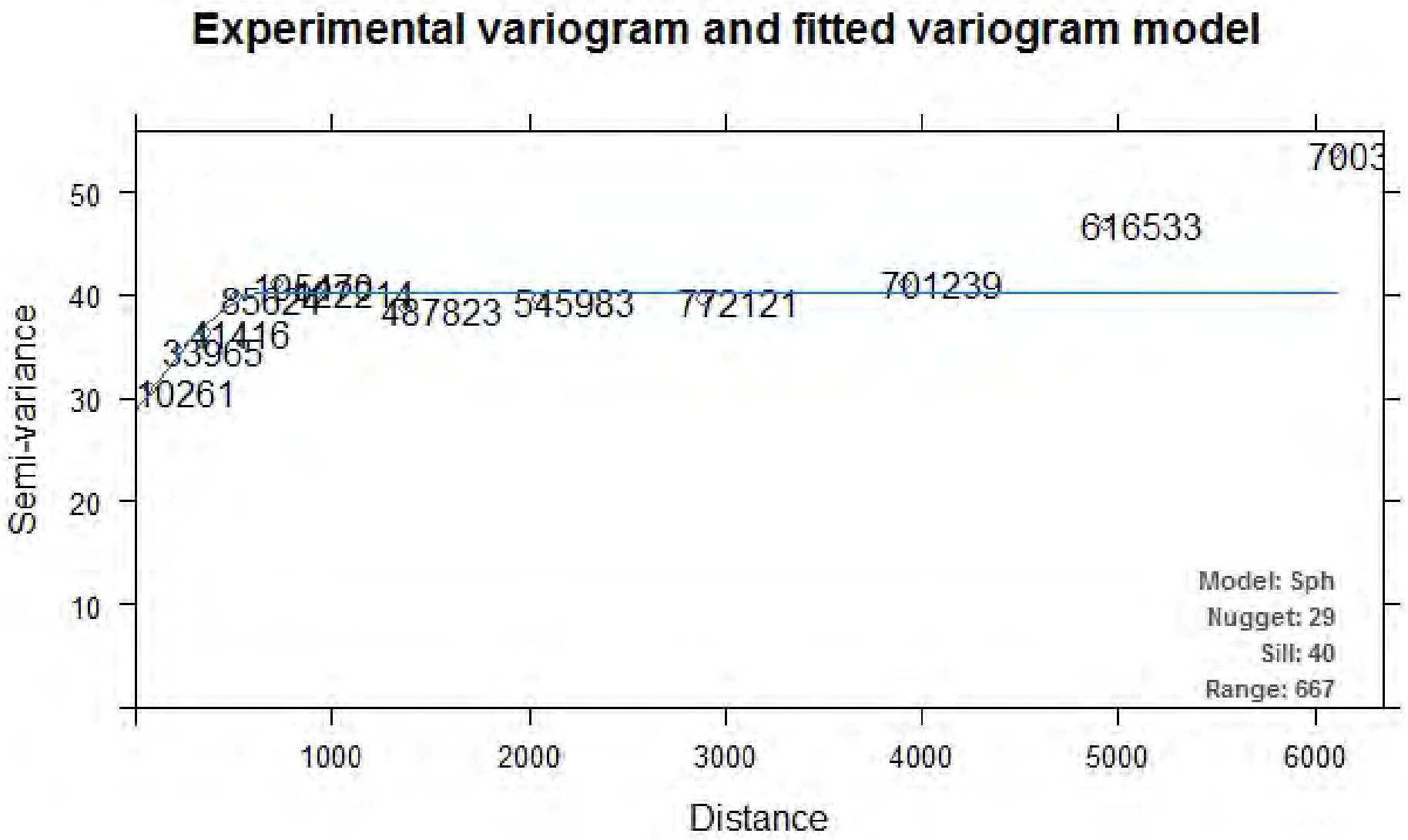

160
120
80
40
Shoot Length
May
June
July/August
Time Interval
Site
Crescent Beach
Mud Bay

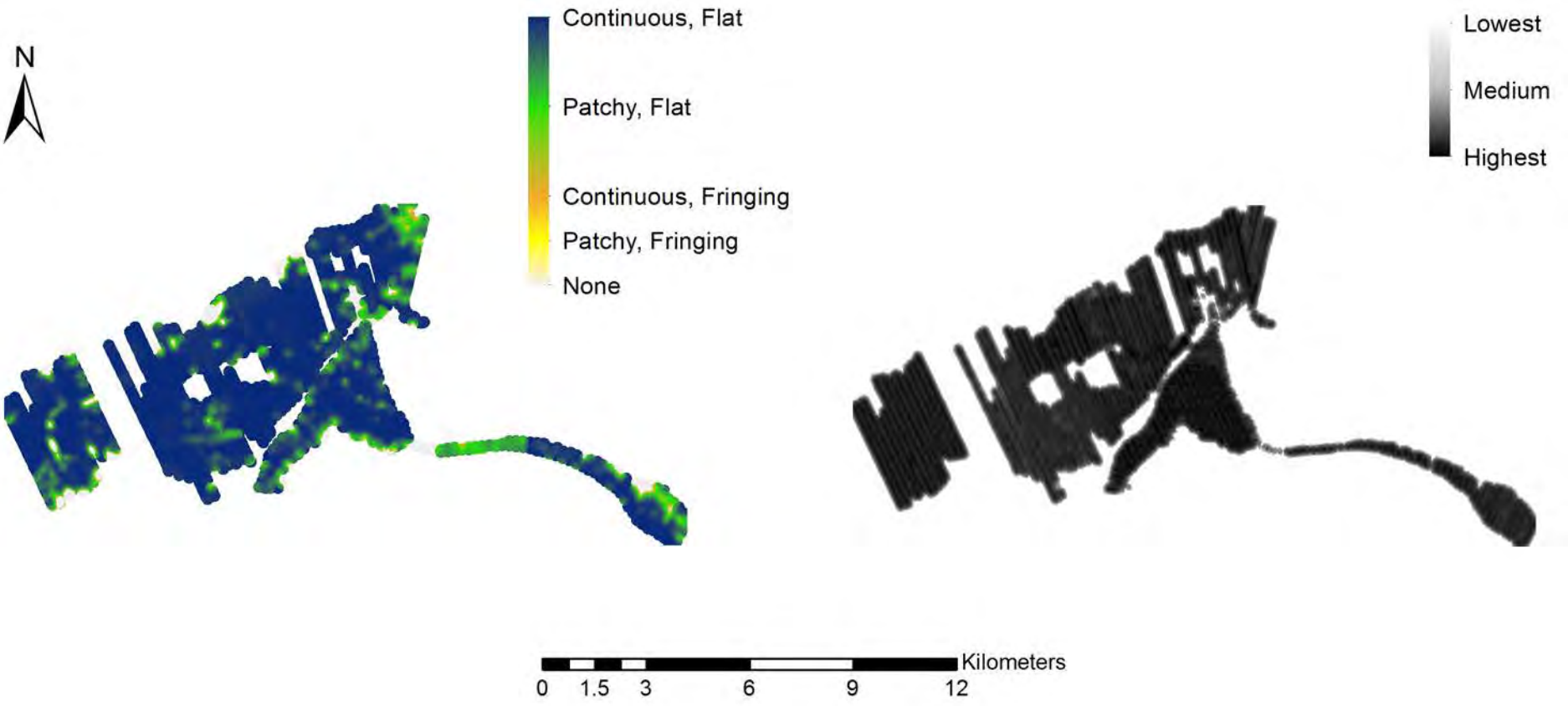

0.6
0.5
0.4
0.3
Leaf Width
May
June
July/August
Time Interval
Site
Crescent Beach
Mud Bay


700
600
500
400
300
200
100
Shoot Density
May
June
July/August
Time Interval
Site
Crescent Beach
Mud Bay

Mapping


Bed Type Points
Continuous, Flat
Continuous, Fringing
Patchy, Flat
Patchy, Fringing
CANADA
UNITED STATES
Bed Type Polygons
Continuous, Flat
Continuous, Fringing
Patchy, Flat
Patchy, Fringing
White Rock
CANADA
UNITED STATES
0
2
4
8
Kilometers


Experimental variogram and fitted variogram model
Semi-variance
Distance
10
20
30
40
50
1000
2000
3000
4000
5000
6000
10261
33965
41416
85024
487823
545983
772121
701239
616533
7003
Model: Sph
Nugget: 29
Sill: 40
Range: 667


N
Continuous, Flat
Patchy, Flat
Continuous, Fringing
Patchy, Fringing
None
Lowest
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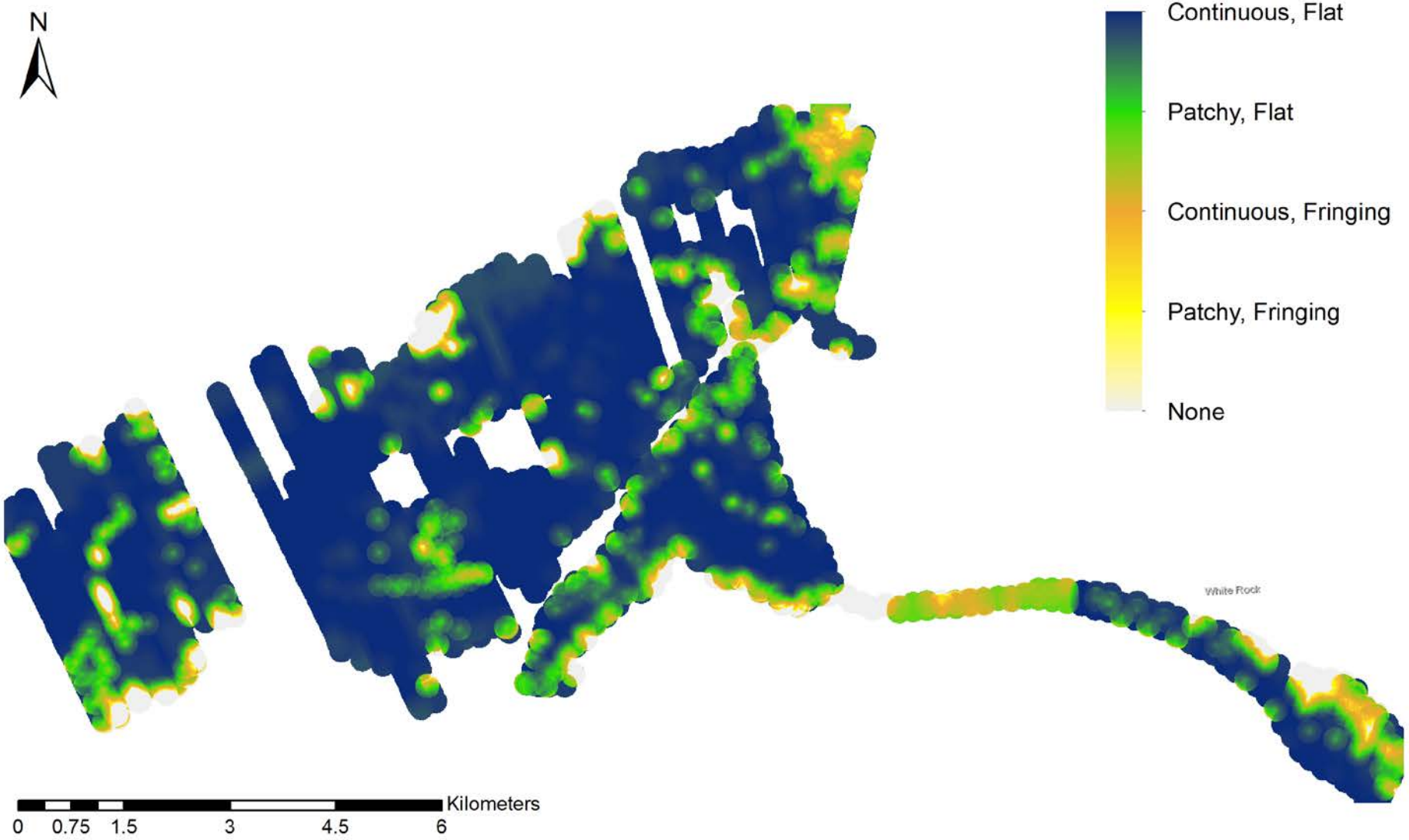
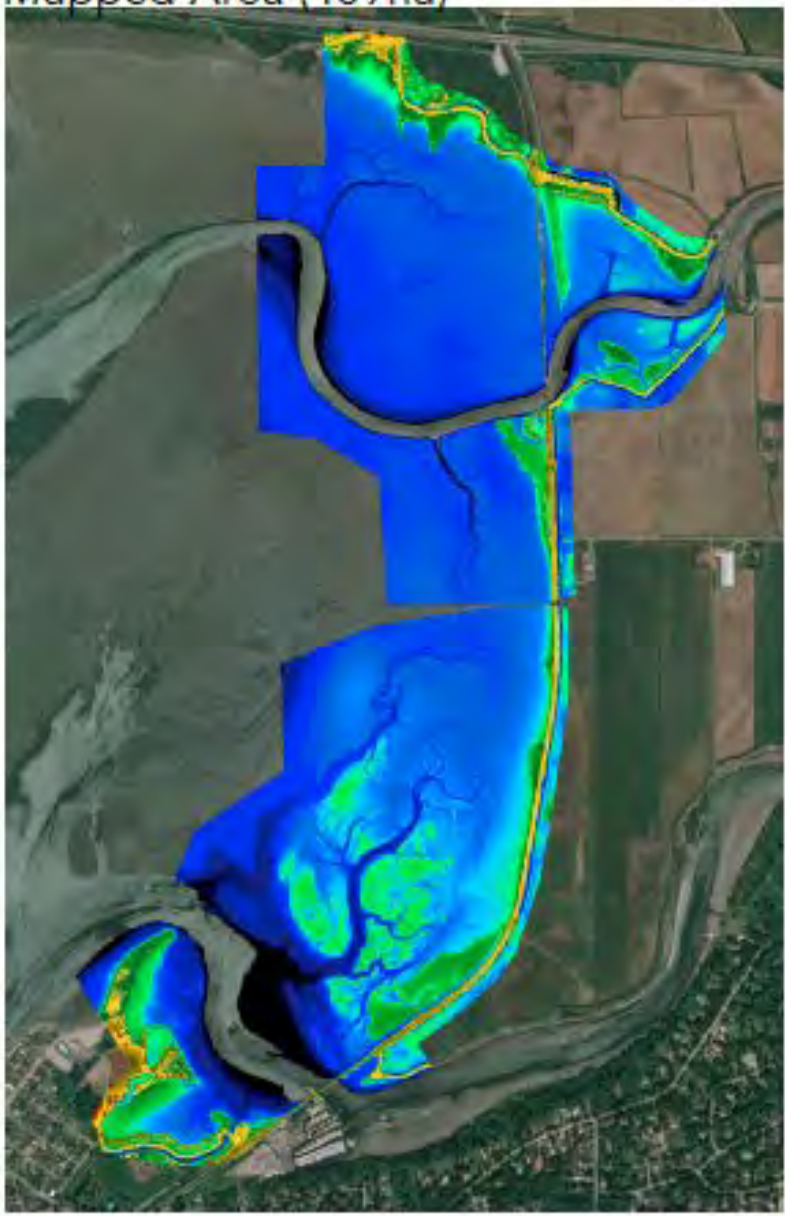
Highest
Kilometers
0 1.5 3 6 9 12



Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

Seasonal Site Boundaries (220ha)

Mapped Area (409ha)



smart SHORES

smart SHORES

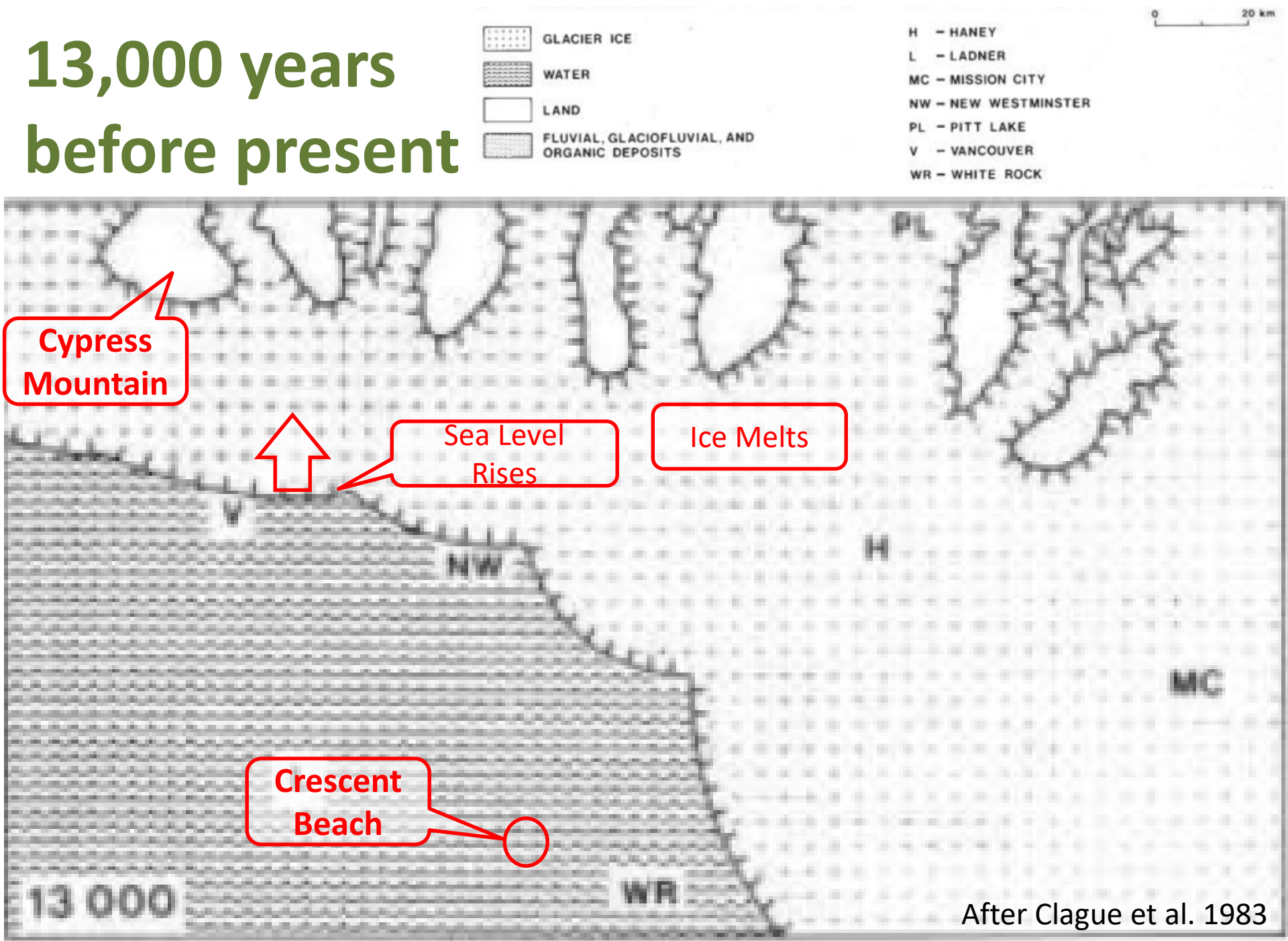
smart SHORES

smart SHORES

Geomorphology Review and Shoreline Classification

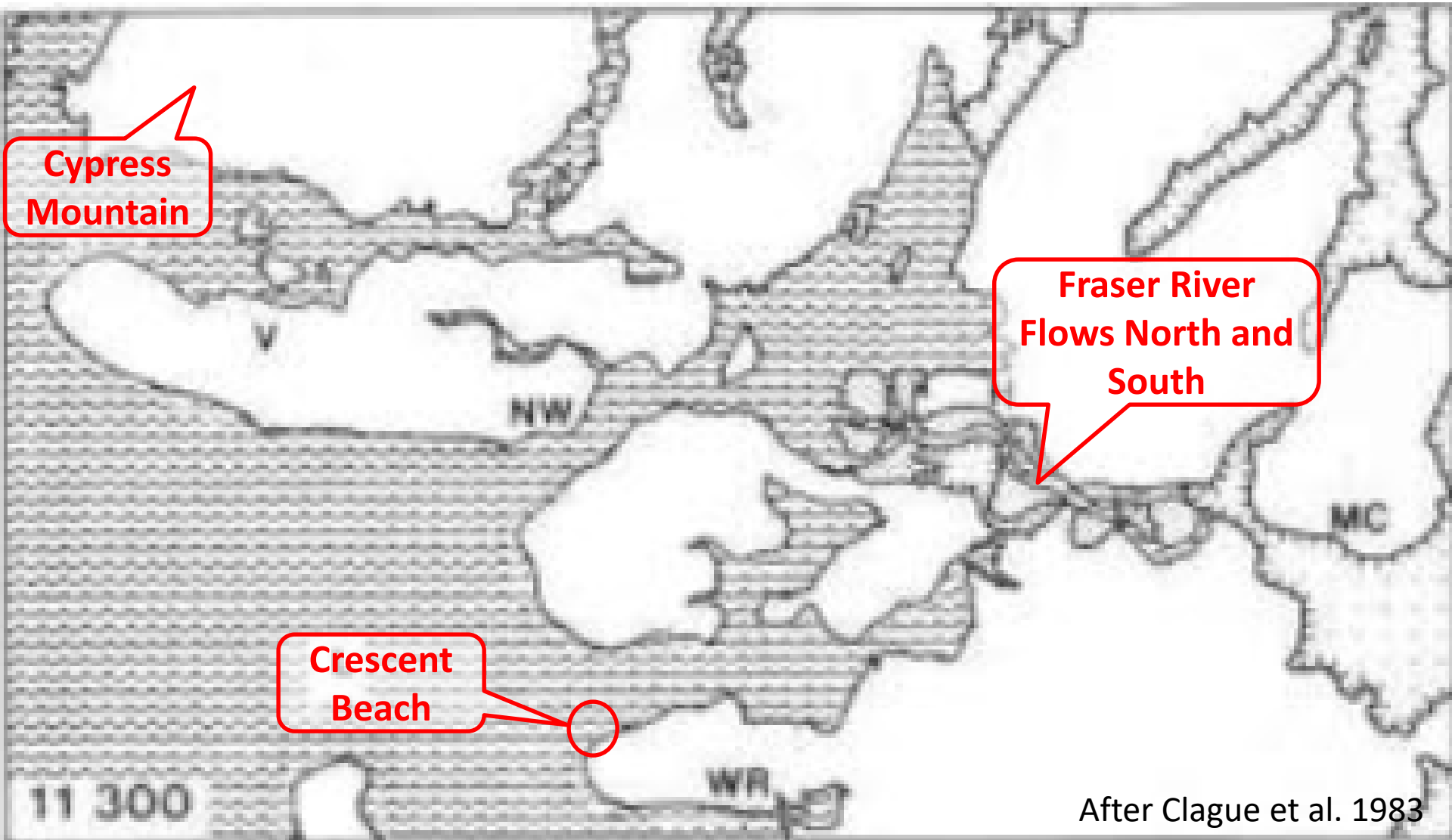
Ilana Klinghoffer | Geomorphologist
Northwest Hydraulic Consultants

13,000 years before present



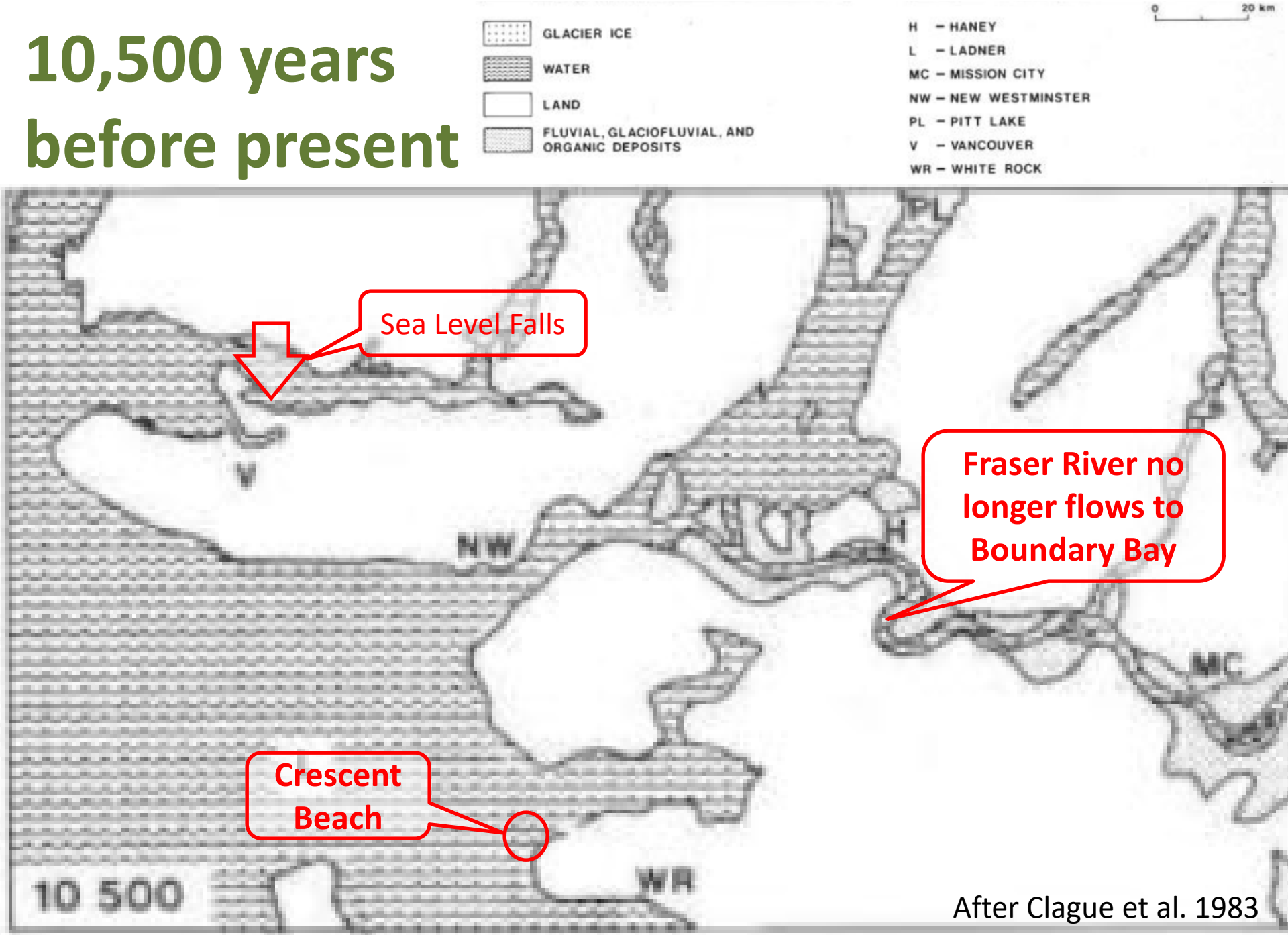
After Clague et al. 1983

11,300 years before present



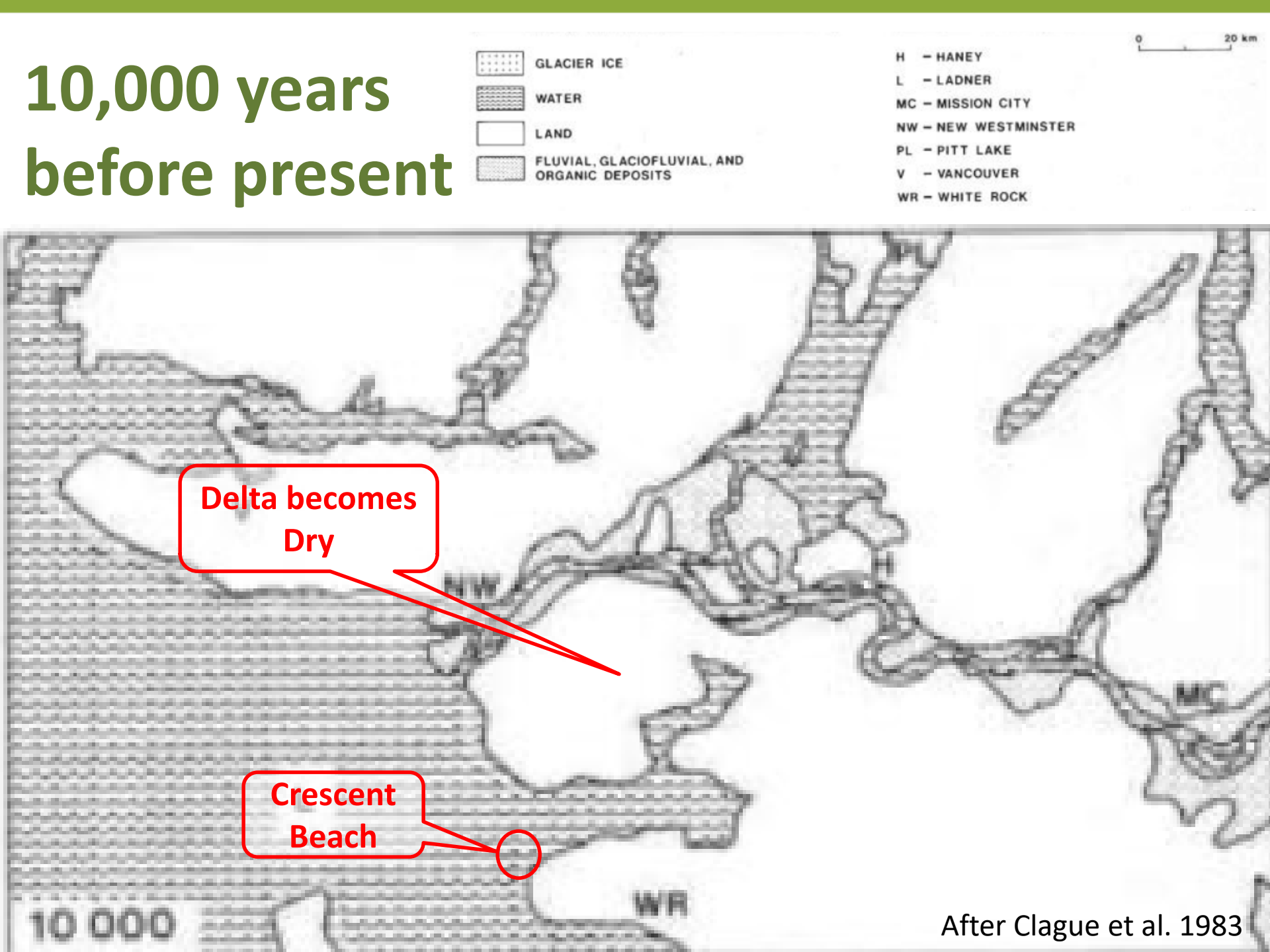
After Clague et al. 1983

10,500 years before present



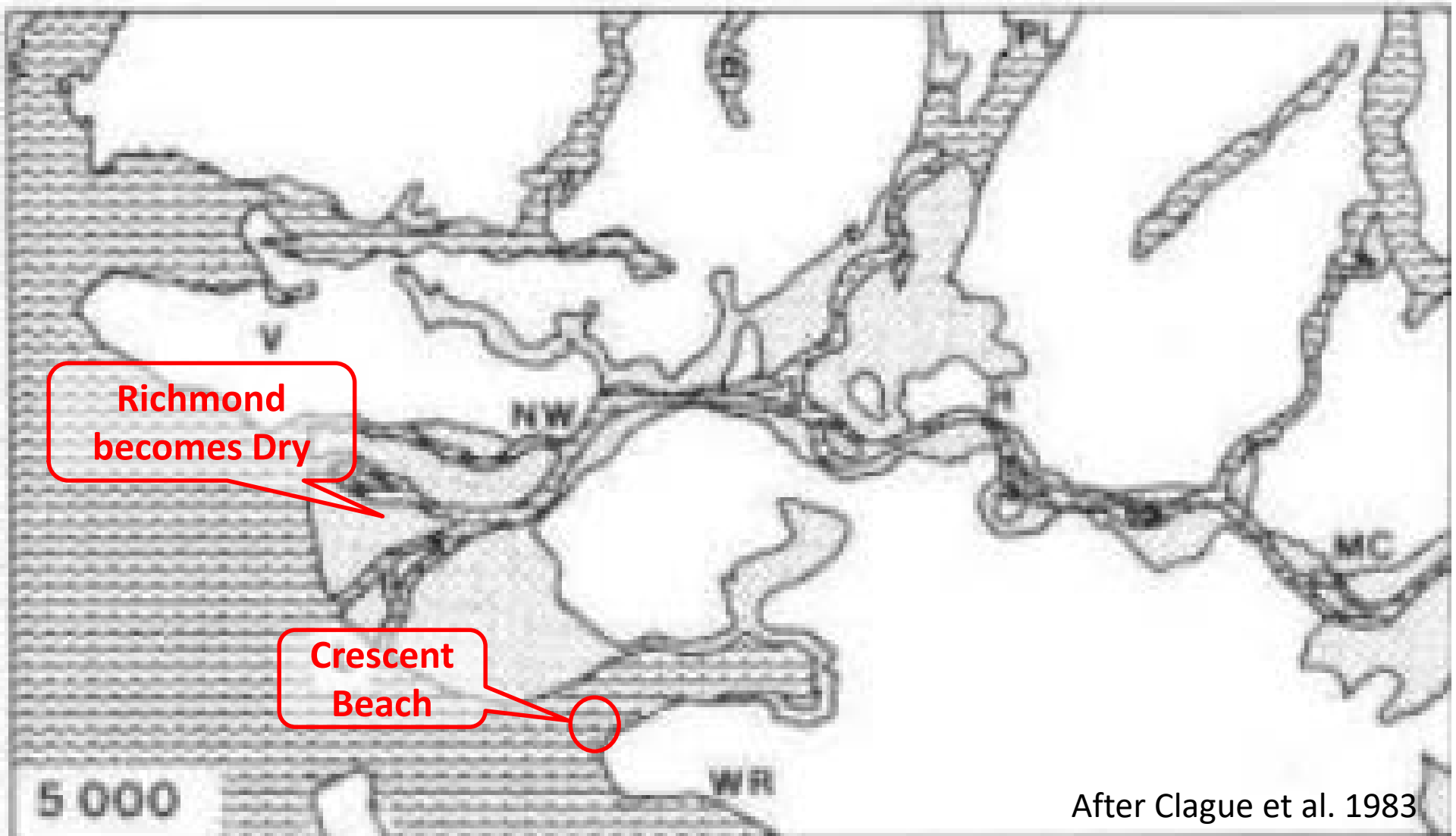
After Clague et al. 1983

10,000 years before present



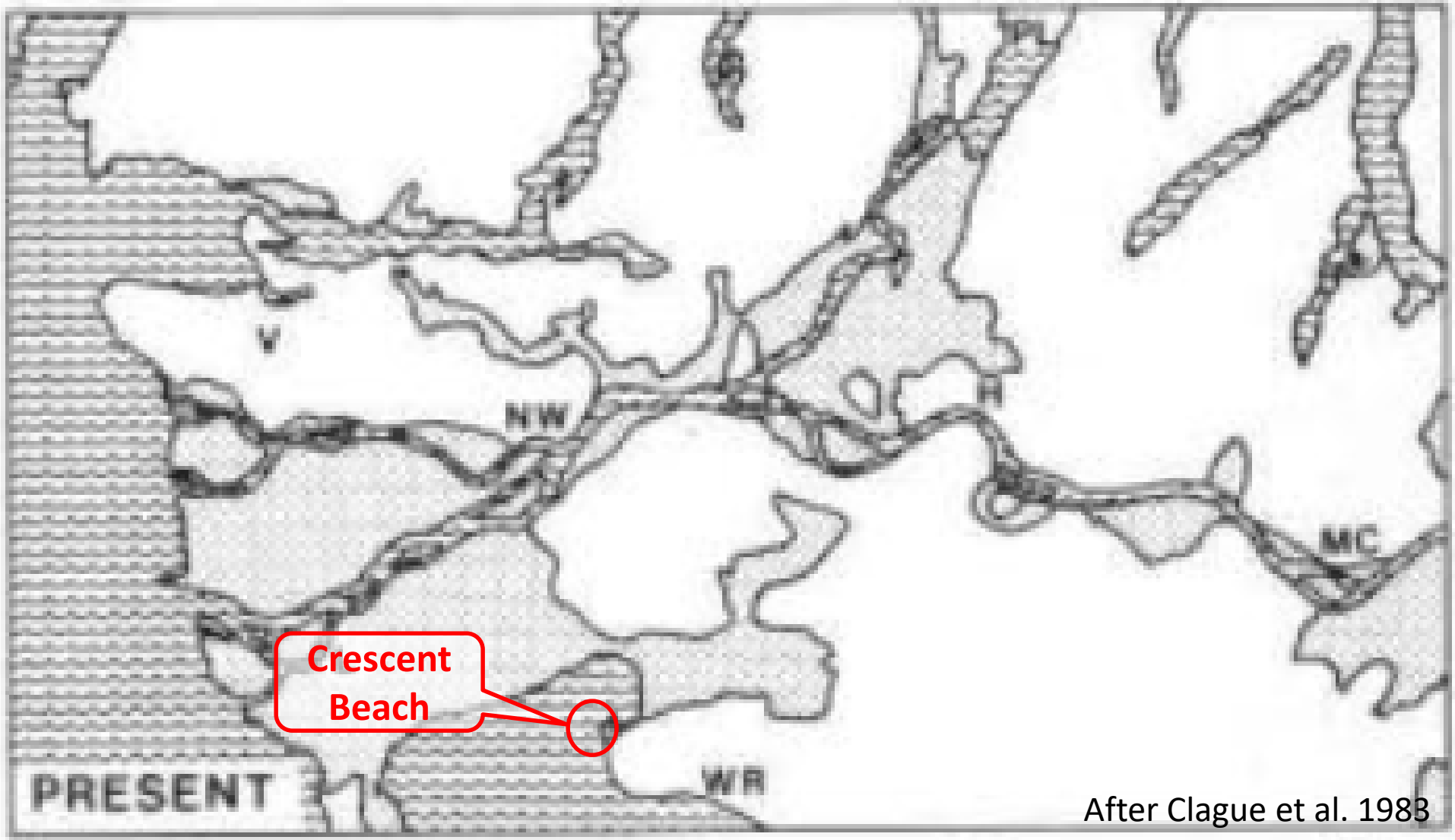
After Clague et al. 1983

5,000 years before present



After Clague et al. 1983

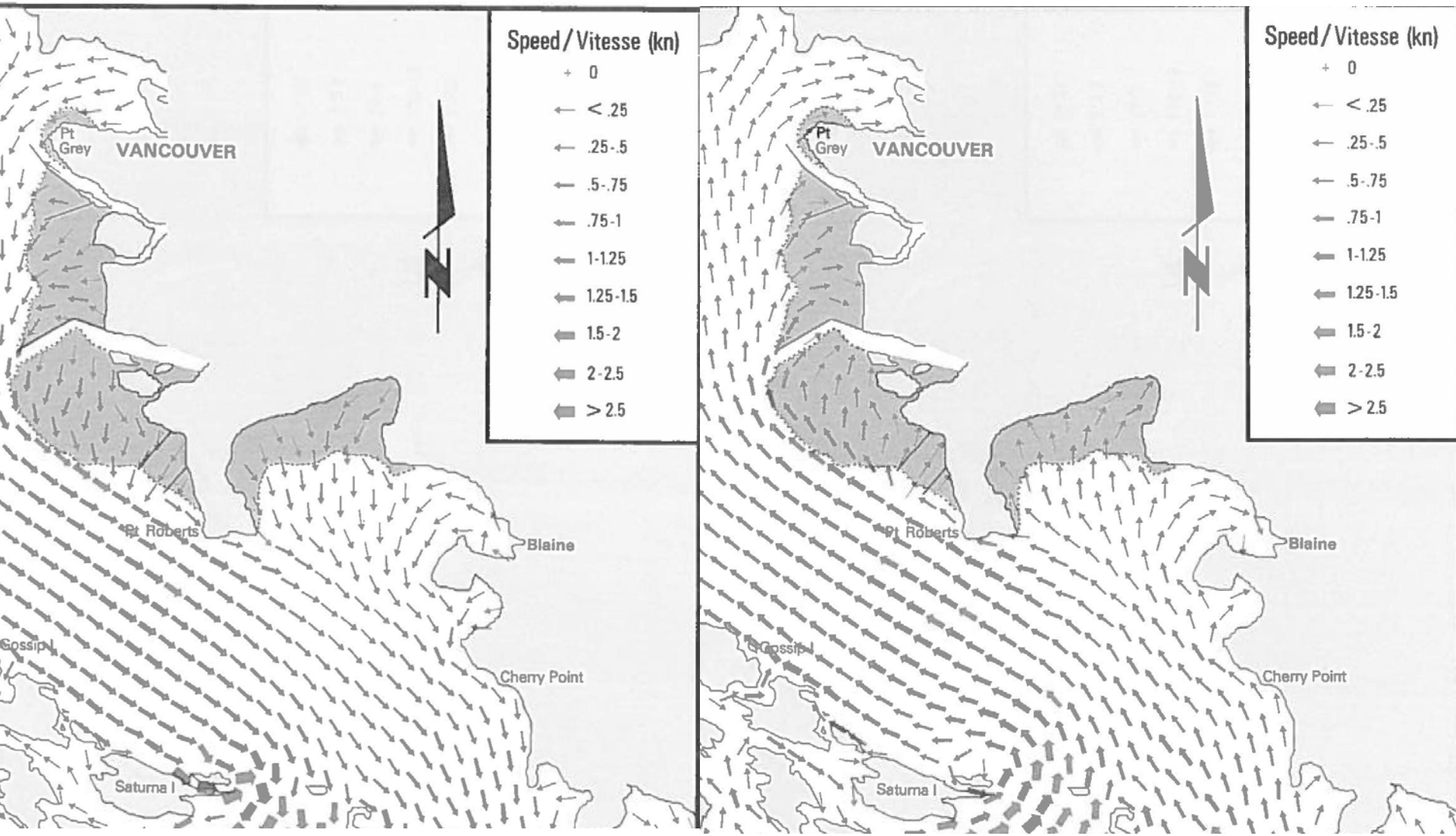
European Settlement



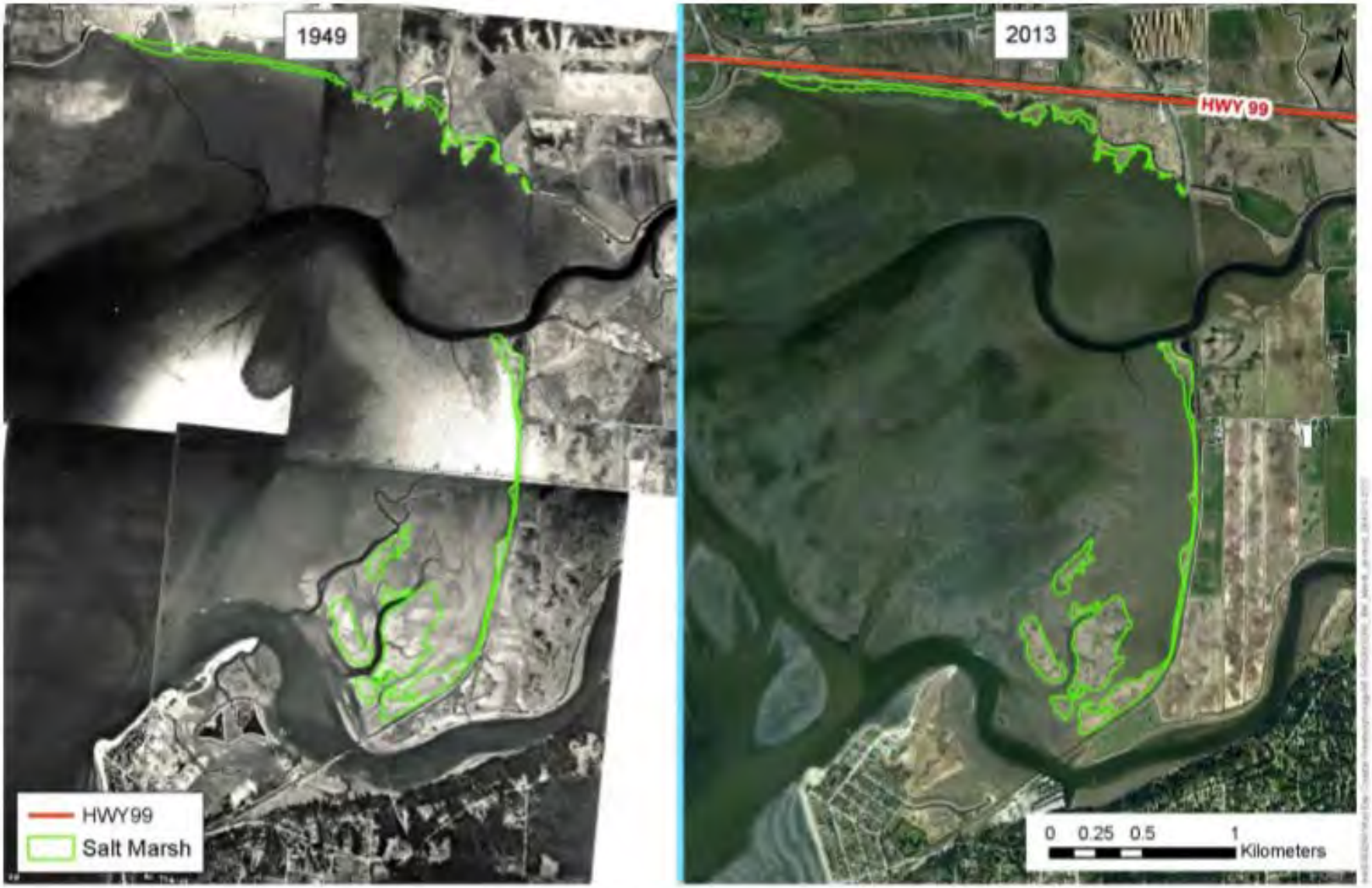
After Clague et al. 1983

Ebb Tide

Flood Tide



Source: CHS Current Atlas



DATA SOURCES:Province of British Columbia Historical Air Photos (1949); City of Surrey Orthophotos (2013)

ure 5.7 **Approximate 2013 extent of salt marshes in Mud Bay overlaid on 1949 and 2013 imagery.**

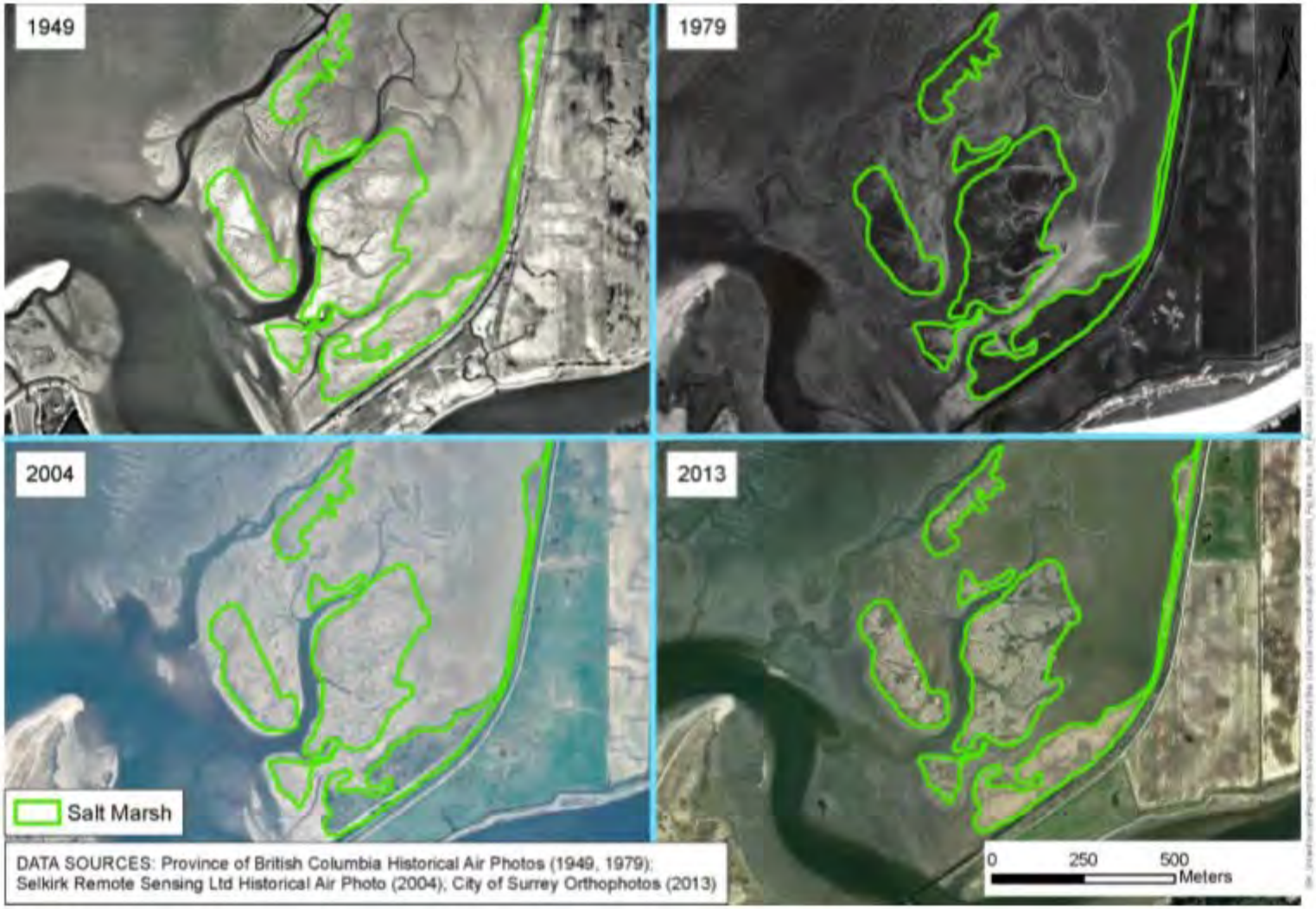
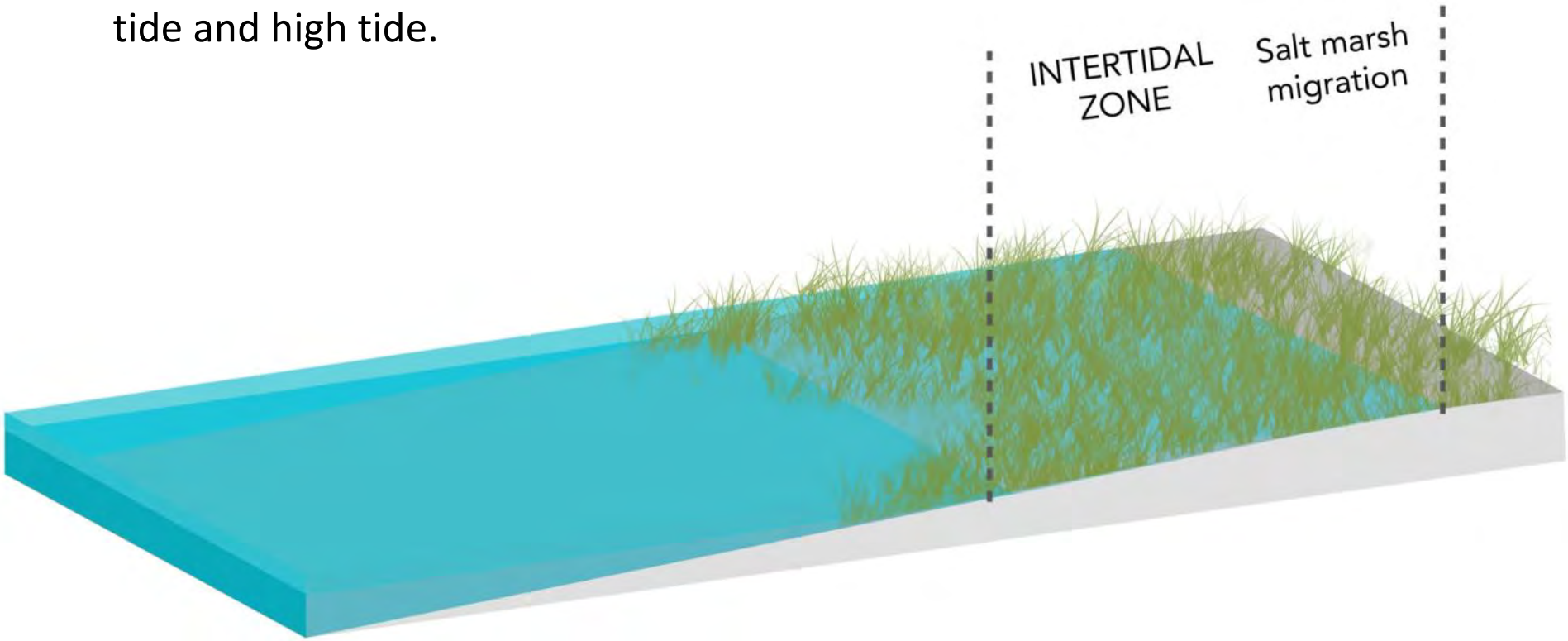


Figure 5.8 Approximate 2013 extent of salt marshes in southeastern portion of Mud Bay overlaid on 1949, 1979, 2004, and 2013 imagery

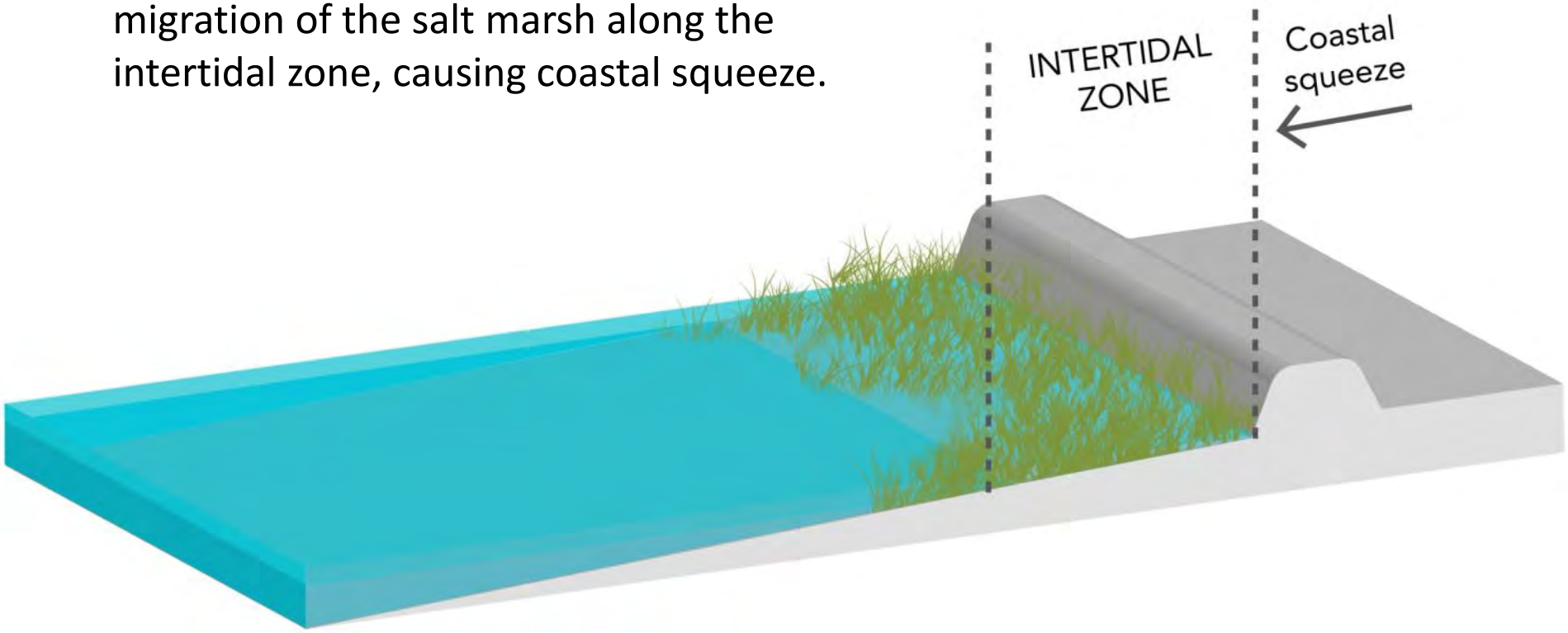
Natural Shoreline

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



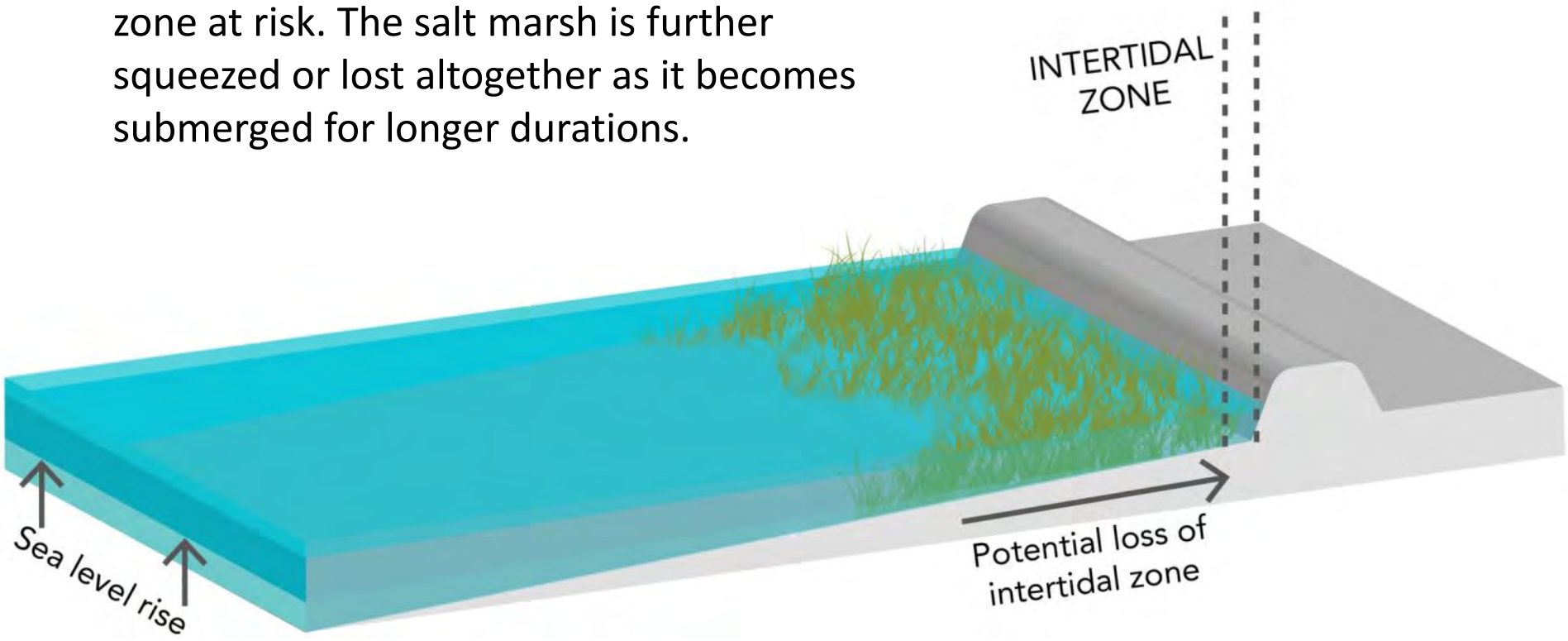
Shoreline with Dyke

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.

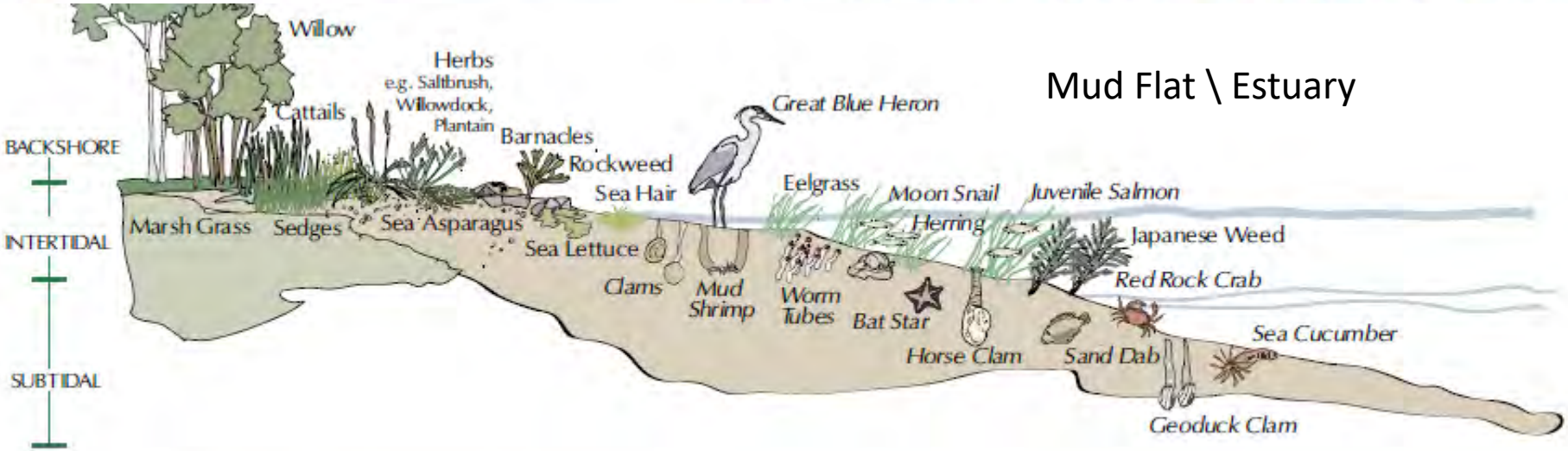


What's at risk?

Sand Shoreline

28 Adapted from a sketch by Archipelago Marine Research Ltd. COASTAL SHORE STEWARDSHIP

Mud Flat \ Estuary



30 Adapted from a sketch by Archipelago Marine Research Ltd. COASTAL SHORE STEWARDSHIP

Credit: Coastal Shore Stewardship, a guide for Planners, Builders, and Developers (2002)

Riparian Squeeze Example #1

Aug. 29 ‘08

Jan. 16 ‘09

Riparian Squeeze Example #1

- April 1, 2013

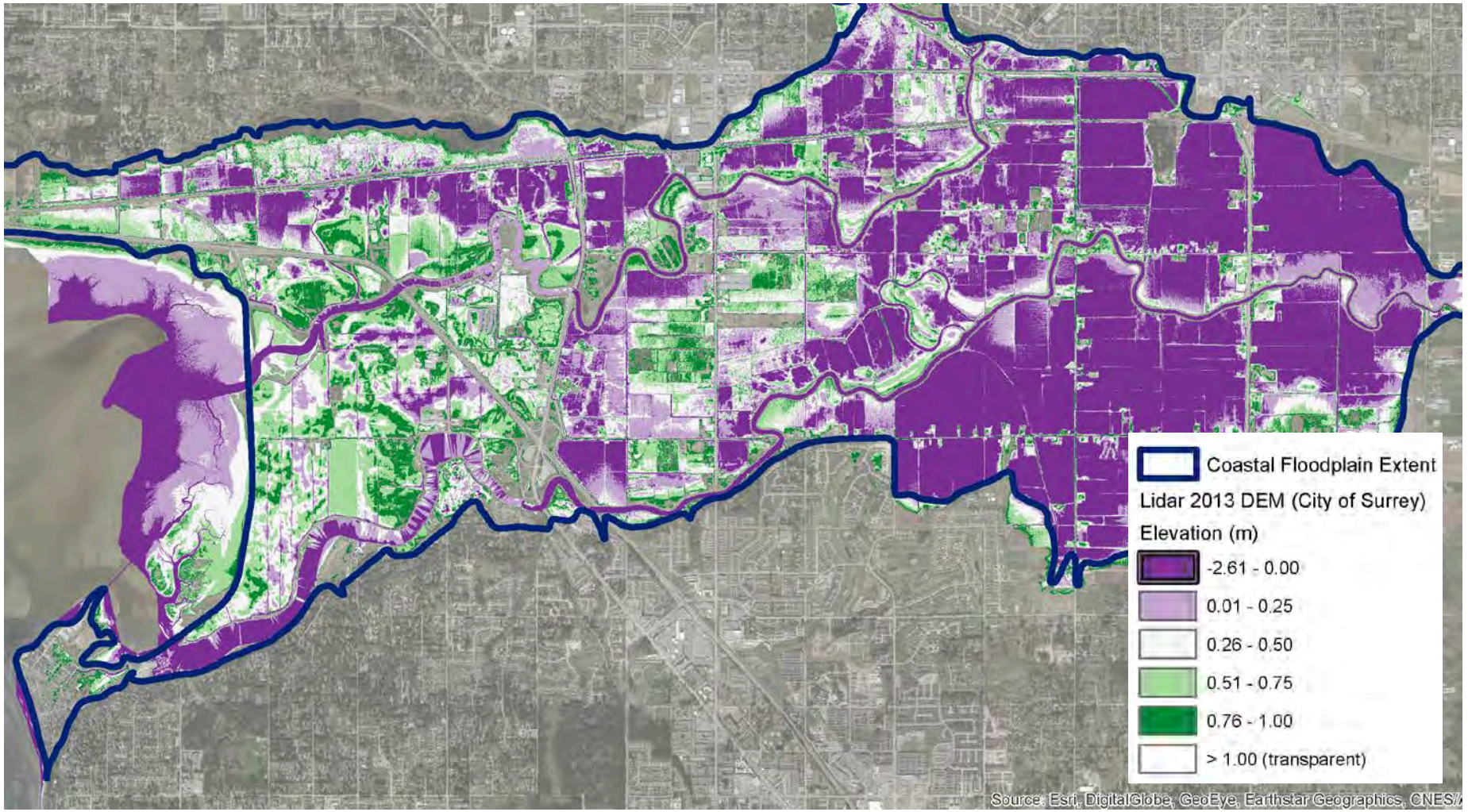
Riparian Squeeze Example #2

Illustration 8-28

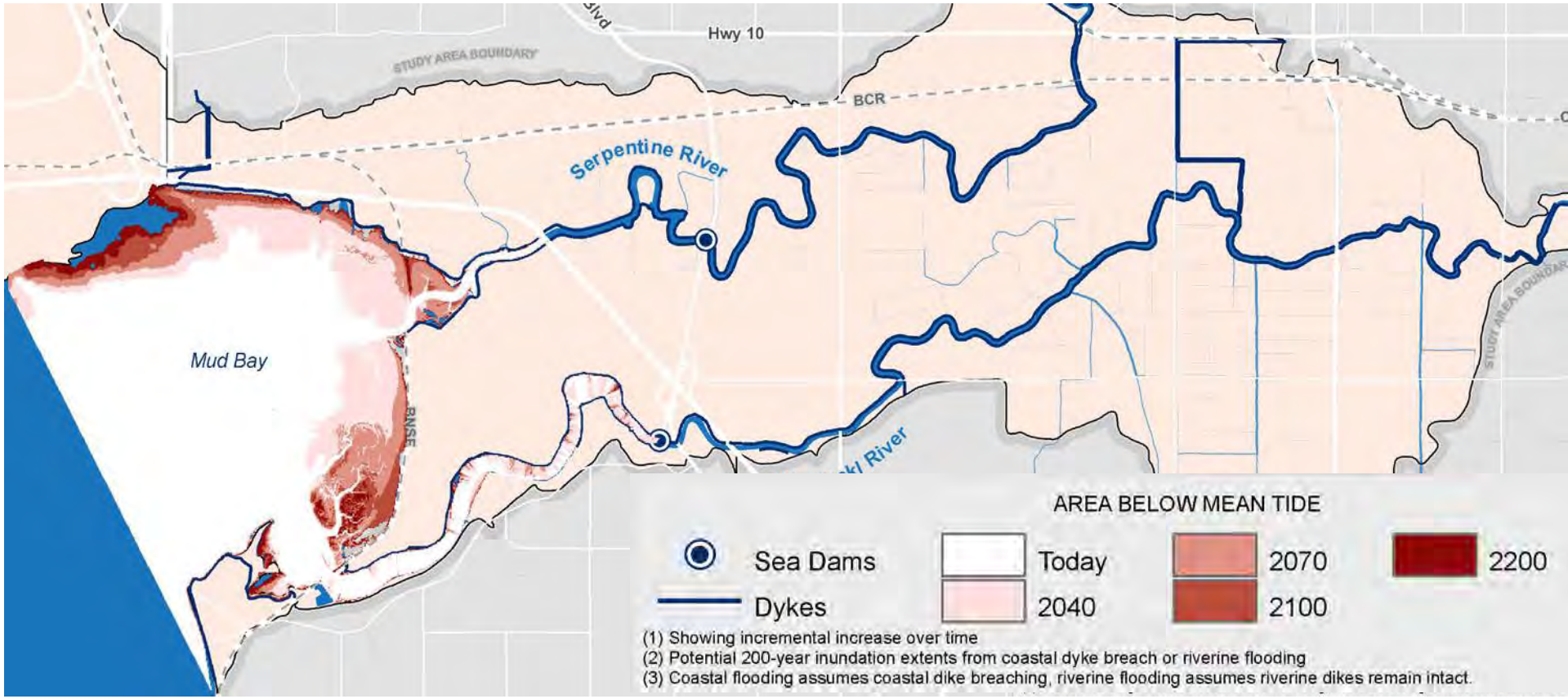
Barrie Sanford

Source: Surrey Story

Floodplain Elevation

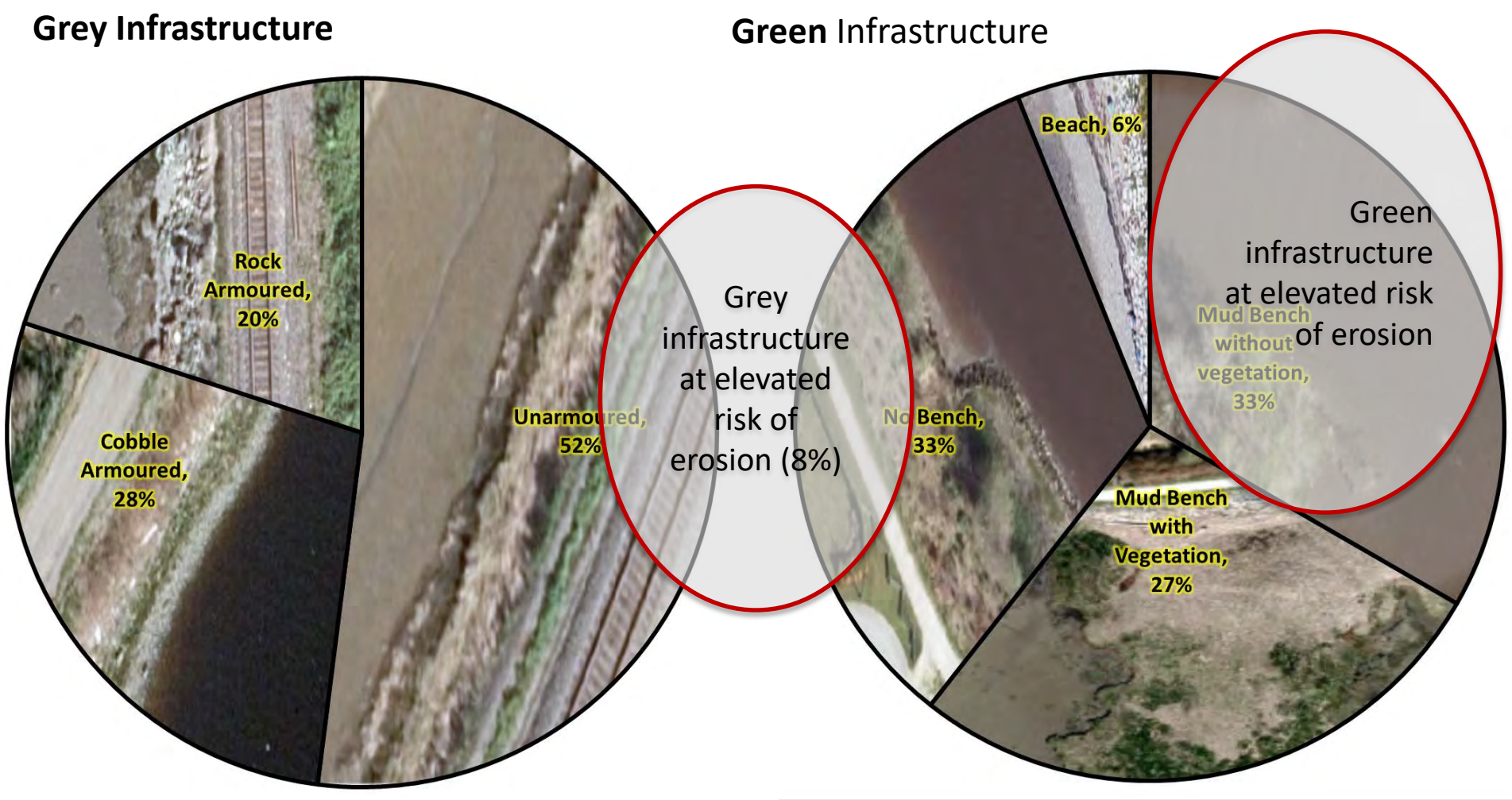


Mean Sea Level Migration



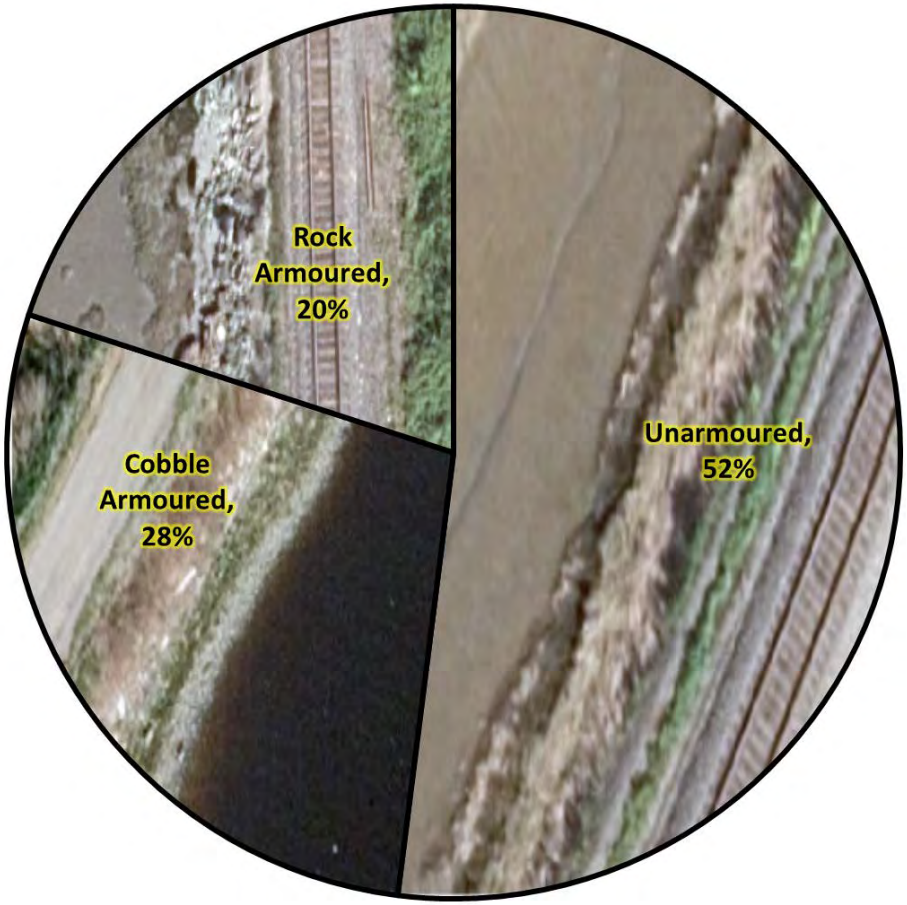
Shoreline Inventory

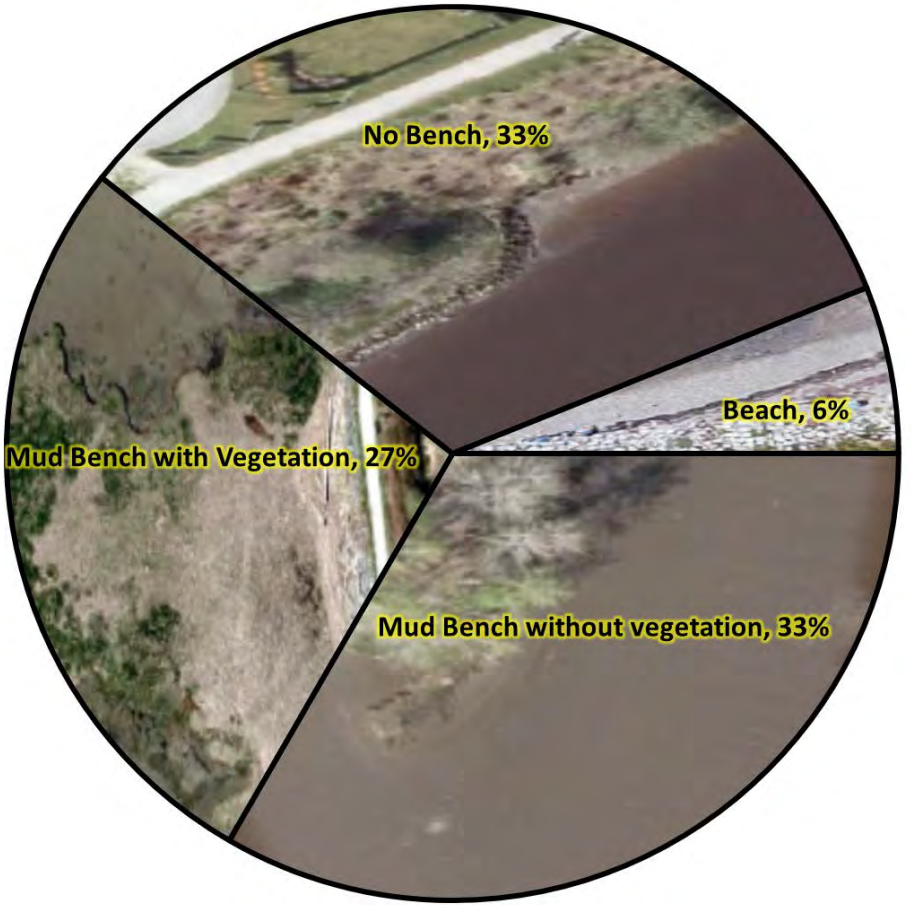
Additional shoreline mapping was completed by Golder and Associates, 2018



Future vulnerability?

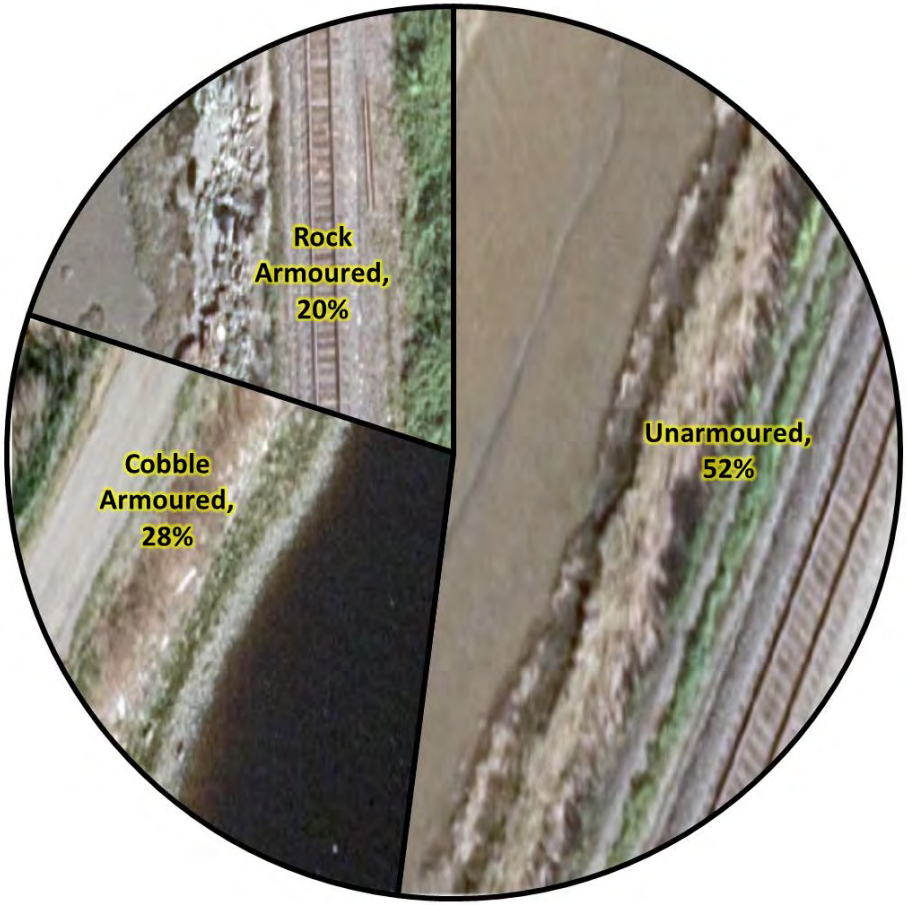
Additional shoreline mapping was completed by Golder

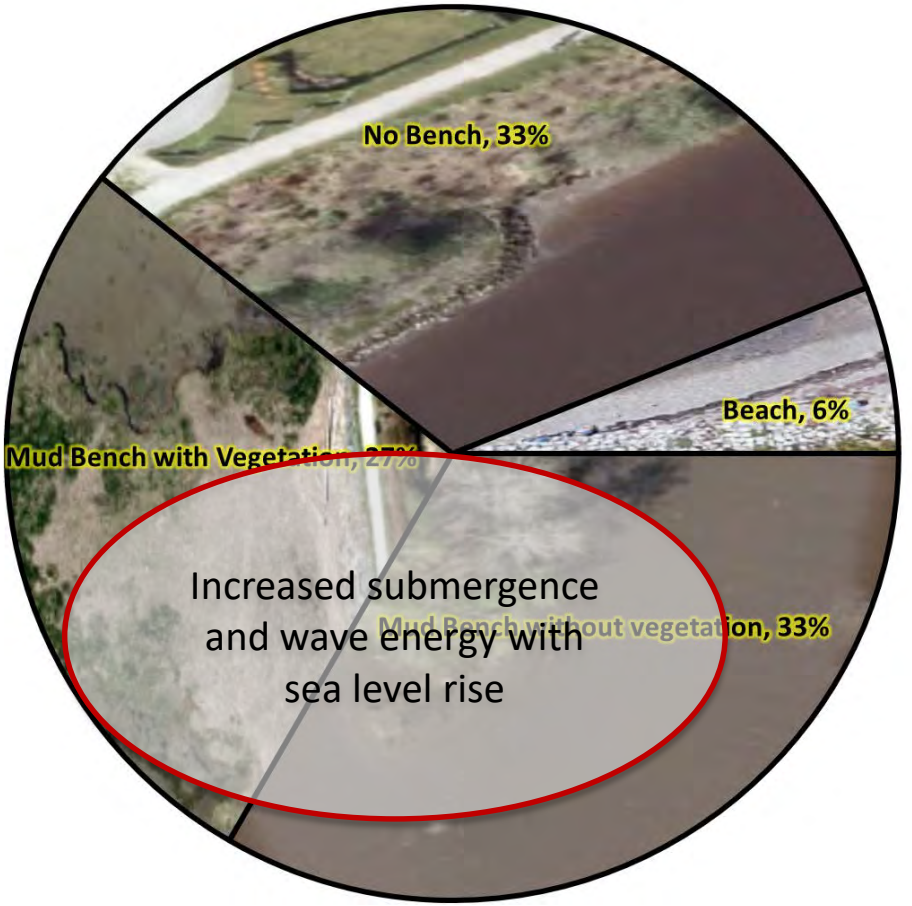




Future vulnerability?

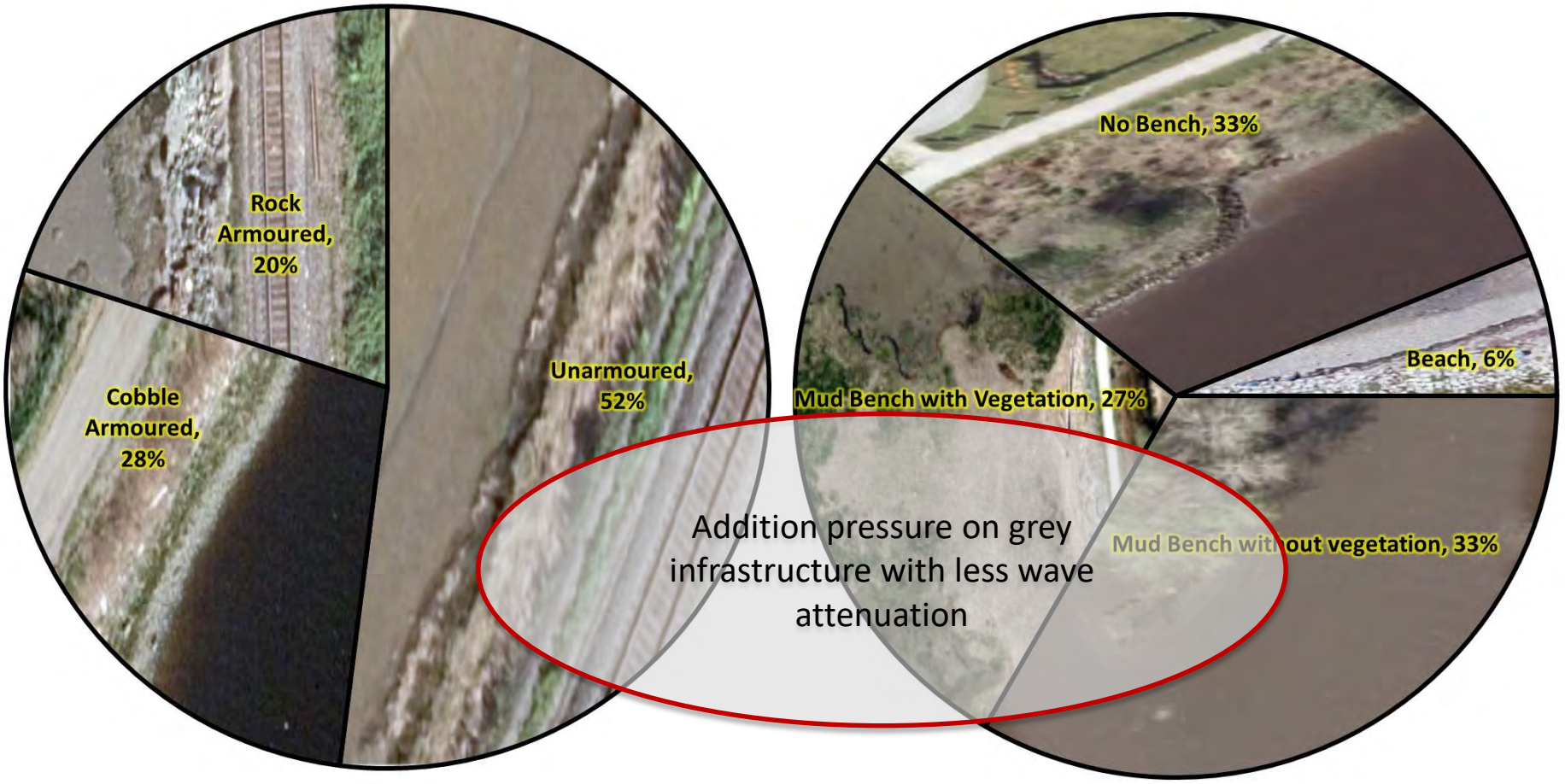
Additional shoreline mapping was completed by Golder





Future vulnerability?

Additional shoreline mapping was completed by Golder



24% of the shoreline is partially **protected by a vegetation bench** and is not armoured

22% of the shoreline is partially **protected by an unvegetated bench** and is not armoured

- Rising sea levels may require some of these areas to be armoured in future as coastal squeeze impacts the vegetative buffer.

Summary

- Mud Bay is an inherited landscape
- Mud Bay has not undergone large changes in sedimentary conditions in recent years
- Mud Bay is at risk of coastal squeeze with sea level rise
- Green infrastructure interacts with grey infrastructure

What are we doing?

Today's objective: To gather relevant stakeholders to discuss potential consequences of the predicted environmental effects. These consequence scores will be used to calculate risk to understand how to direct mitigation efforts.

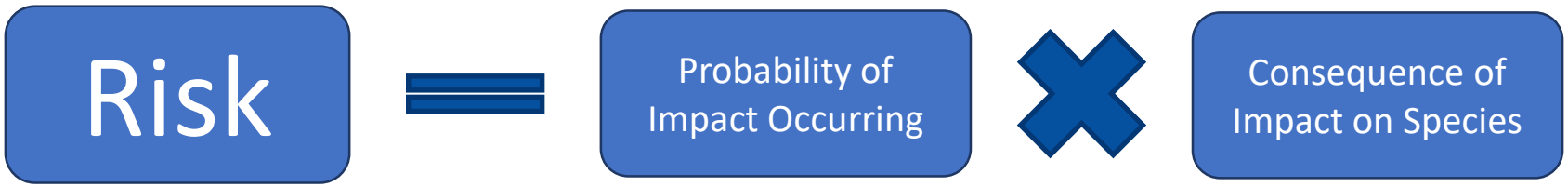
Project objective: To identify what are likely to be the greatest impacts that the expected sea level rise will have on ecosystem processes, habitat and wildlife species in the study area, and prioritize these impacts and potential solutions.

Limitations

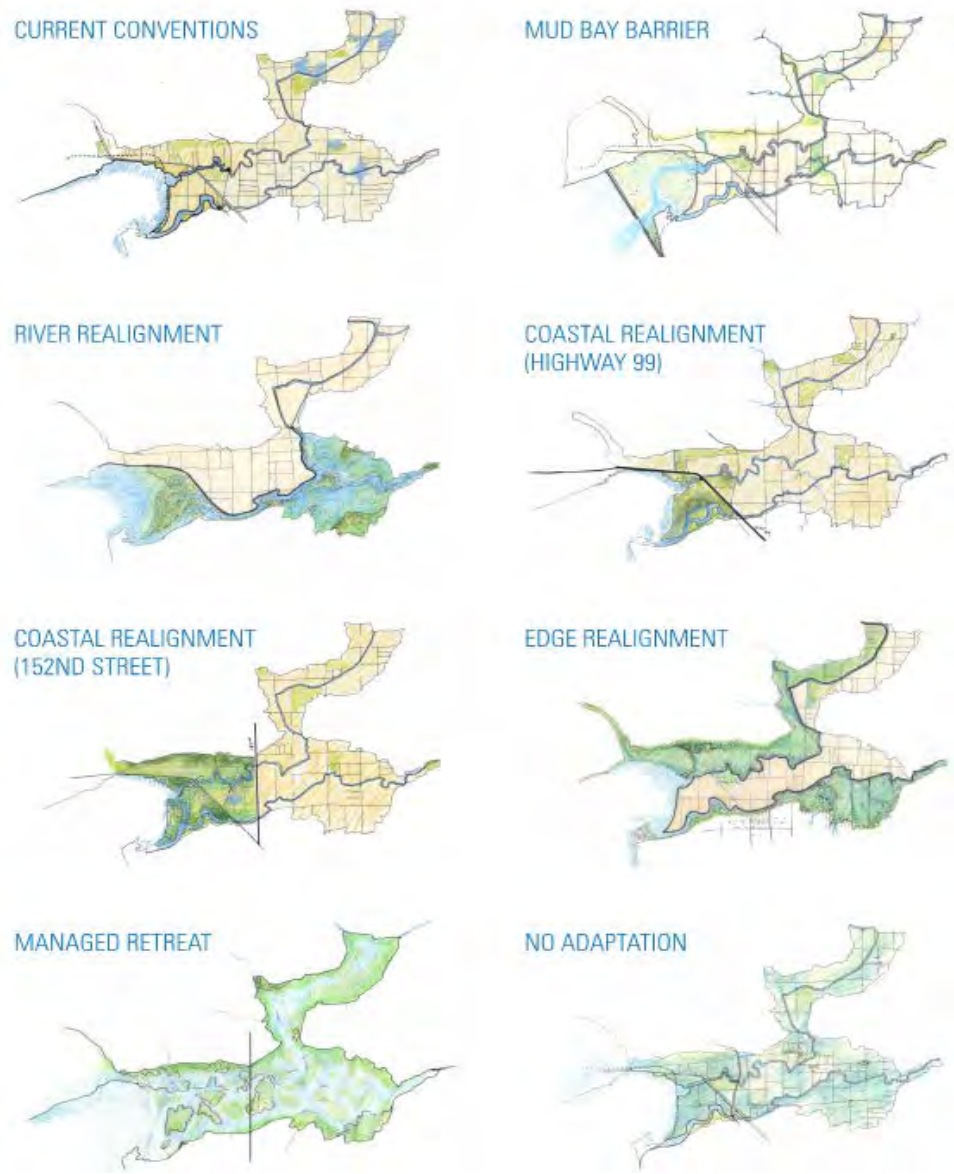
- There is a lot of uncertainty associated with this planning project
- We recognize the complexity of the limitations.
- The predictions for climate change and sea level rise, and their influence on habitat is uncertain
- Predicting how natural systems will react over the next 100 years is extremely difficult
- This is the start of a long planning process.
- This exercise is not meant to provide firm answers or decisions
- It is intended to inform an ongoing discussion on future management of the affected areas

Risk Framework

Potential environmental effects of expected changes in climate have been pre-assessed and narrowed down for this workshop. To save time, the probability of the effect occurring has been provided.



Preliminary Options Overview



1. **Current Convention**
2. Mud Bay Barrier
3. Coastal Realignment to 152nd Street
4. River Realignment
5. **Coastal Realignment to Highway 99**
6. Edge Realignment
7. Managed Retreat
8. No Adaptation

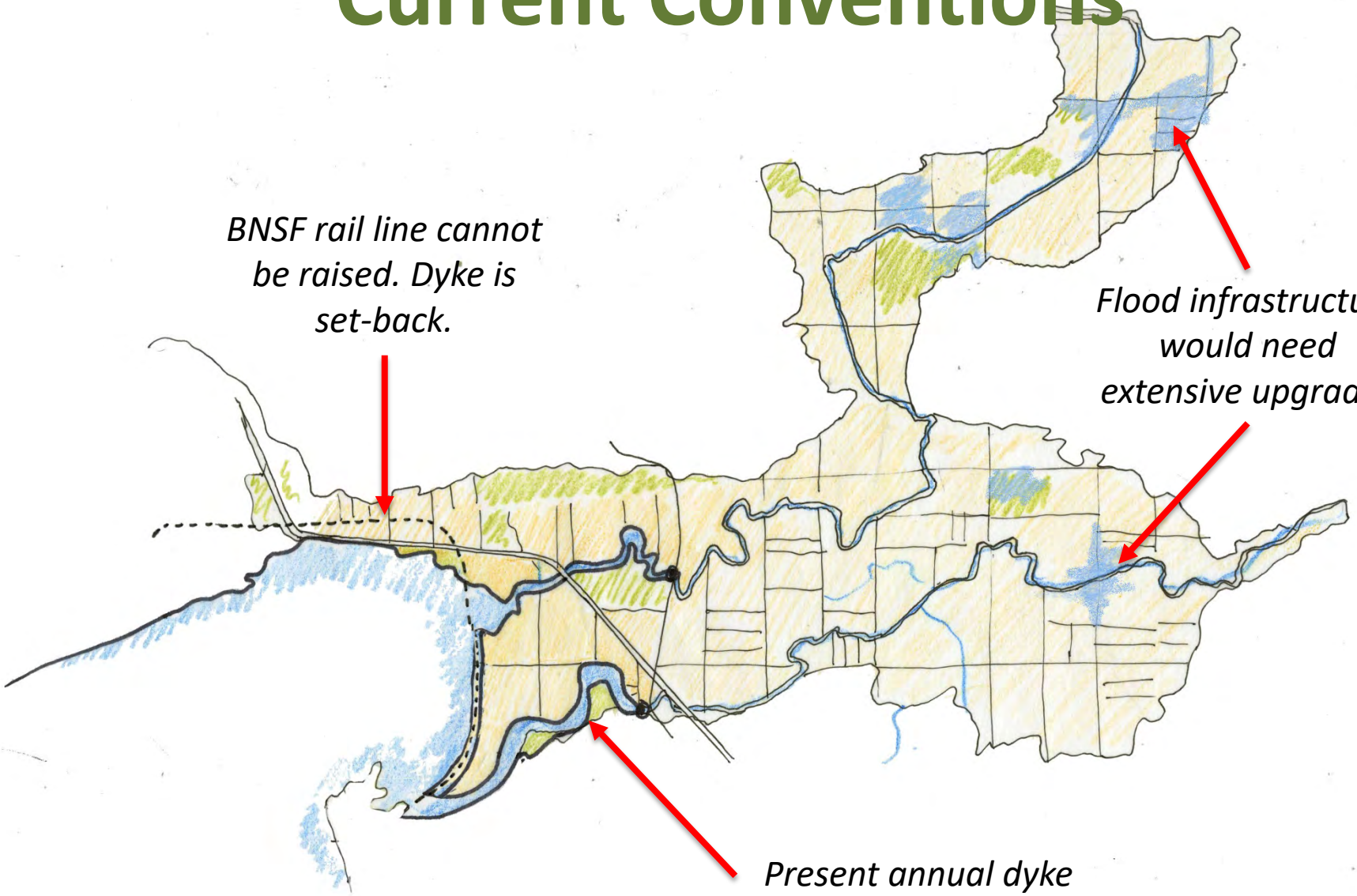
CURRENT CONVENTIONS

OPTION DESCRIPTION:

- ***Surrey continues raising current dykes to meet projected flood protection requirements.***
- ***Present annual dyke maintenance costs of about $1 million increase substantially with time.***
- ***The BNSF railway embankment along Mud Bay is not a dyke and, as such, cannot be raised; a separate parallel dyke is required.***
- ***As sea levels continue to rise, the time the sea dams remain open is shortened and significant additional pumping capacity is required.***
- ***Alternatively, river dykes could be raised. Raising of dykes and other upgrades will be implemented and phases as required.***
- ***Ongoing costs would be significant. Agriculture drainage worsens as riverine flooding & groundwater levels rise.***

Year 2100

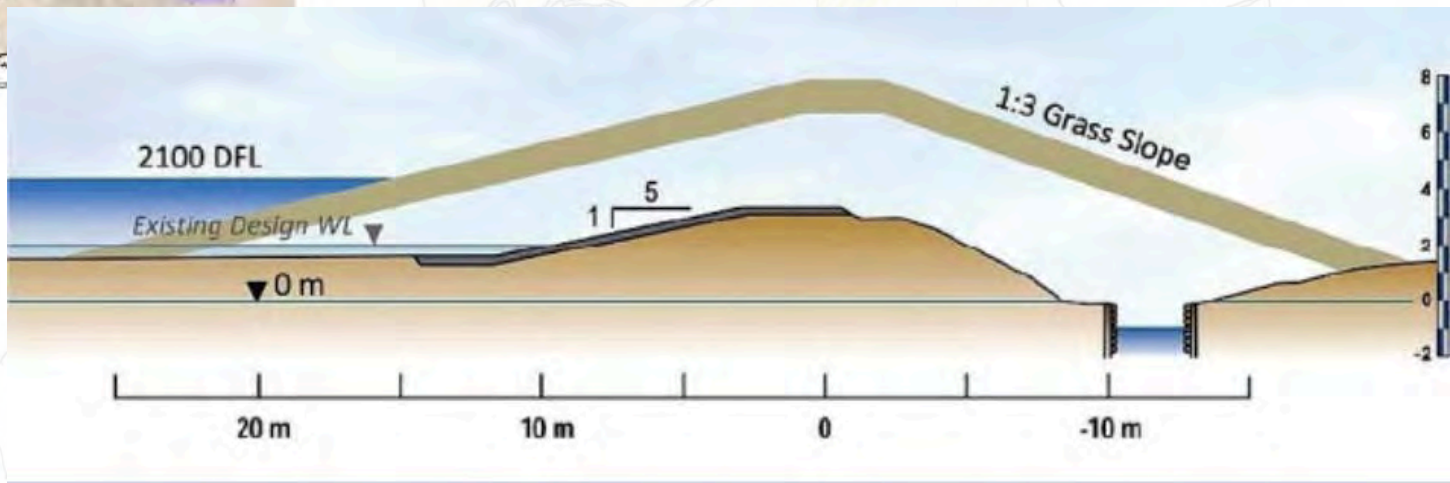
Current Conventions



Current Conventions

WHAT THIS COULD LOOK LIKE

CBC news story on Lower Mainland dyke upgrades.



Cross-section showing increased height and width of new dykes compared to existing.

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Current Conventions

TECHNICAL CRITERIA BY 2100

Flood damage prevention would be largely reactive (poor). The outcome of failures would be poor. Geotechnical stability is poor. The adaptability of the option over time is limited and operation and maintenance costs are high (very poor). Capital cost are between $100M to $1B.

Technical Ranking:

VERY POOR | POOR | LIMITED | GOOD | VERY GOOD

Capital Costs:

$ = <100M
$$ = 100M – 1B
$$$ = 1B+

FLOOD DAMAGE PREVENTION	
OUTCOME OF A FAILURE	
GEOTECHNICAL STABILITY	
ADAPTABILITY OVER TIME	
CAPITAL COST CoS	$$
O&M COST CoS	

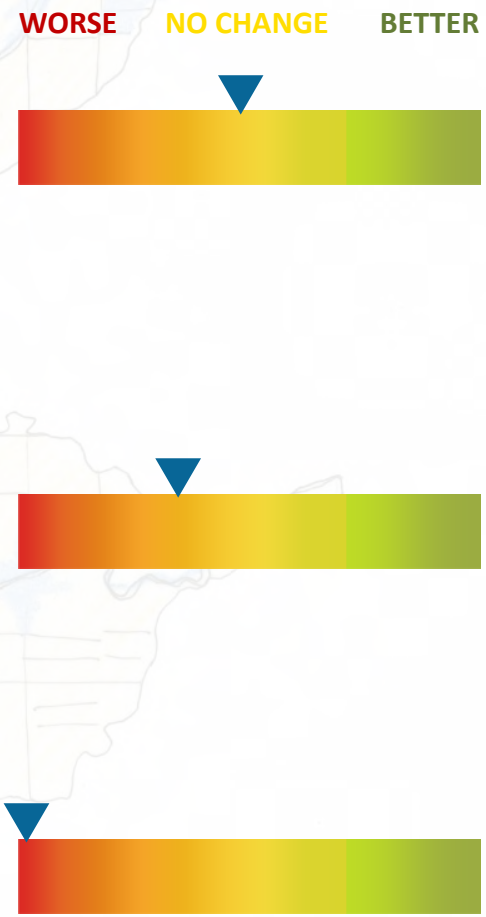
Current Conventions

VALUES CRITERIA BY 2100

RESIDENTS: No residents are displaced, however, risk levels elevate as more people may build in flood zones. Land ownership remains intact with additional rights to land along dykes provided to the City.

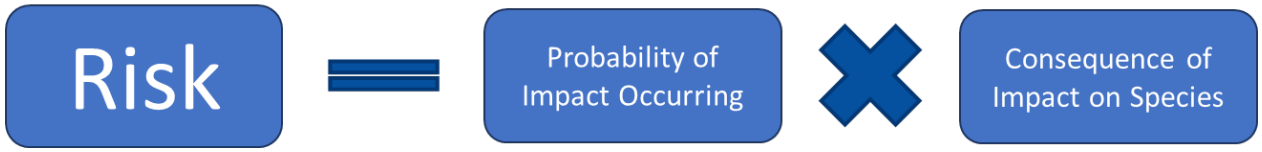
AGRICULTURE: Minimal agriculture is displaced, but salinization and subsidence continues to be an issue. Some agricultural land is lost due to raising and widening of dykes.

ENVIRONMENT: Salt marsh is negatively impacted by coastal squeeze. Sea dams would be replaced with ones that have fish ladders allowing salmon migration. Migration from land to water could also be difficult for some species due to larger dykes.



Today's Activity

To determine the consequence of the 5 selected environmental effects under a maintaining current conventions scenario, using a scale of 0-5.



2 Tables:

1. *Birds & Mammals* - DUC
2. *Aquatic Species, Amphibians & Invertebrates* - DHC

5 minutes – individual consequence scoring of environmental effects
20 minutes – group discussion of potential environmental effects and consequences
5 minutes – summarize group discussion for reporting back

Today's Activity

Consequence Rating of the impact on species groups		
0	No effect	Will have no impact on population levels
1	Very low	Insignificant or negligible effect on population levels
2	Low	May impact some individuals but will not have a significant impact on the local population levels
3	Moderate	Will have a noticeable impact on population levels. With habitat replacement/restoration it will be possible for the populations to recover
4	High	Will have a significant and permanent impact on population levels in the study area. With habitat replacement/ restoration it may not be possible for populations to recover
5	Very high	Will have impacts that could potentially result in the extrication of this group from the study area

Ecosystem Vulnerability Workshop

Plenary Discussion

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DRAFT table for discussion and feedback

Birds & Mammals

		Cosequence of Impact on Species Groups				
Possible Detrimental Environmental Effects	**Probability of Impact**	**Song Birds**	**Waterfowl Birds**	**Shorebirds**	**Raptors**	**Mammals**
	(1 low -5 High)	Spotted Towee	Mallard	Western Sandpiper	Red-tailed Hawk	Townsend's Vole
Loss of intertidal habitat	5	0	2	4	2	3
Less exposure time of mud flats	5	0	2	5	2	0
Loss of eelgrass commmunity	4	0	5	3	2	0
Loss of terrestrial habitat	2	1	1	2	4	4
Increase salinity in freshwater habitat	3	1	1	0	1	1
Possible Detrimental Environmental Effects		**Risk Rating**				
Loss of intertidal habitat		0	10	20	10	15
Less exposure time of mud flats		0	10	25	10	0
Loss of eelgrass commmunity		0	20	12	8	0
Loss of terrestrial habitat		2	2	4	8	8
Increase salinity in freshwater habitat		3	3	0	3	3

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DRAFT table for discussion and feedback

Aquatic Species, Amphibians & Invertebrates

			Cosequence of Impact on Species Groups			
Possible Detrimental Environmental Effects	**Probability of Impact**	**Marine Fish**	**Marine Crustaceans**	**Freshwater Fish**	**Amphibians**	**Invertebrates**
	(1 low -5 High)	Coho Salmon	Littleneck Clam	Cutthroat Trout	Pacific Tree Frog	Anise Swallowtail
Loss of intertidal habitat	5	2	3	0	0	2
Less exposure time of mud flats	5	1	2	0	0	1
Loss of eelgrass commmunity	4	5	4	0	0	1
Loss of terrestrial habitat	2	1	1	0	1	3
Increase salinity in freshwater habitat	3	1	1	3	5	3
Possible Detrimental Environmental Effects		**Risk Rating**				
Loss of intertidal habitat		10	15	0	0	10
Less exposure time of mud flats		5	10	0	0	5
Loss of eelgrass commmunity		20	16	0	0	4
Loss of terrestrial habitat		2	2	0	2	6
Increase salinity in freshwater habitat		3	3	9	15	9

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Expected Risks

The loss of exposure time for foraging associated with mud flats. The greatest impact from this will be to **migratory shorebirds** which rely heavily on this area as a stopover to feed and replenish their reserves for the continued migration north.

Mitigation: Monitor sediment transport in Mud bay and design engineering interventions to promote the retention of and depth of sediment.

Photo by Bill Boulton. From: https://deltafarmland.ca/resources/farmland-wildlife/shorebirds/western-sandpiper/

Expected Risks

The loss of eel grass communities. The depth of Mud Bay is expected to increase, which could reduce the available habitat for eel grass communities which support a **diversity of marine species and birds**.

Mitigation: Monitor the extent of eel grass communities and their tolerance to changing depths. Design engineering interventions to promote the retention of sediment to the preferred depth of eel grass.

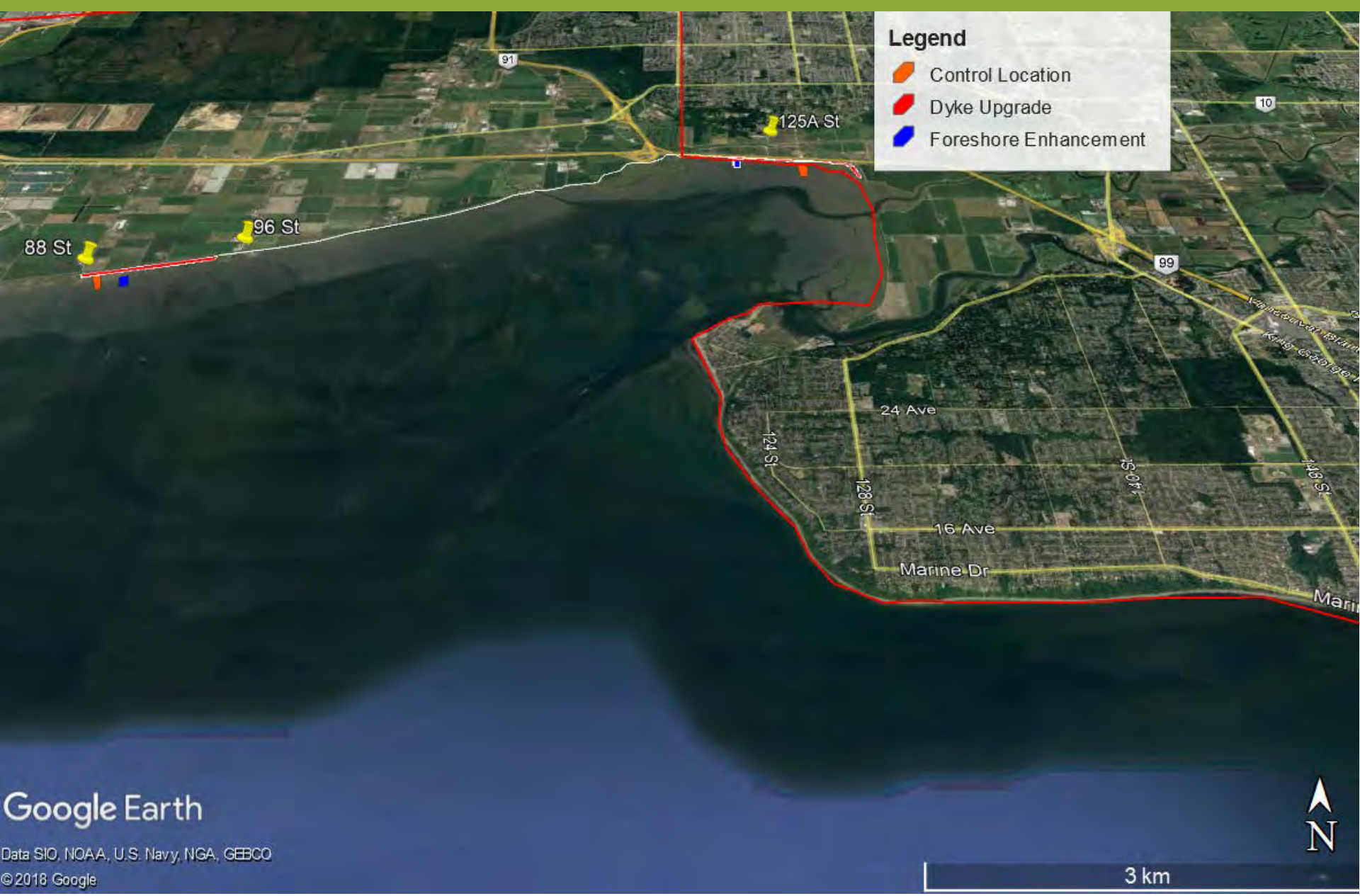
Photo by Jim Dickson From:
http://linnet.geog.ubc.ca/ShowDBImage/ShowStandard.aspx?index=366

Expected Risks

Loss of intertidal habitat. This transition zone between the marine and terrestrial habitat is highly productive and used by a wide range of species. Its loss will impact forage opportunities for **migratory & resident birds**, **mammals**, as well as **marine life**.

Mitigation: Promote "Green Shores" approach to all new dikes. Design intertidal features to help trap sediment and extend the intertidal zone out as far as possible.

Photo of Mud Bay Park, from the Surrey Biodiversity Strategy



- Subject to federal funding application and acceptance
- 2 pilot locations, 2 control locations

The Message Box

Tool to streamline the information into concise messaging

- What are the problems/conflicts/issues involved?
- Why does this information matter to the identified audience?
- What are some of the possible solutions to this problem?
- What are the potential benefits of resolving this problem?

EXAMPLE for discussion

Problems

- Large fish biomass declined by at least 90% across the global ocean
- Baseline: prior to industrial exploitation there were 10 times more large fish
- Initial declines happened very rapid and are often poorly documented
- Management will underestimate decline
- Species composition has undergone large changes as well
- The entire ocean has been transformed, no "blue frontier" left
- Changes very uniform from the tropics to the poles, close and distant to shore

Benefits?

- Among the last free-ranging large animals on earth
- Most valuable wild animals on earth = huge economic benefits
- Important ecological roles
- Lions and tigers of the sea
- First large land mammals and freshwater fish, then coastal, then whales - now everything else is reaching the limit
- Its time to turn this around

Global Overfishing

So What?

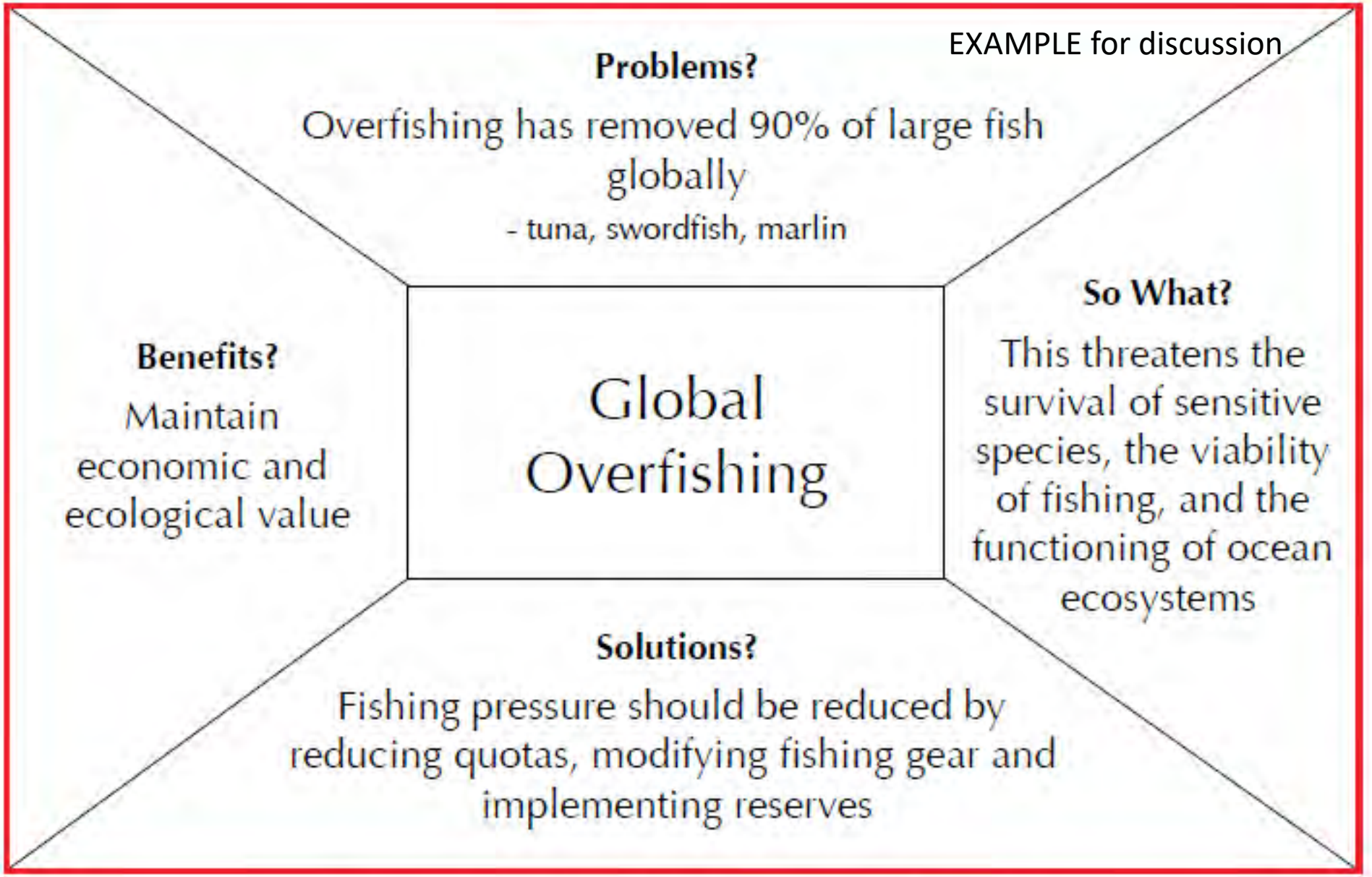
- Fisheries will suffer, possibly collapse
- This likely has major ecosystem consequences (but we are ignorant to what precisely will happen)
- Populations and species may go extinct

Solutions?

Recovery by reducing fishing pressure

- Reduce effort (hard to control because fishing pressure increases)
- Reduce quota (hard to achieve and on its own almost always not (sufficient)
- Marine reserves (many promising examples, almost never fail to halt declines)

EXAMPLE for discussion



Audience: National & International Media

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EXAMPLE for discussion

Problems?

- Humans have degraded marine ecosystems, making them more favorable for jellyfish
- Lack of longterm data to assess changes in populations
- Polyp lifestage can be tolerant to harsh conditions
- Many complicated and interacting factors can lead to an increase in jellyfish (overfishing of predators and competitors, eutrophication, aquaculture, climate change, vectors for invasive species)

Benefits?

- Prevent environmental catastrophe
- Maintain healthy and productive ecosystems
- Allow natural ecosystems to control jellyfish populations (cheaper than doing it ourselves)
- Use jellyfish (which are interesting) to communicate complex but important marine conservation issues

Jellyfish Takeover

So What?

- Loss of ecosystem services and food security
- Interference with human activities (tourism, fishing, aquaculture, industry)
- Ecosystems can enter a 'jellyfish spiral' where jellies prevent the recovery of fish stocks

Solutions?

- Ecosystem-Based Management
- Stop marine pollution (especially eutrophication)
- Stop overfishing and destructive fishing
- Stop fishing down food webs
- Create marine reserves
- Focus and increase research initiatives

Audience: General Public

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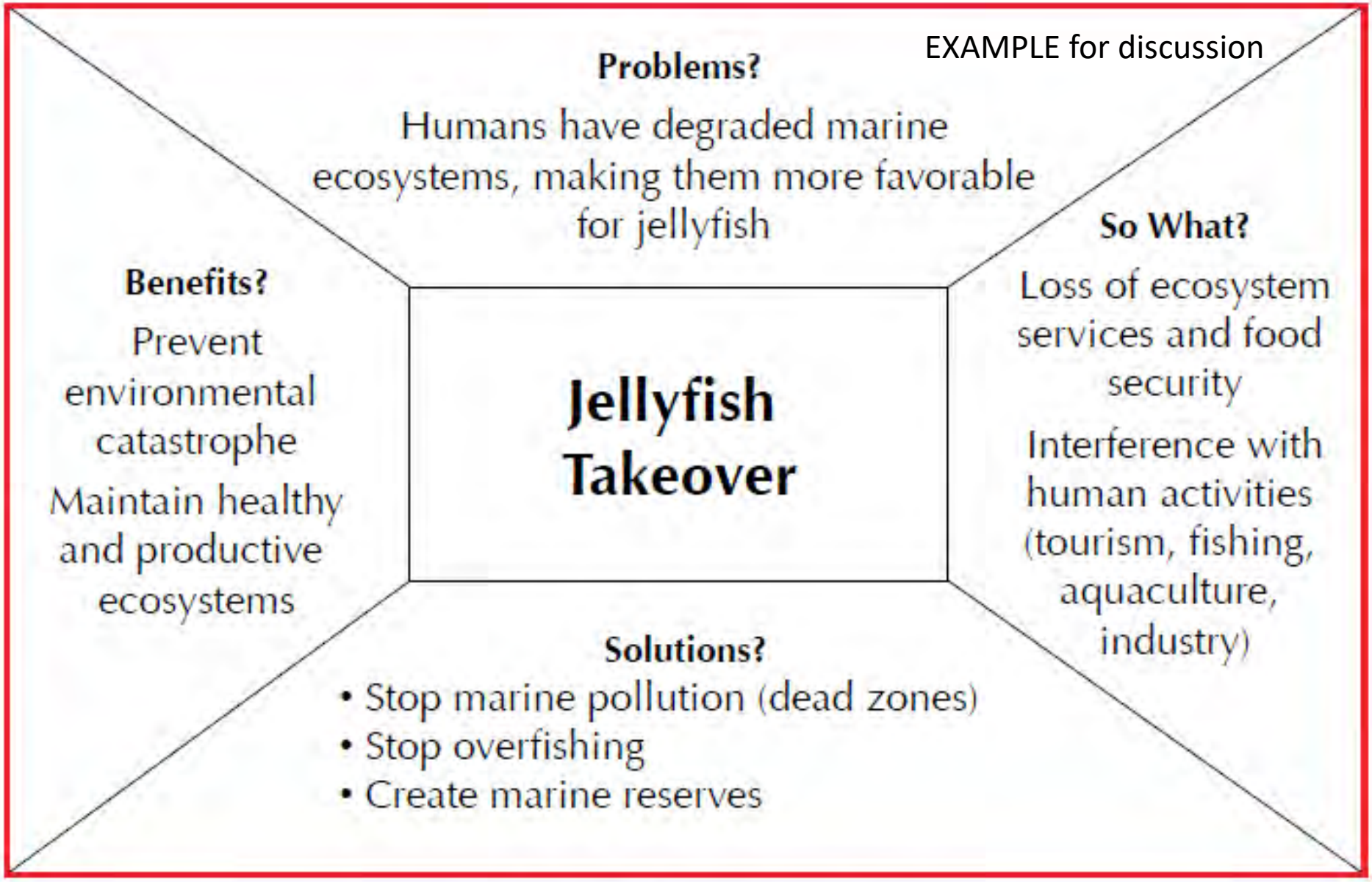
EXAMPLE for discussion



Audience: General public

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Surrey - Coastal Flood Adaptation Strategy
Communications Plan

Nathan Vadeboncoeur, PhD
President – Smart Shores

Science and Storytelling

smart SHORES

Connect

smart SHORES

Engage

smart SHORES

Inspire

smart SHORES

Ecosystem Vulnerability Workshop

Next Steps

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DMAF

Blue Carbon

Municipal Natural Assets Initiative

Data Availability/Sharing & Collaboration

CFAS

Crowd-funding with MEOPAR

Eelgrass mapping, monitoring and research

Shared Waters

Boundary Bay Health Conservation Committee

Coastal Restoration Fund

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SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

Thank you!

Ducks Unlimited Canada | RESCUE OUR WETLANDS | CITY OF SURREY the future lives here. | FCM FEDERATION OF CANADIAN MUNICIPALITIES FÉDÉRATION CANADIENNE DES MUNICIPALITÉS