

Crescent Beach a link between Biodiversity and an ever changing environment



May 24, 2016
Presentation by Stephen Godwin, R.P.Bio.
Environment Manager

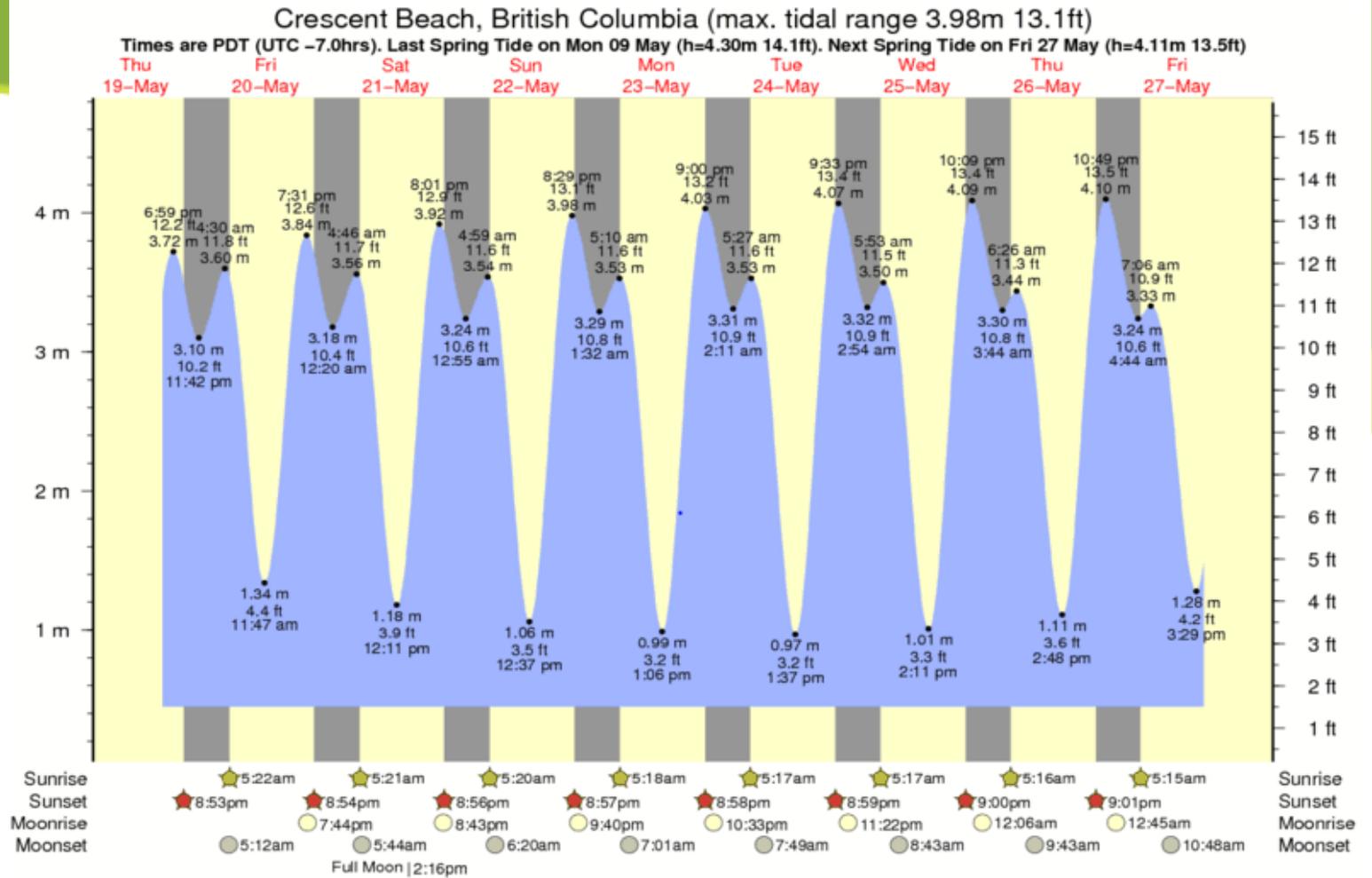
What makes Crescent Beach so special?

Dynamic conditions -ever changing

- Tidal Cycles (high tide to low tides)
- Storms
- Seasons
- Influences of Rivers on Ocean and vice versa
- Cliffs
- Sediment movement
- Ecotone (adjacent habitat types)
- Wildlife



Tides



Crescent Beach Tide Chart. The largest known tidal range at Crescent Beach is 3.98m 13.1 feet

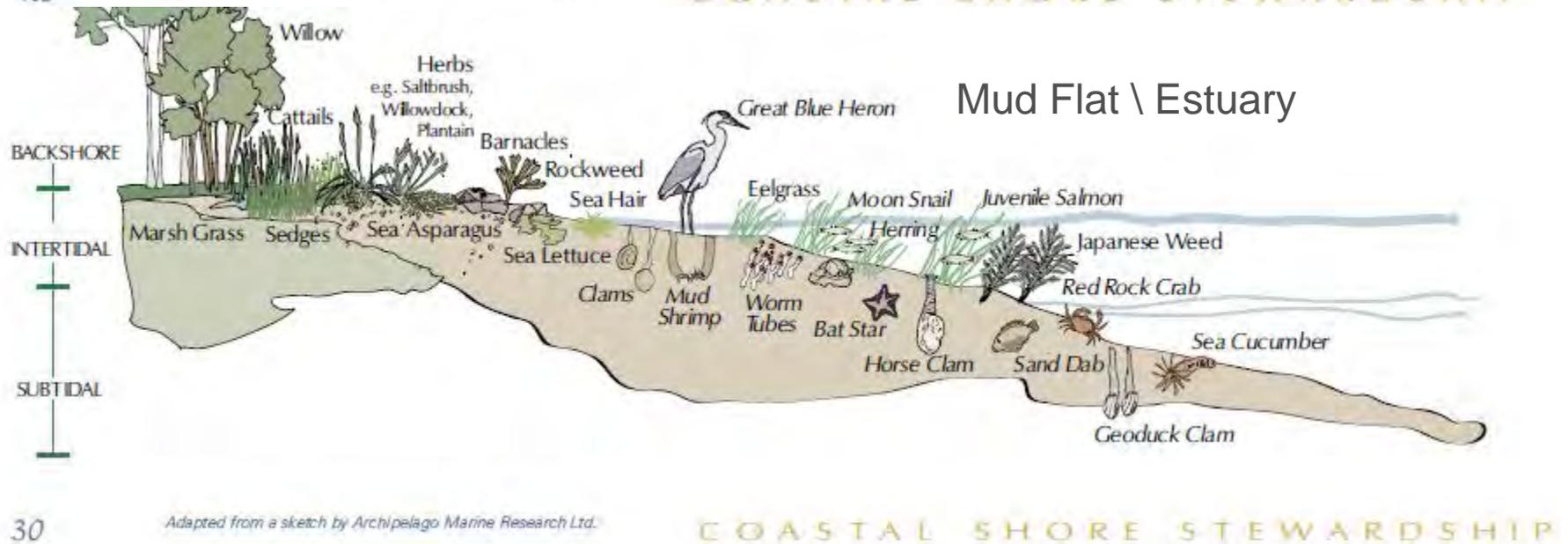


Tides – Highs to Lows

Sand Shoreline



Mud Flat \ Estuary



Storms

Distribution of energy



Christopher Polbn



Seasons

- Spring
- Summer
- Fall
- Winter

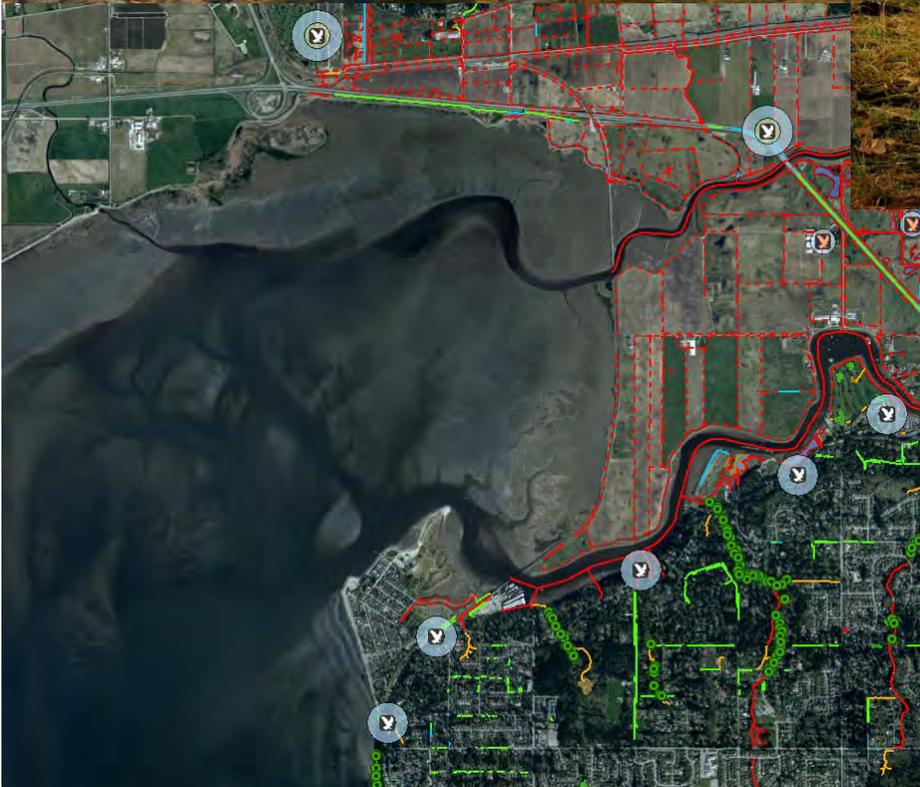


Affects

- Tides
- Weather
- Storm force
- Temperature
- Precipitation



Influences of Rivers



- Sediment transport
- Changes in salinity
- Debris / nutrient contributions
- Flows
- Diversity of aquatics

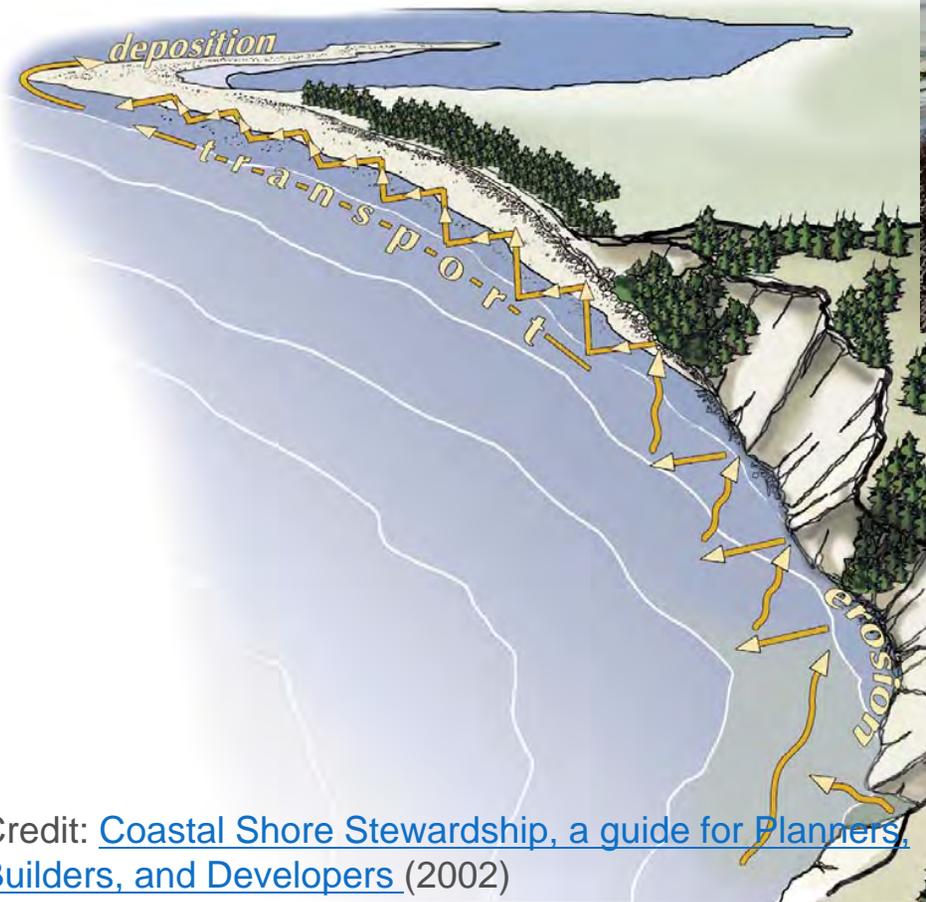
Cliffs / Bluffs

Soil movement

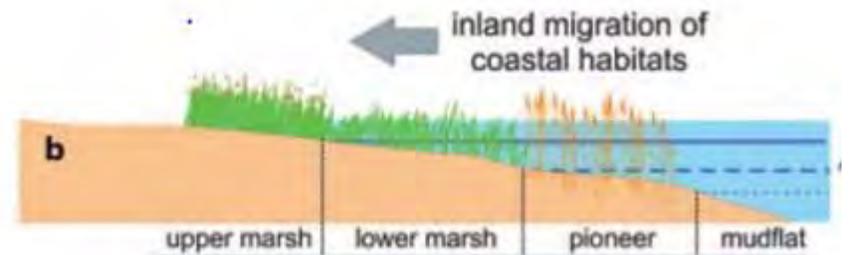
Gravel deposition



Sediment Movement



Source: Winson Tang Photocreative, Flickr

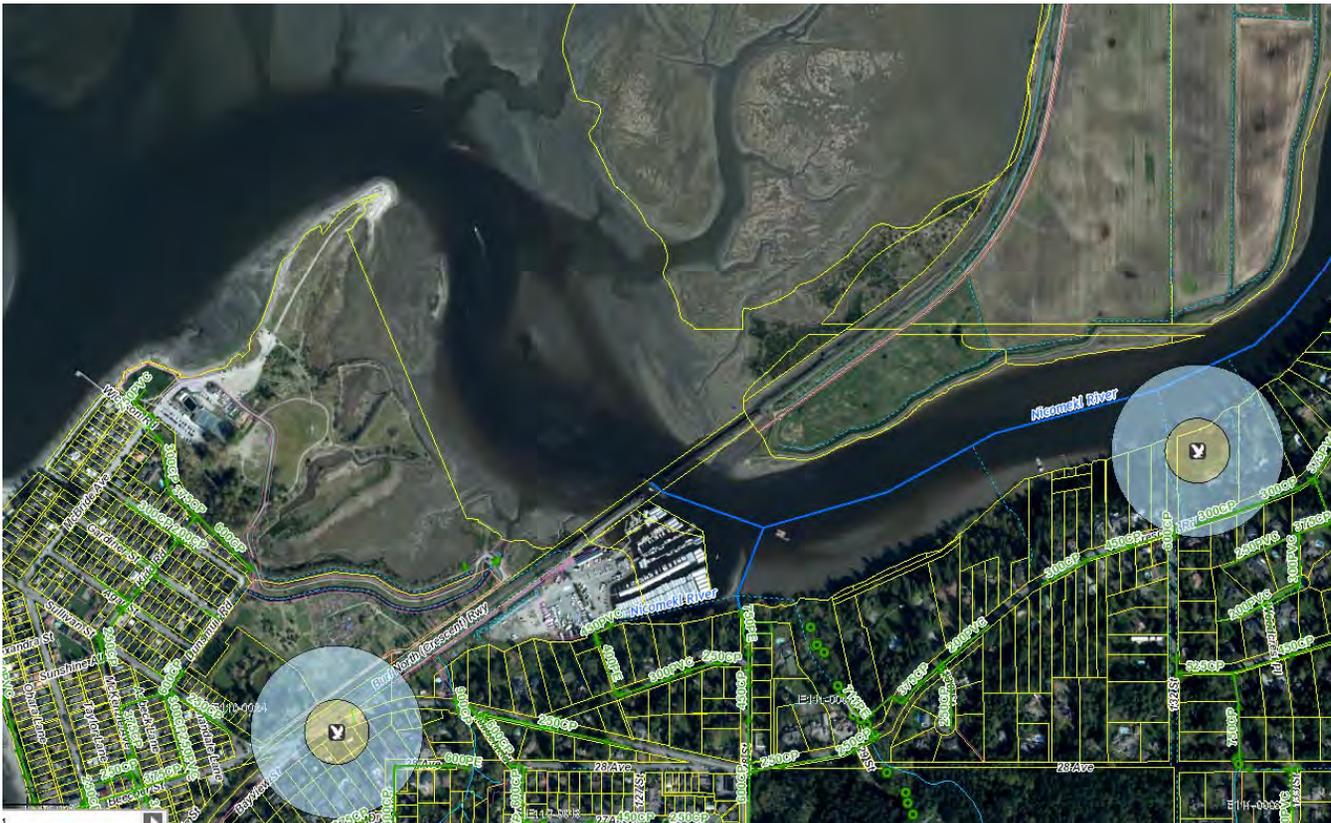


Source: Managed Realignment: A viable Long-Term Coastal Management Strategy, L. S. Esteves, 2014

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

Ecotone

Differing habitat types in adjacency = complimentary



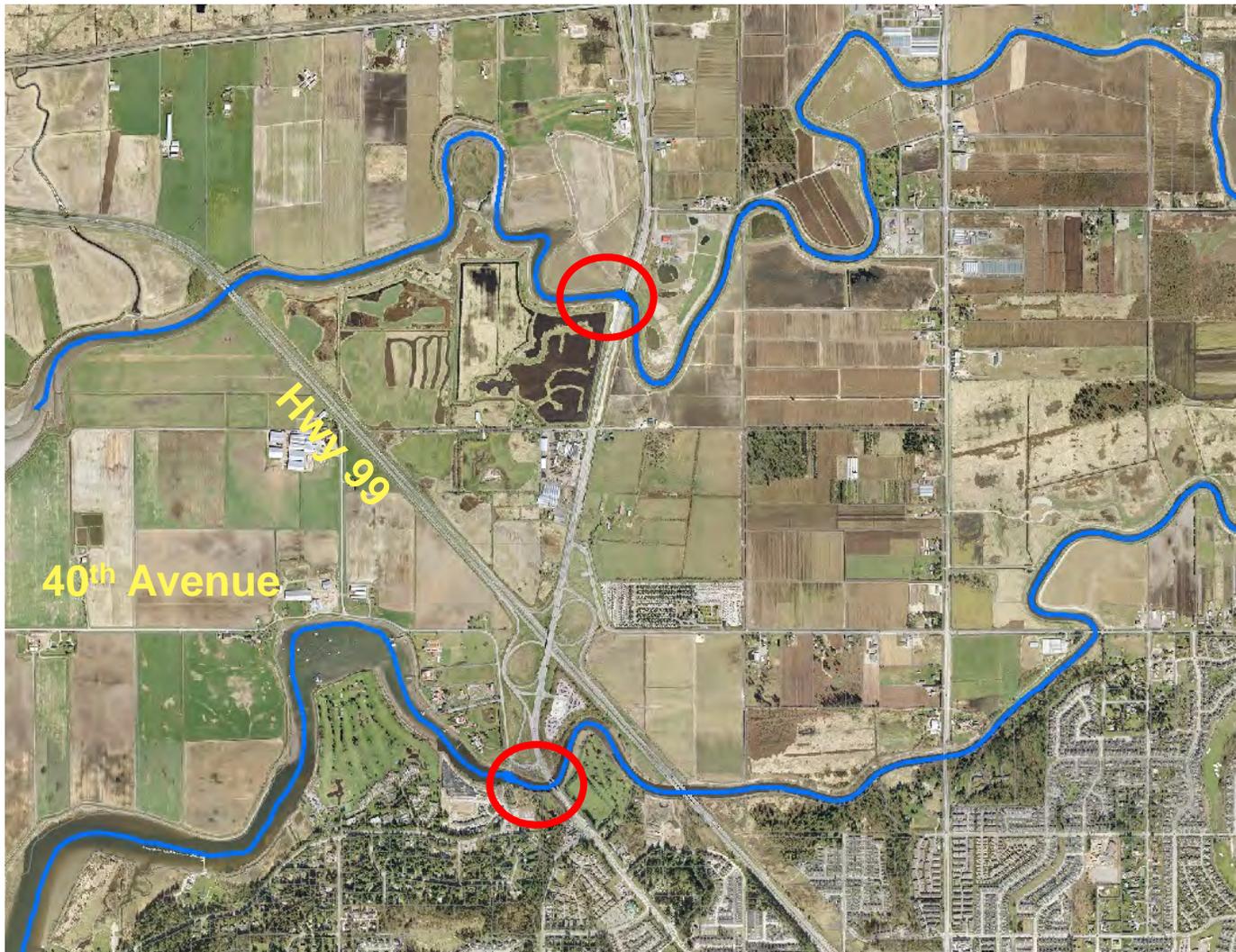
Recent limited pinning of movement

Sea Dams

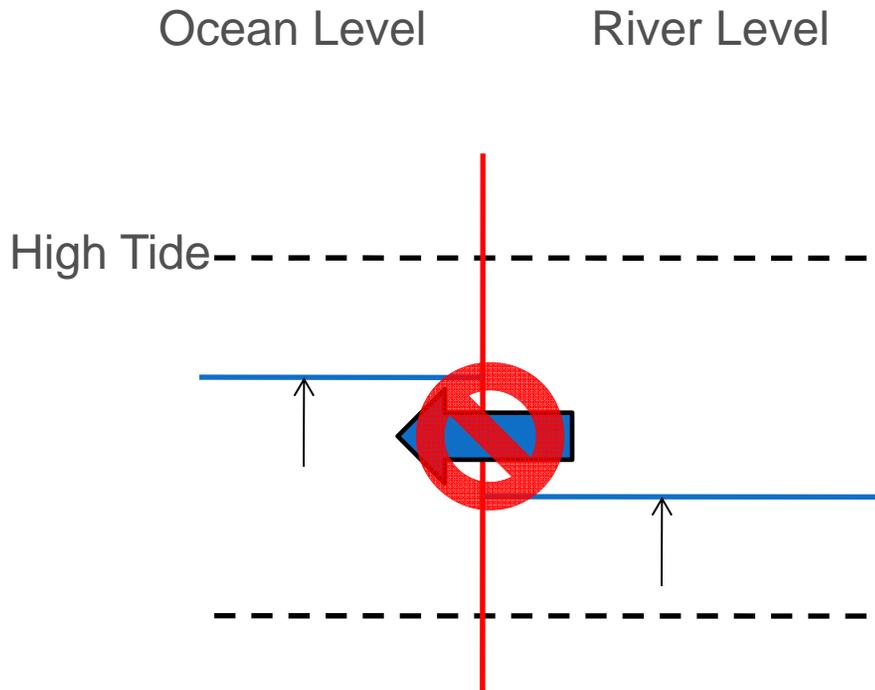
Dykes

Railways tracks

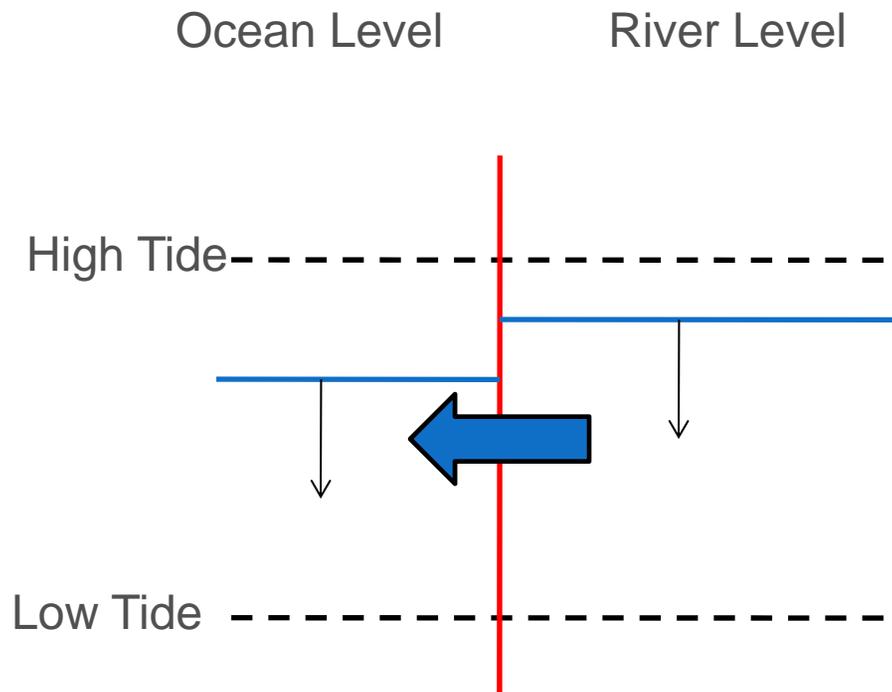
The Serpentine River & Nicomekl River Sea Dams – Pins the salt wedge



The Serpentine River & Nicomekl River Sea Dams



The Serpentine River & Nicomekl River Sea Dams



Dyking of Serpentine and Nicomekl – Pins the river



Railway – pins the cliffs



Photo by Don Pitcairn



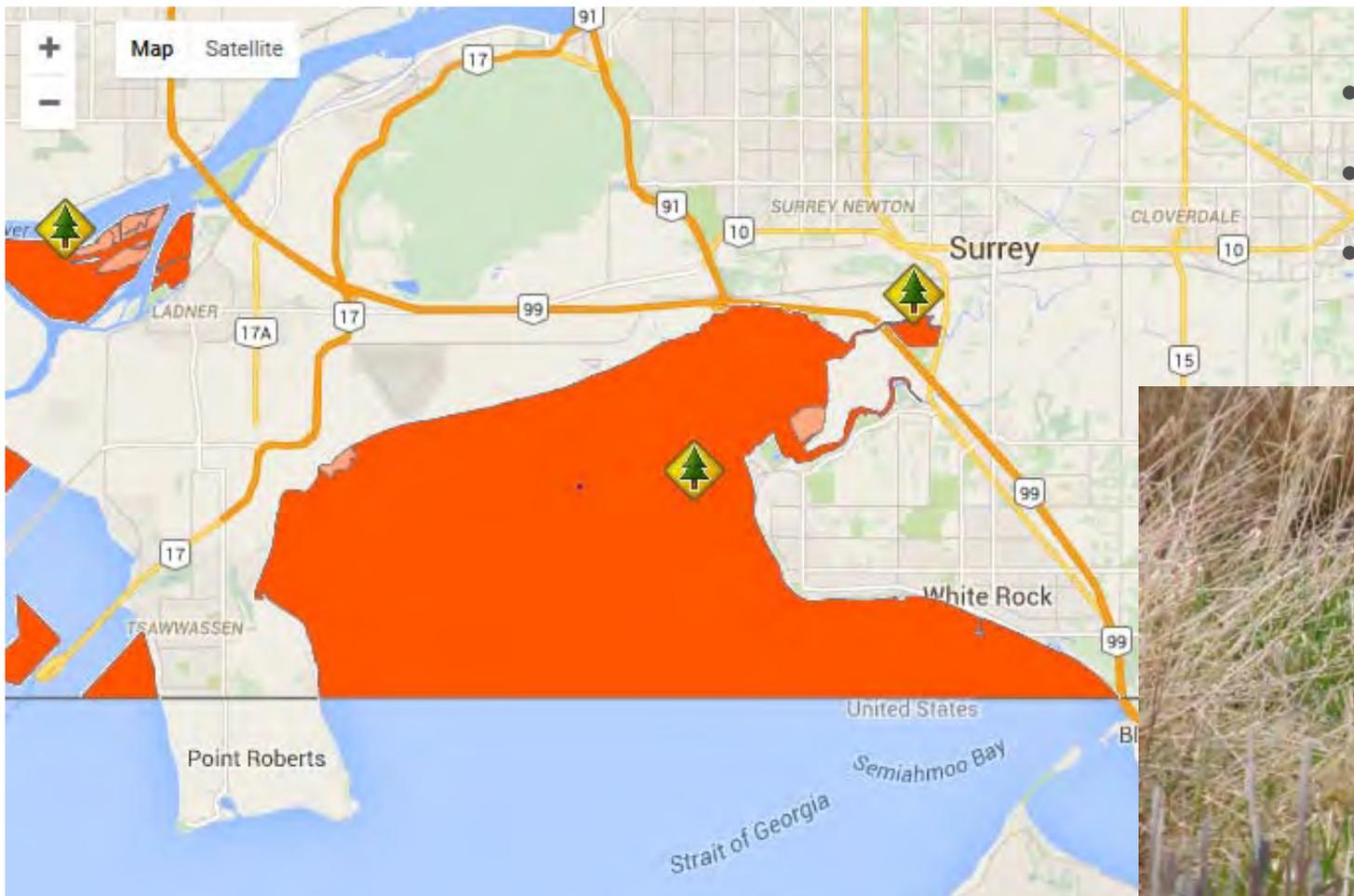
High Biodiversity – Makes Crescent Beach so interesting!

Due to the unstable nature and diversity of conditions, Biology responds by adapting with high levels of biodiversity.



Ministry of Forests, Lands and Natural Resource Operations

Boundary Bay Wildlife Management Area

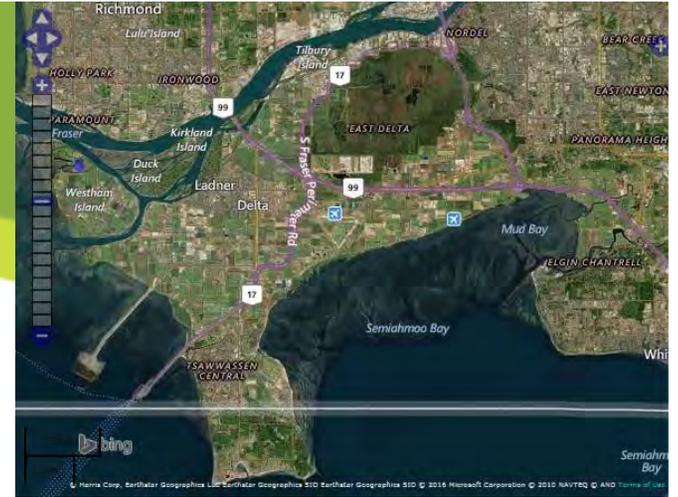


- Migratory birds
- Resident Birds
- Marine Mammals





Ramsar



The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources

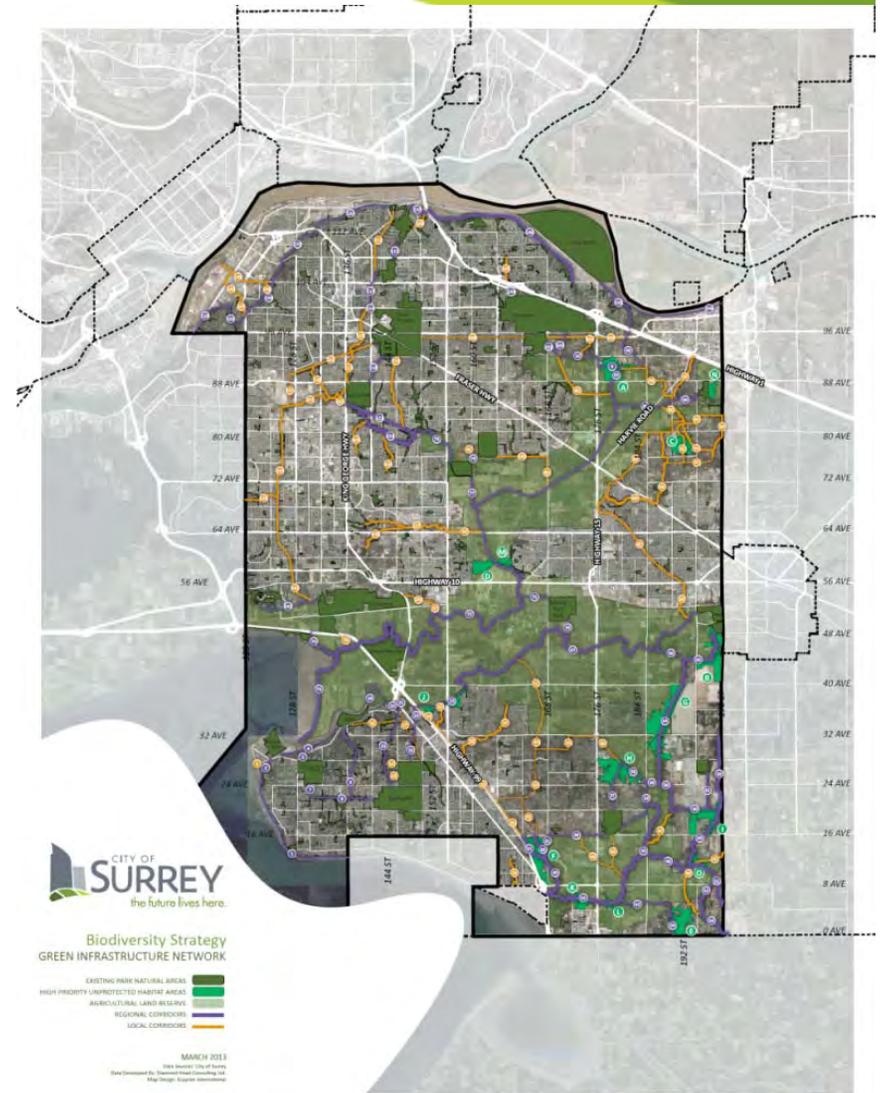
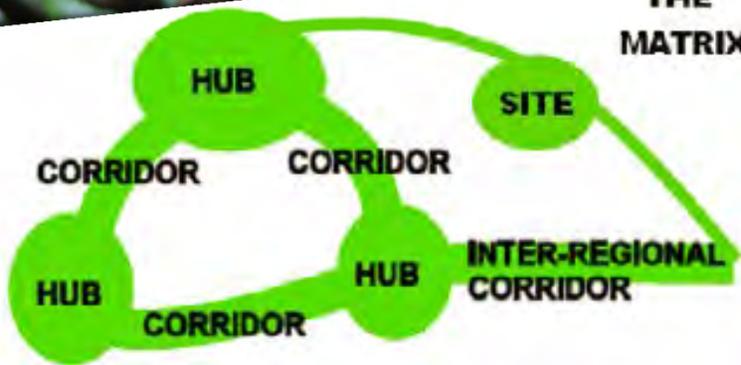
Fraser River Delta. 24/05/82; British Columbia; 20,682 ha; 49°06'00"N 123°03'00"W. IBA, WHSRN. The site is formed by six components (Burns Bog, Sturgeon Bank, South Arm Marshes, Boundary Bay, Serpentine, and the former 'Alaksen' Ramsar Site), all in the Metro Vancouver Region and part of the the most important river delta/estuary for fish and birds on the west coast of Canada.

The complex provides an internationally critical migratory stopover area for the Western Sandpiper (*Calidris mauri*), one of the most common shorebirds in the western hemisphere. It provides feeding and roosting sites to about 250,000 migrating and wintering waterfowl and 1 million shorebirds

Biodiversity Conservation Strategy



**THE
MATRIX**



What makes Crescent Beach so special?

The ever changing environment and conditions...
Draws in mass amounts of biodiversity.



Courtesy of Surrey Archives



SFU

ACT

Adaptation
to Climate
Change Team



Presentation to Crescent Beach Residents

**Climate Change Vulnerability and Resilience:
Considerations for Coastal Communities**

May 24, 2016

Deborah Harford, Executive Director, ACT

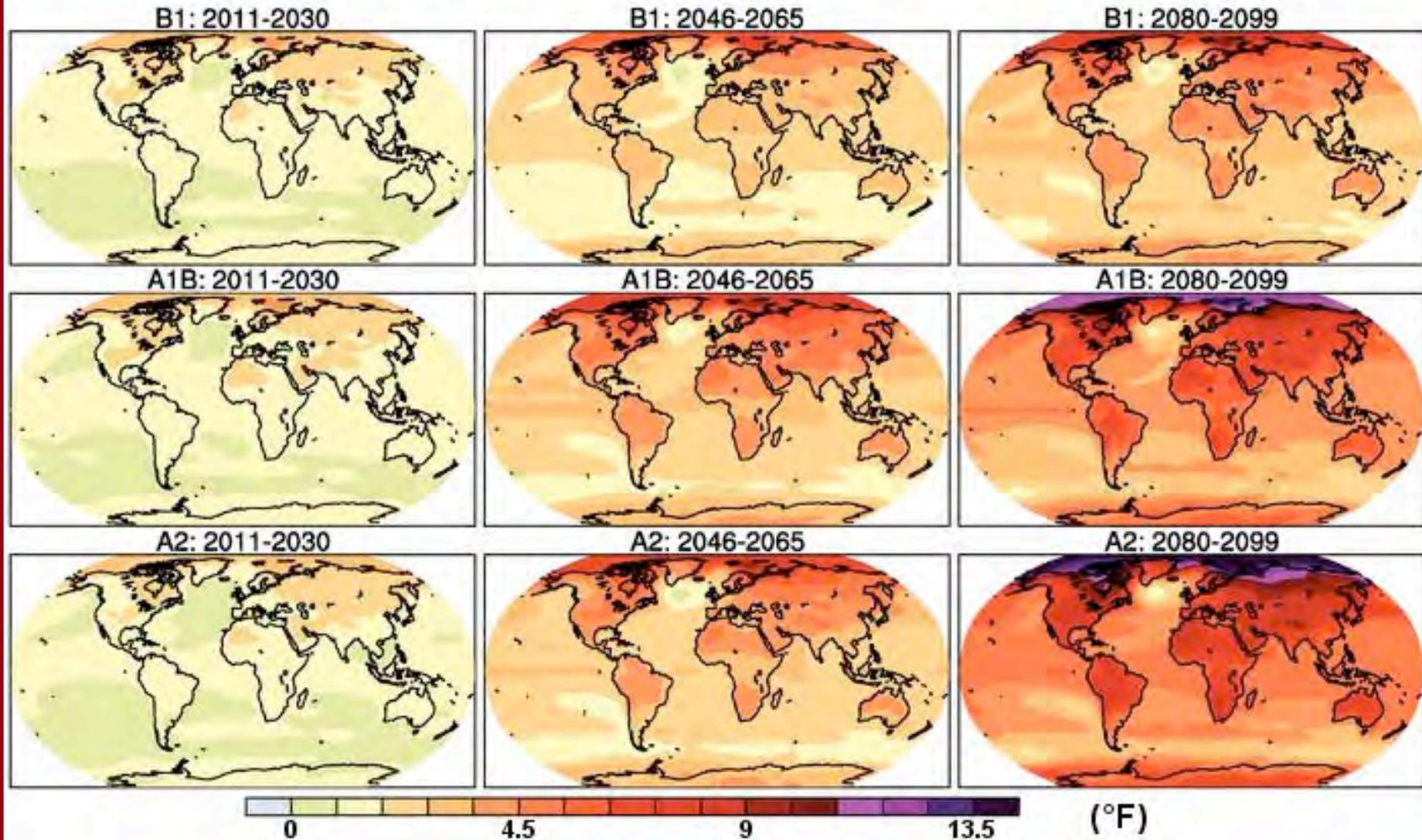
The Climate Change Challenge



The world is committed to significant changes in climate regardless of future emissions of greenhouse gases.

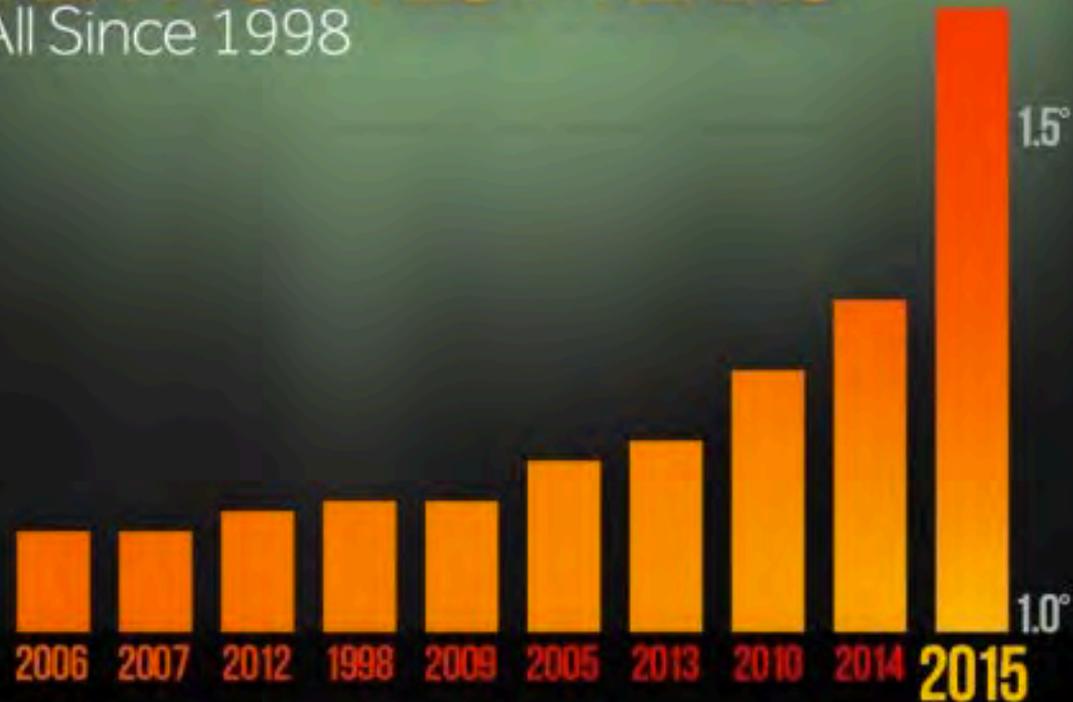
While **emissions reduction is important** to avoid catastrophic changes in climate, this means that **adaptation to the effects of global warming is necessary to reduce vulnerability and enhance resilience.**

Projected Impacts: Heat



Observed Global Trend

TEN HOTTEST YEARS All Since 1998



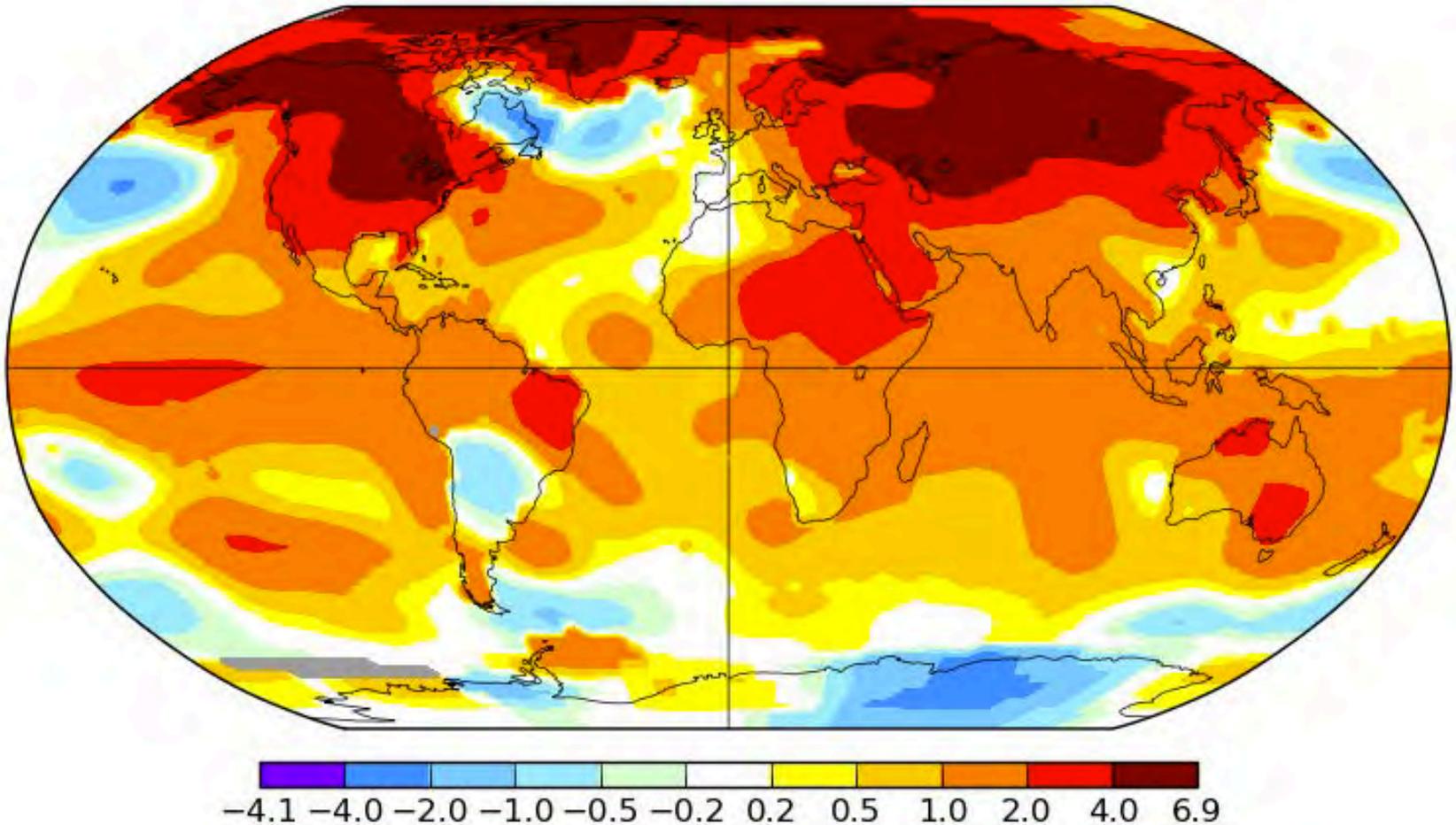
2015 tied hottest year with 2016, 2017. Columns represent difference from 20th-century average.
Data as of January 26, 2016. Subject to change based on final annual data.
Source: NASA/NOAA

Observed Global Trend

March 2016

L-OTI(°C) Anomaly vs 1951-1980

1.29

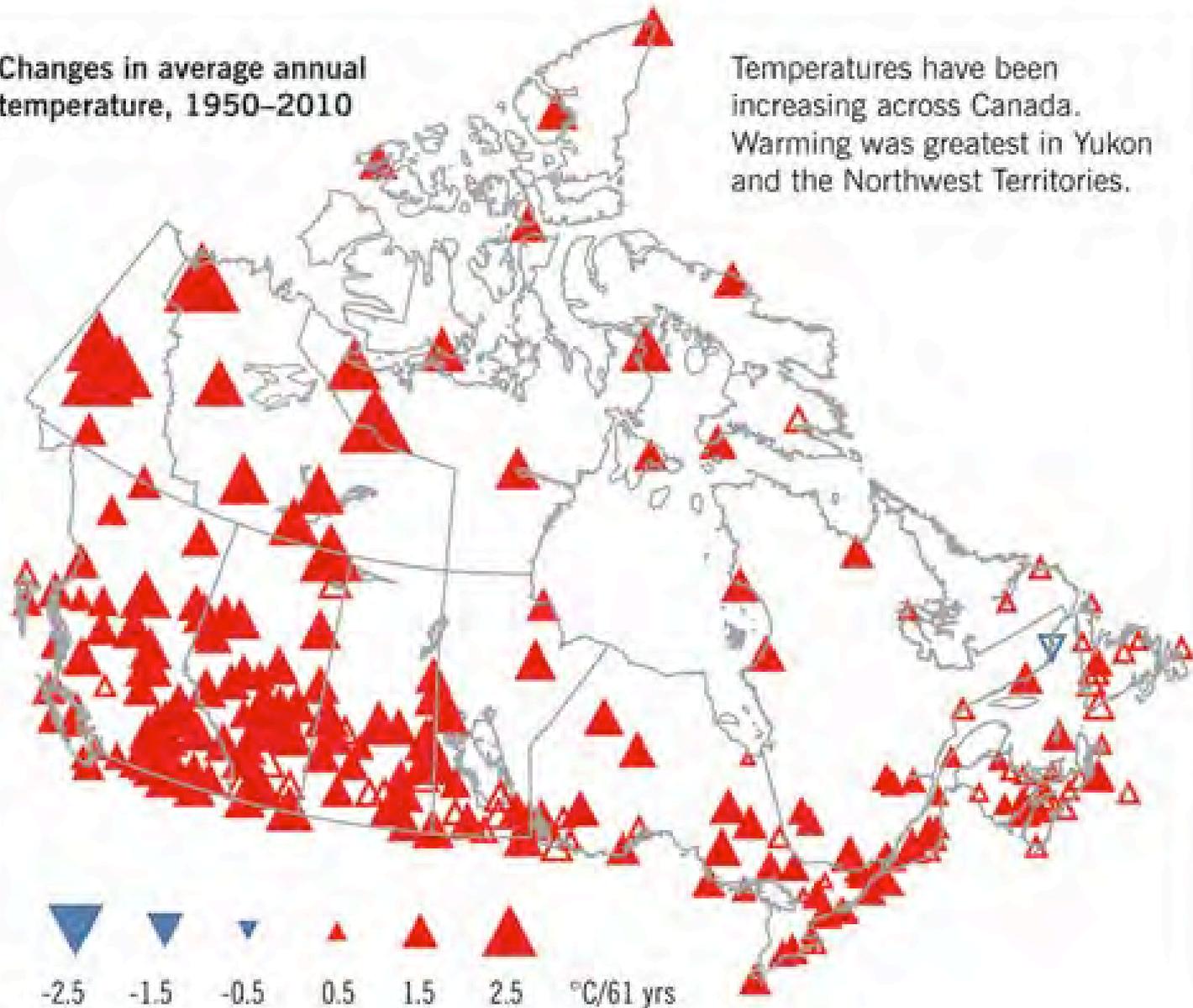


March 2016 was the warmest March since at least 1891, making it the 11th consecutive month to set a global temperature milestone.

Observed Changes in Canada

Changes in average annual temperature, 1950–2010

Temperatures have been increasing across Canada. Warming was greatest in Yukon and the Northwest Territories.



Hotter, Drier Summers = Fires/Less Watering



< Vancouver, June 16th, 2015

Vancouver, July 6th, 2015 >
(Approx 180 wildfires
burning across province)

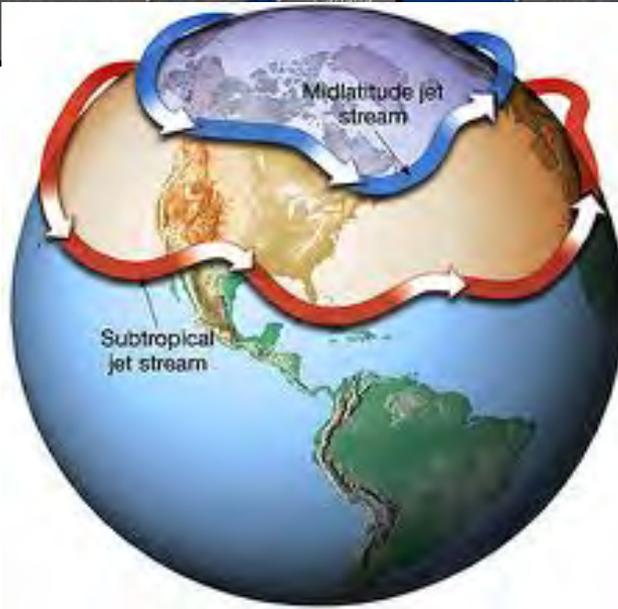
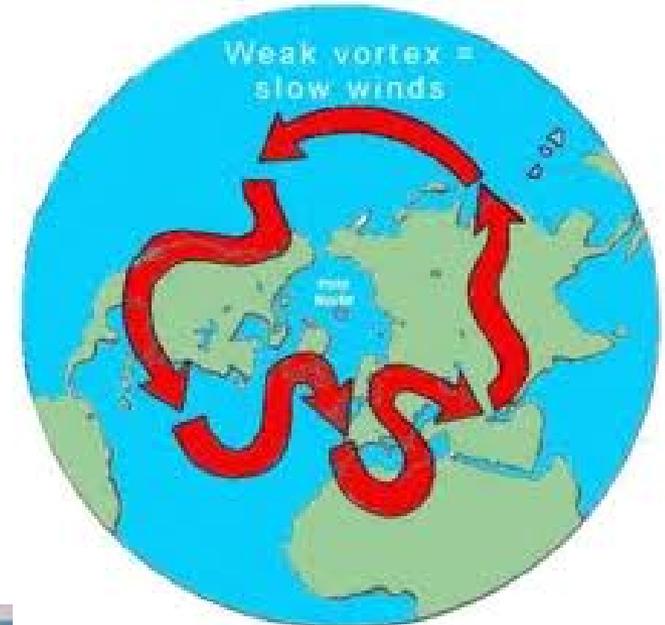


< Fort McMurray, April 14 2014

Fort McMurray, May 4 2016 >
Costliest disaster in Canadian
History: \$9 billion? (IBC)



Arctic Influence on Weather

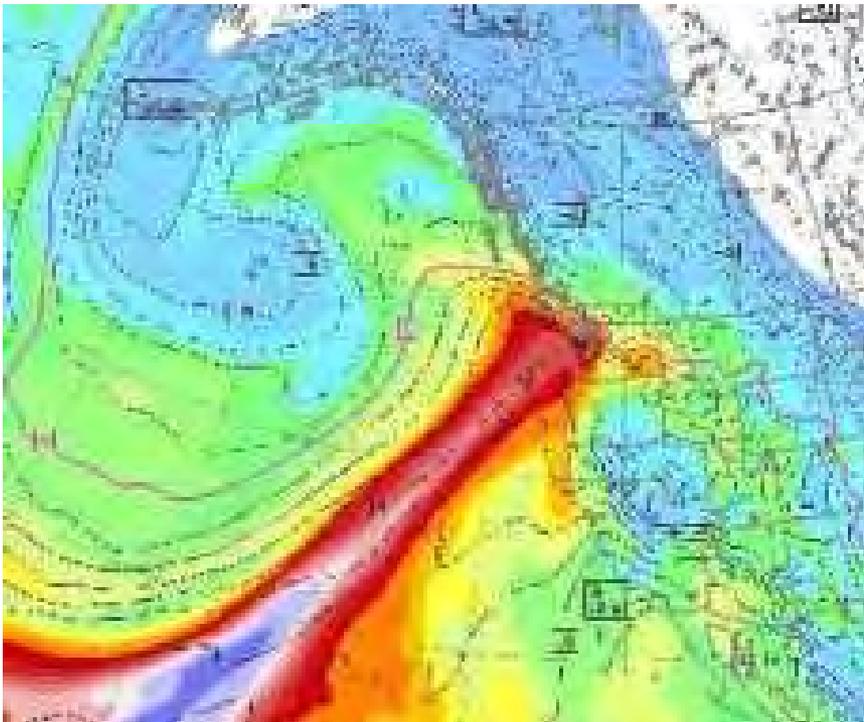


Atmospheric Moisture Influence

Clausius Clapeyron relation:

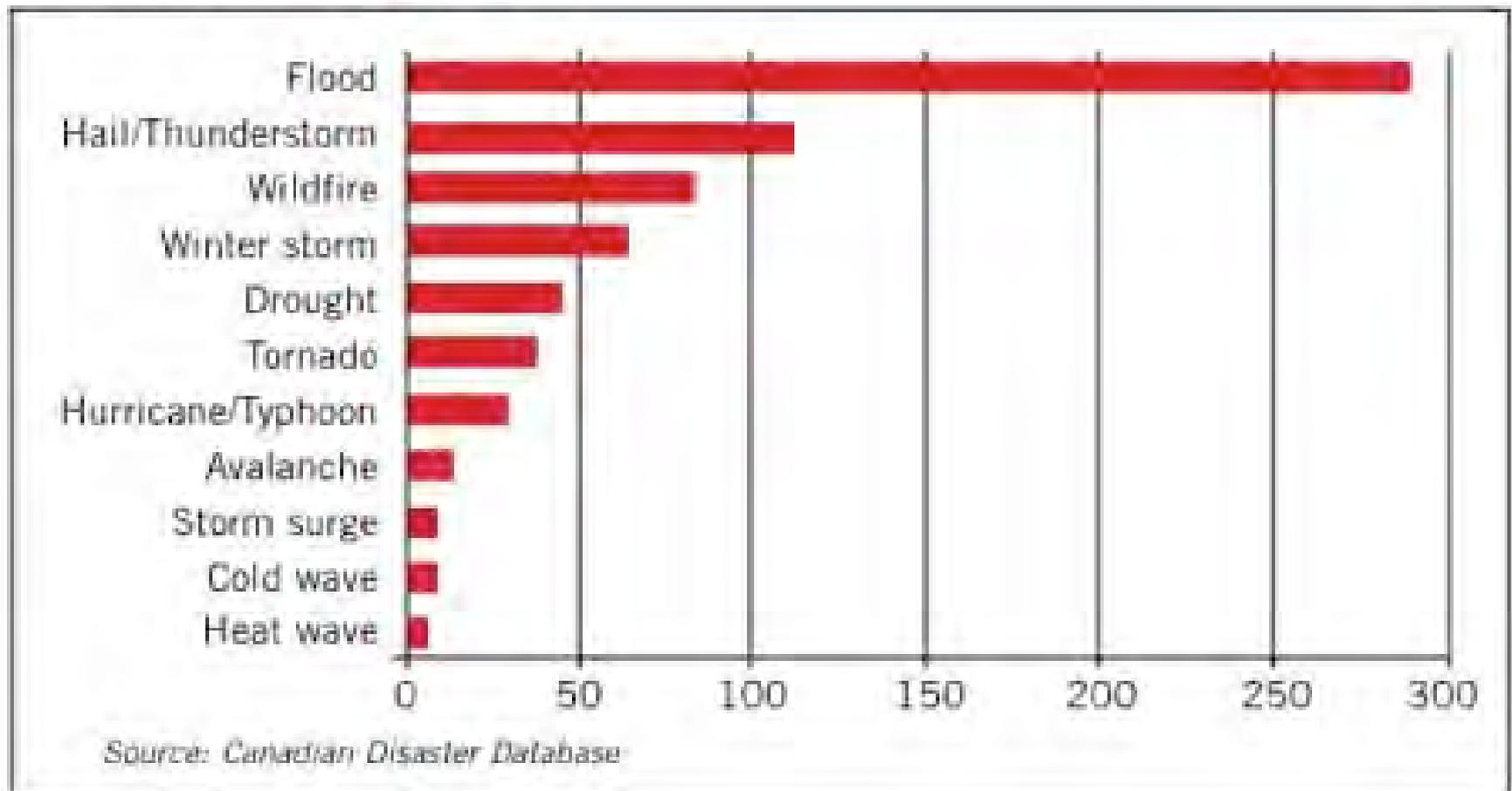
1° warming = +7% moisture in atmosphere

= Supercharged atmospheric rivers



Observed Changes in Canada

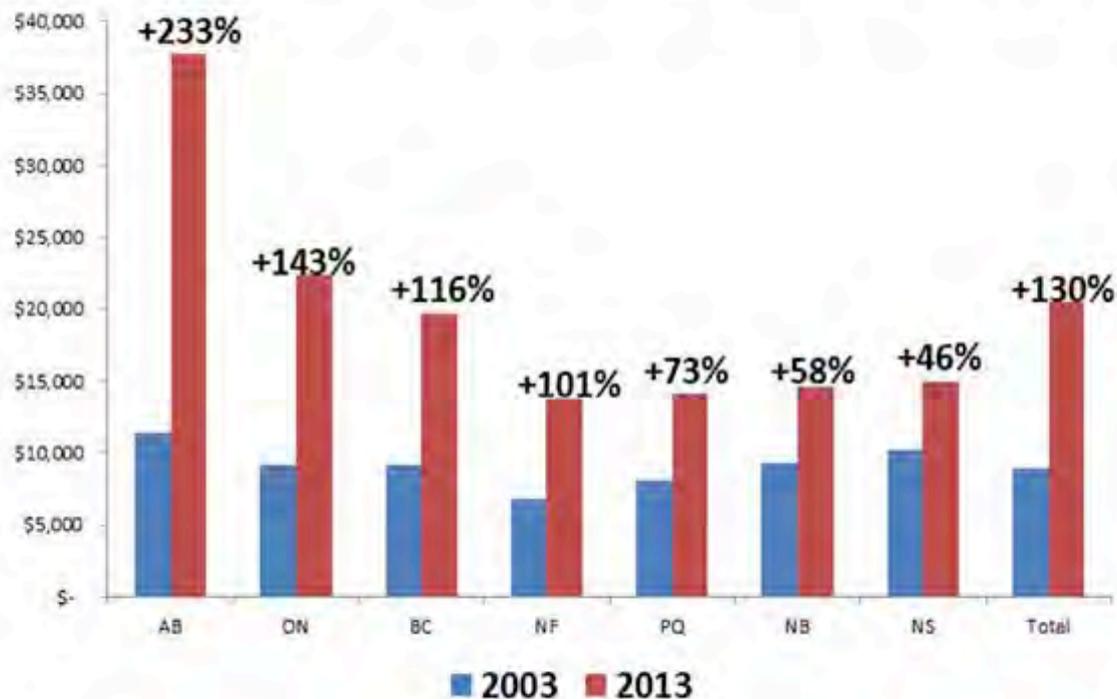
Figure 1:
**Number of Hydrological and Meteorological Disaster Events
in Canada (1900-2013)**



Observed Global Trend

“...One out of every two dollars paid for homeowners’ insurance goes to cover the cost of water damage claims . . .equals the costs of all other perils combined . . . “perfect storm” confronting insurers - combined effects of climate change, aging infrastructure, and the increased value of insured property located below grade.” ~ IBC, 2014

Comparison of Average Cost of Water Damage Claims 2003 vs. 2013



Saskatchewan, Manitoba, PEI and the territories were not broken out due to small number of claims.

Projected Impacts in Canada



Extreme weather = increased severity and frequency of:

Heat waves

Drought

Wildfires

Rain/storms

River/coastal flooding



Changes in the cryosphere = loss of:

Permafrost

Sea ice

Lake ice

Snowpack

Glaciers



Projected Impacts in Canada



Sea level rise – locked in now.

(BC est.: 1m by 2100):

Increased storminess and storm surge

Erosion

Infrastructure impacts

Loss of beaches and coastal ecosystems

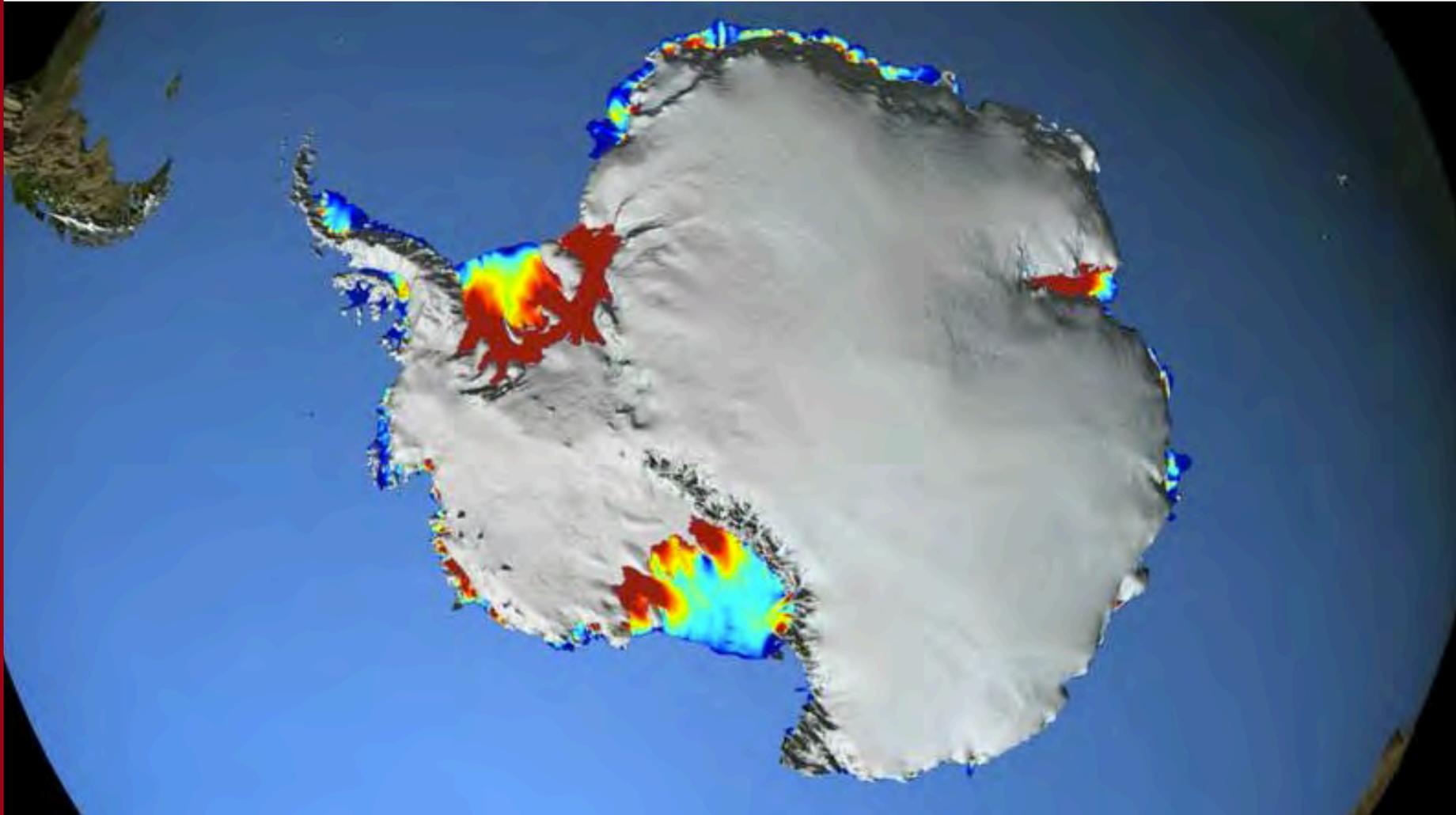
Soil salinization

River influence – e.g. levels, salt wedging

Groundwater pooling

Sea Level Rise

Current provincial guidelines: 1m by 2100, 2m by 2200



Observed Impacts Around the Globe



President of Maldives (8 feet above sea level) holds underwater Cabinet meeting in 2009 as message to global community



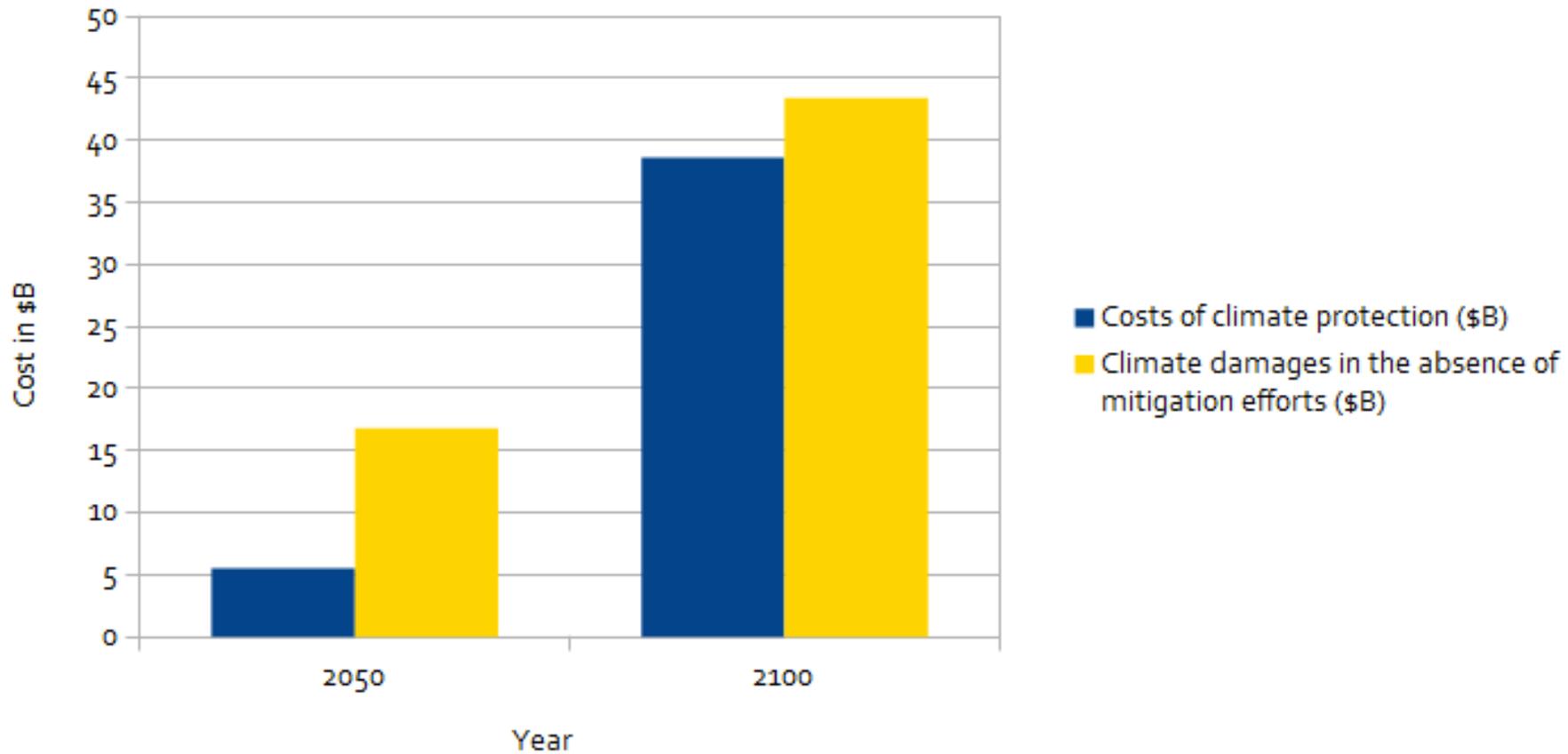
Result: New Conditions



Result of climate changes plus additional influences:

- **Historical data obsolete**
- **Engineering and building standards need continually updating**
 - (e.g. IDF curves)
- **Ability to project conditions based on experience not reliable**
- **Extreme weather of magnitudes we cannot foresee**
- **Levels of damage beyond our experience**

Costs of Adaptation: Spend Now, Save Later!

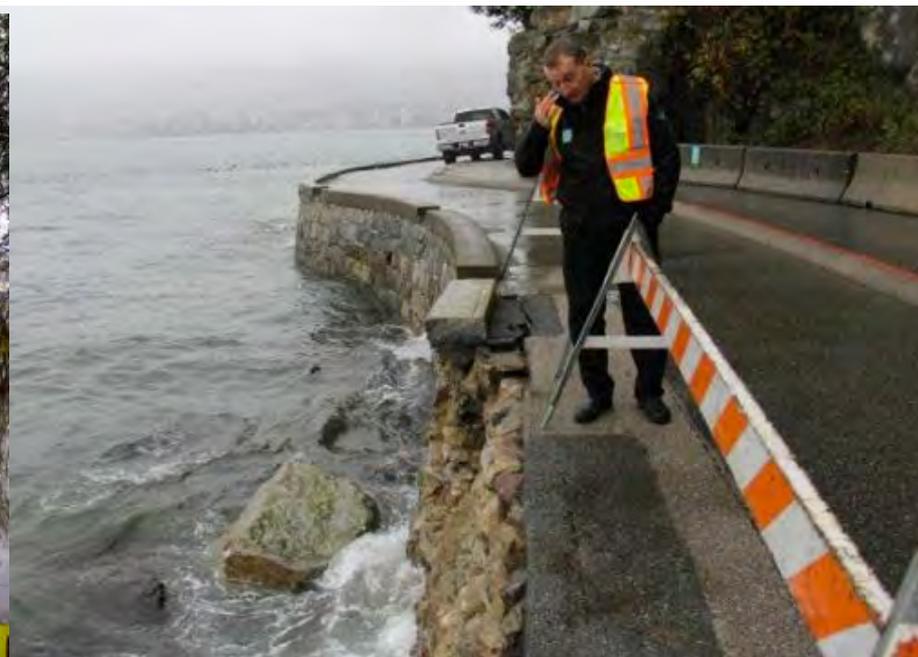


Metro Vancouver At Risk

Metro's international airport, major ports, freight terminals, agricultural land and tourist destinations are all at risk (11th in world), representing billions of dollars of infrastructure investment. (OECD 2013)



Local Impacts to Date in Metro Vancouver



Local Impacts to Date in Crescent Beach



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Presentation to Crescent Beach Residents

How are Other Coastal Communities Adapting to Climate Change?

May 24, 2016

Deborah Harford, Executive Director, ACT

Deborah Carlson, Staff Counsel, West Coast Environmental Law

SLR Challenges

Eg: Coastal squeeze for people and ecosystems



Forecasted Change in the Environment

- The River – Increase Spring Melt & Runoff
- The Sea – Tidal Change & Sea Level Rise
- The Land – Currently at or below Sea Level



Richmond, BC

SLR Collaborative for Metro Local Govts

WCEL/ACT combined funding for regional collaboration on climate change adaptation and water regional collaboration.

Municipalities identified SLR as top priority.



Coastal Cities at Risk Project

- Partners: Metro Vancouver/Bangkok/Manila/Lagos
- Planning/research for four major international cities dealing with sea level and other climate impacts including:



Key Adaptation Actions Needed

1. **Engage** stakeholders from community and business to ensure they understand the challenges and participate in developing solutions.
2. **Identify options:** *Protect, *avoid, *accommodate, *retreat?
(Examples coming!)
3. **Innovate:** Resist, recover, *creative transformation?*

Great Garuda Sea Wall: Jakarta

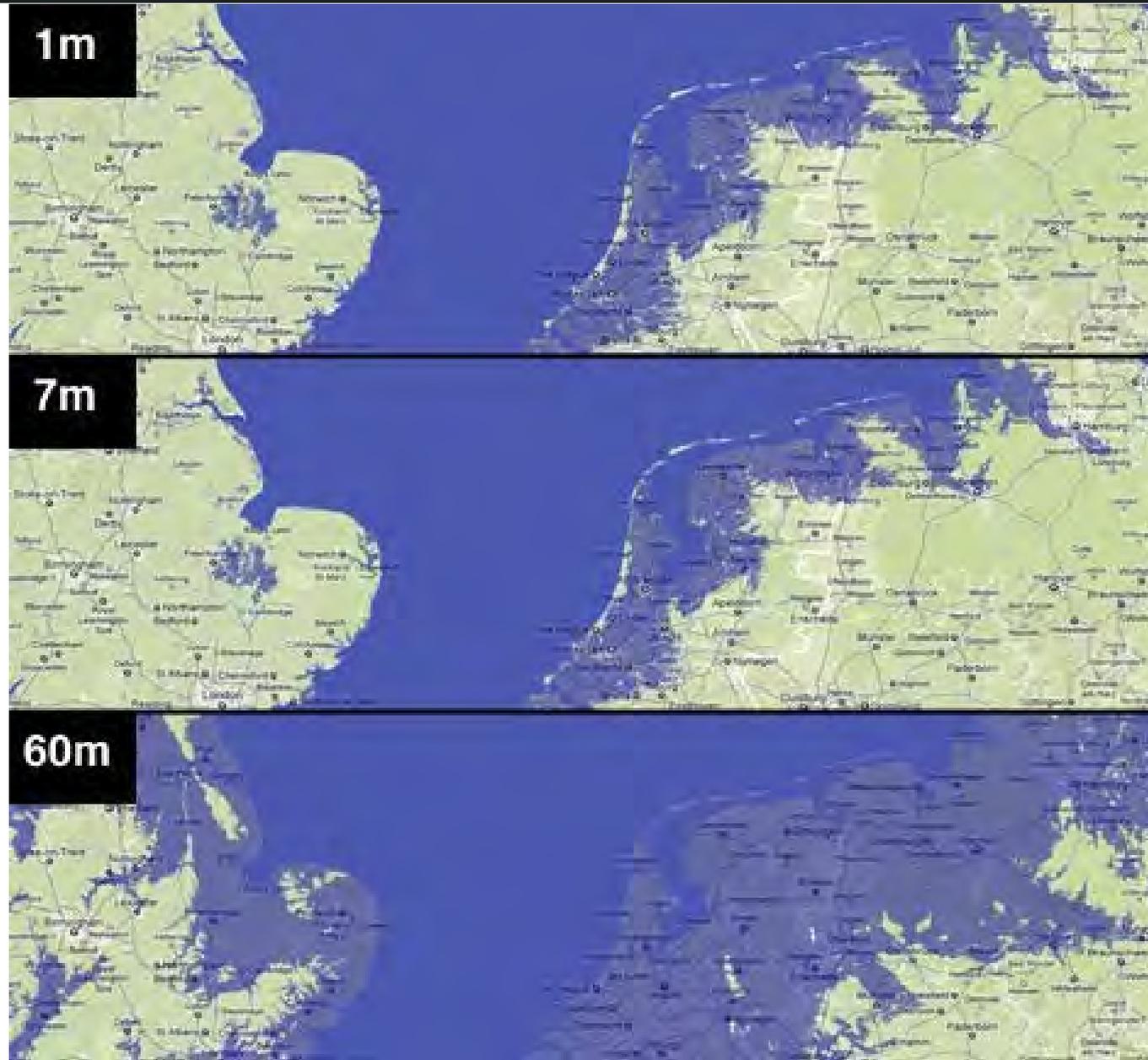
Groundwater pumping sinking soil level by 7-14cm per year plus SLR: "... means that in 10-15 years large parts of Indonesia will be underwater." *Victor Coenen, Dutch construction company Witteveen+Bos*

(*



Dutch Courage In the Face of Climate Change

“In certain countries, people say ‘Let’s wait and see,’ but in our situation we think, ‘No, uncertainty is not an excuse for waiting.’ We try to enforce that in our decision making.” ~ Jos van Alphen, Dutch Delta Commissioner’s Office



Dutch Courage In the Face of Climate Change

Dutch govt set aside up to €1 bn a year up to 2100 for coastal reinforcement & ecological engineering. (*avoid/*retreat)



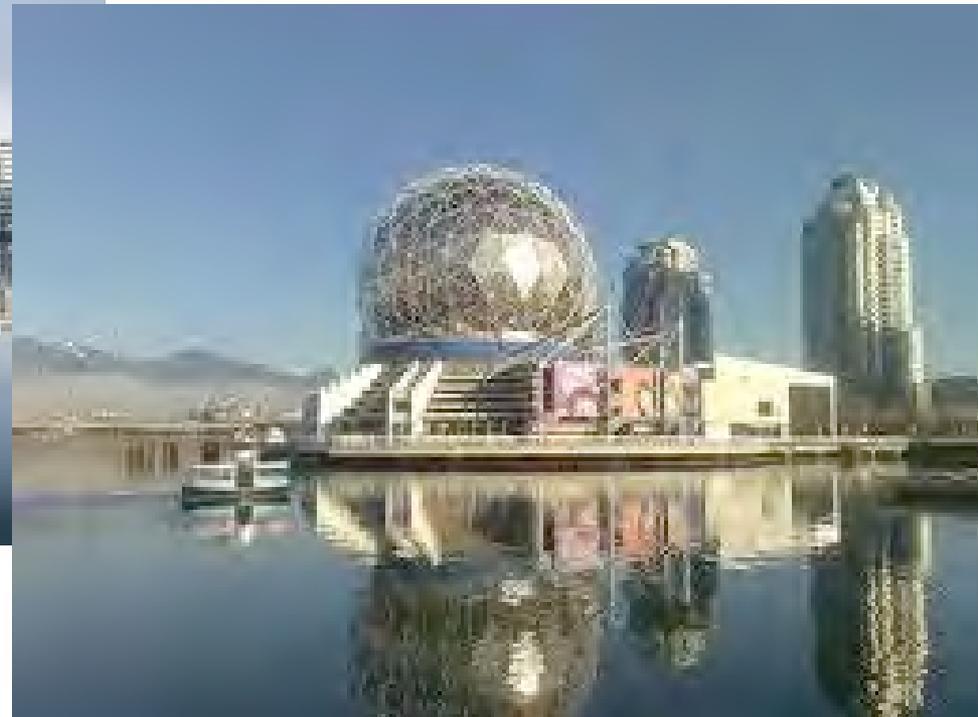
Miami Beach Sea Level Rise Action

Miami Beach has launched a \$400 million project to install 80 pump stations, plus roads on the island's low-lying western edge will be rebuilt higher. (*accommodate)



Vancouver Considers Infrastructure Responses

Former City of Vancouver Chief Engineer Peter Judd discussed flood-control gates (*protect), “sacrificial” first floors (*accommodate), and more for a 200-year future “where it's being conservatively estimated the ocean may rise at least two metres.” Much of Vancouver will need reinforcement.



North Vancouver: Harbourside Village

“Provincial SLR guidelines, taken together with projections of storm surge risks, local wind exposure, sea depth, and related wave effects, have been used to raise flood construction level targets that are significantly higher than the current minimum building elevations.” Golder Associates (*accommodate)



SLR Response Considerations

Wave run-up

King tides

Wind and spray

Storm surge

PLUS

Freeboard

Setbacks

Ecosystems

Adaptability

The Role of Ecosystems in Adaptation



Healthy ecosystems are a key component of climate change adaptation (“critical infrastructure”):

Absorb, store or release carbon (enormous amounts)

Clean the air

Absorb and recycle fresh water

Create shade for cooling

Home for species shifting ranges

Food security

Cheaper to install, operate, maintain and replace

PLUS increase property values/quality of life/health

Valuing Ecosystems



David Suzuki Foundation Nearshore Natural Capital Valuation report:

Wetlands and coastal areas = \$30-\$60 billion in benefits every year.

- Natural carbon sink
- Natural protection against storms worsened by climate change/SLR.
- Habitat for declining salmon stocks.

Gibson's example...

Canadian Blue-Green Infrastructure Examples



Jericho Beach,
Vancouver
(award-winning
Greenshores
project)
(*avoid/
*accommodate)

“It will be too much to try to fight head on, with hard defences to protect all the settled coasts. Ecological approaches are more about adapting to what's happening, rather than fighting it.” ~ William Mitsch, Ohio State University



Corktown Common, Toronto

Delta BC SLR Visualizations: CALP, UBC



Adaptation: Local Benefits



Benefits:

- Less stress
- Safer
- Cheaper in the long run
- Lower insurance
- Amenity benefits
- Robust property values

Adaptation: Local Benefits



Incentives:

- Increased attractiveness for investors/homeowners in resilient cities as concern over SLR and flooding/heat grows.
- Opportunity to stand out with innovative ecosystem-based infrastructure responses.

Adaptation: Local Benefits



Need to:

- Collaborate and think regionally, e.g., on coastlines/watersheds/forests.
- Work together to develop solutions.

ACT

Adaptation
to Climate
Change Team

For more information about ACT, our policy reports, and adaptation resources, please go to:

www.sfu.ca/act

ACT thanks past and present partners:

Wilburforce Foundation, Bullitt Foundation, Zurich Canada, BC Ministry of Environment, AMEC Engineering, BC Hydro, Plutonic Power, NRCan, and the Real Estate Foundation of BC.

Development of a Surrey Coastal Flood Protection Strategy



May 24, 2016

Matt Osler, Project Engineer

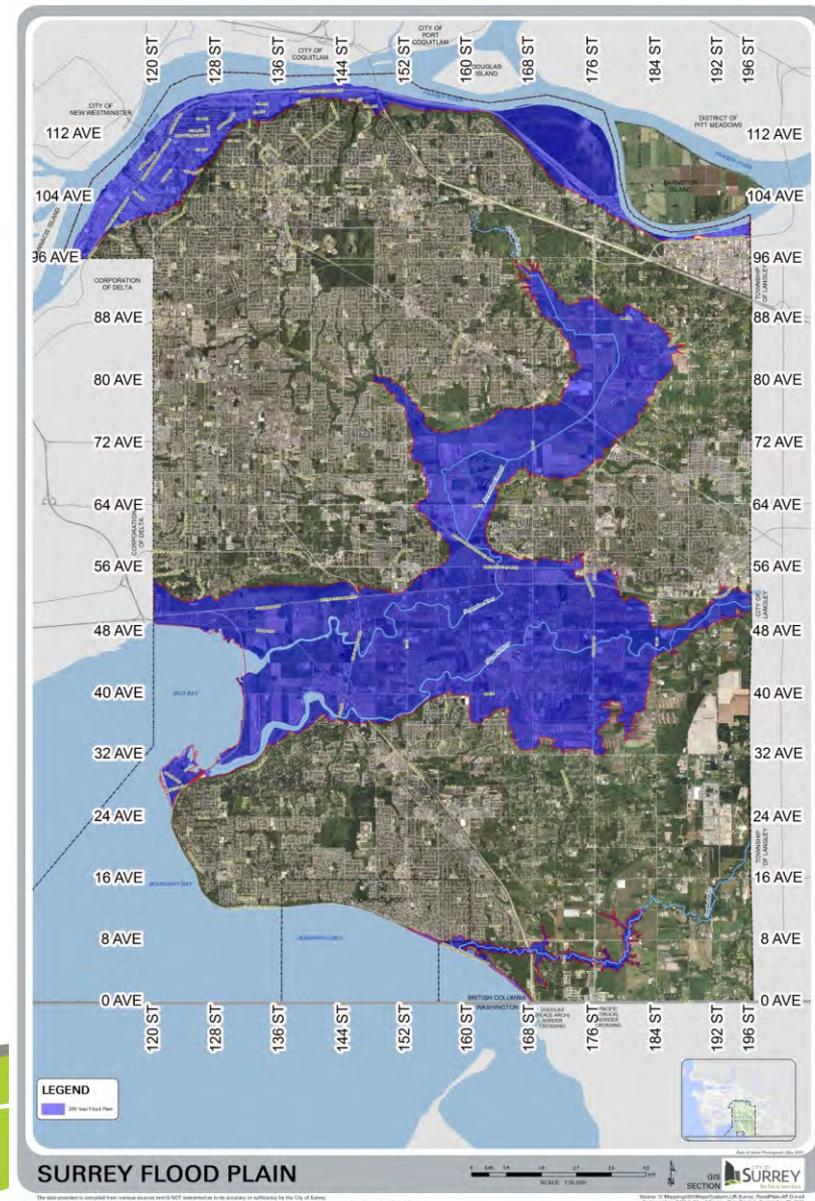
Project Intent

To prepare the City for:

- a changing climate;
- new provincial policies and guidelines
- the protection of Surrey residents and businesses.

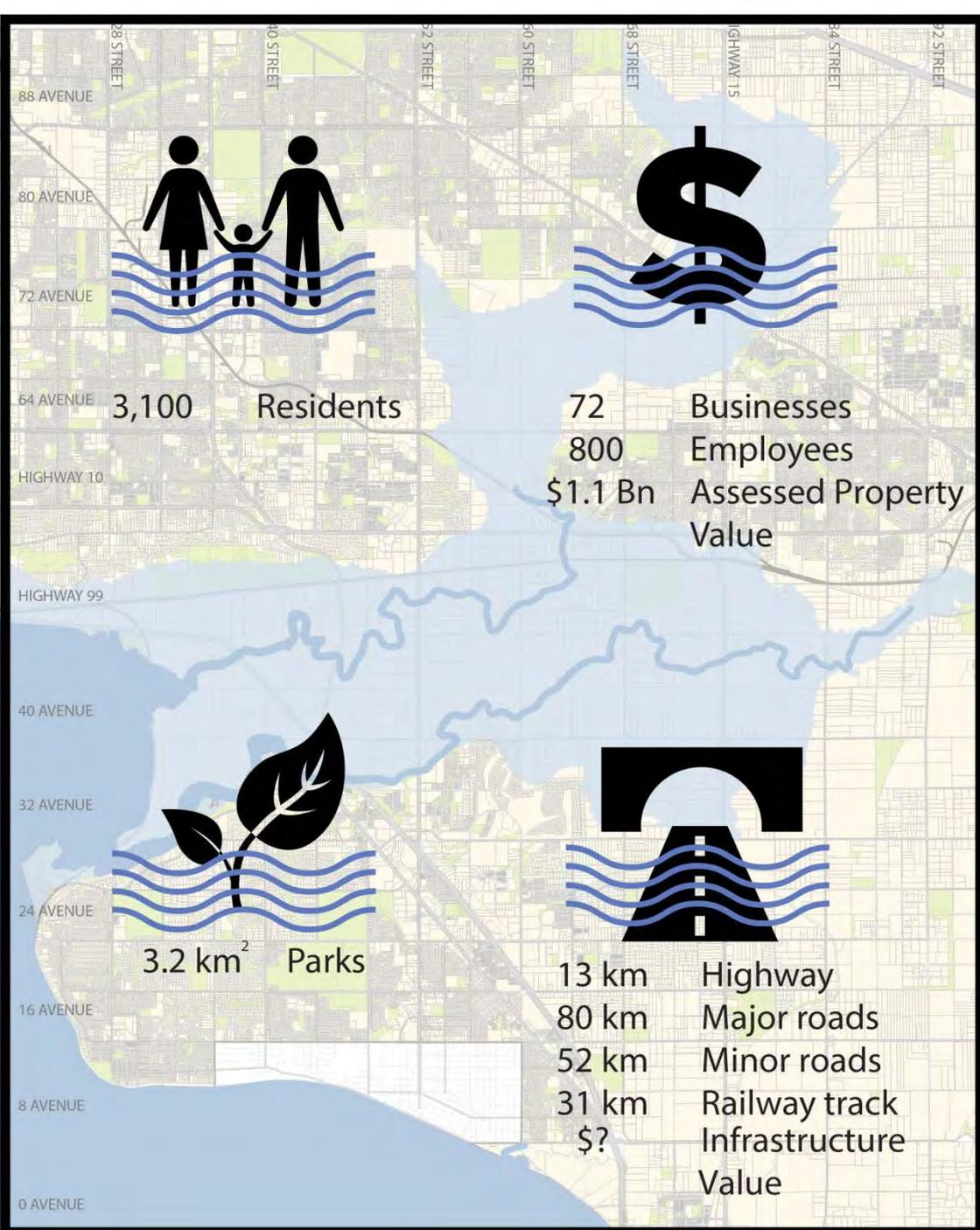
A Surrey coastal strategy will influence the direction of the Regional Flood Strategy (Squamish to Hope) and position the City for external funding.

- Surrey Staff actively involved in regional study



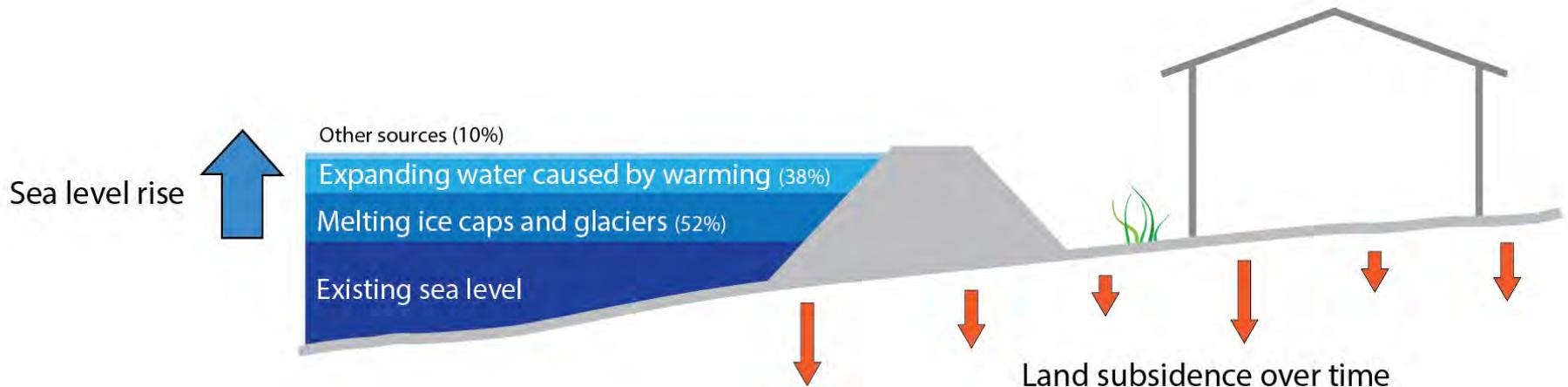
Coastal Flood Protection Strategy

3 year public and stakeholder engagement to determine how best address sea level rise.

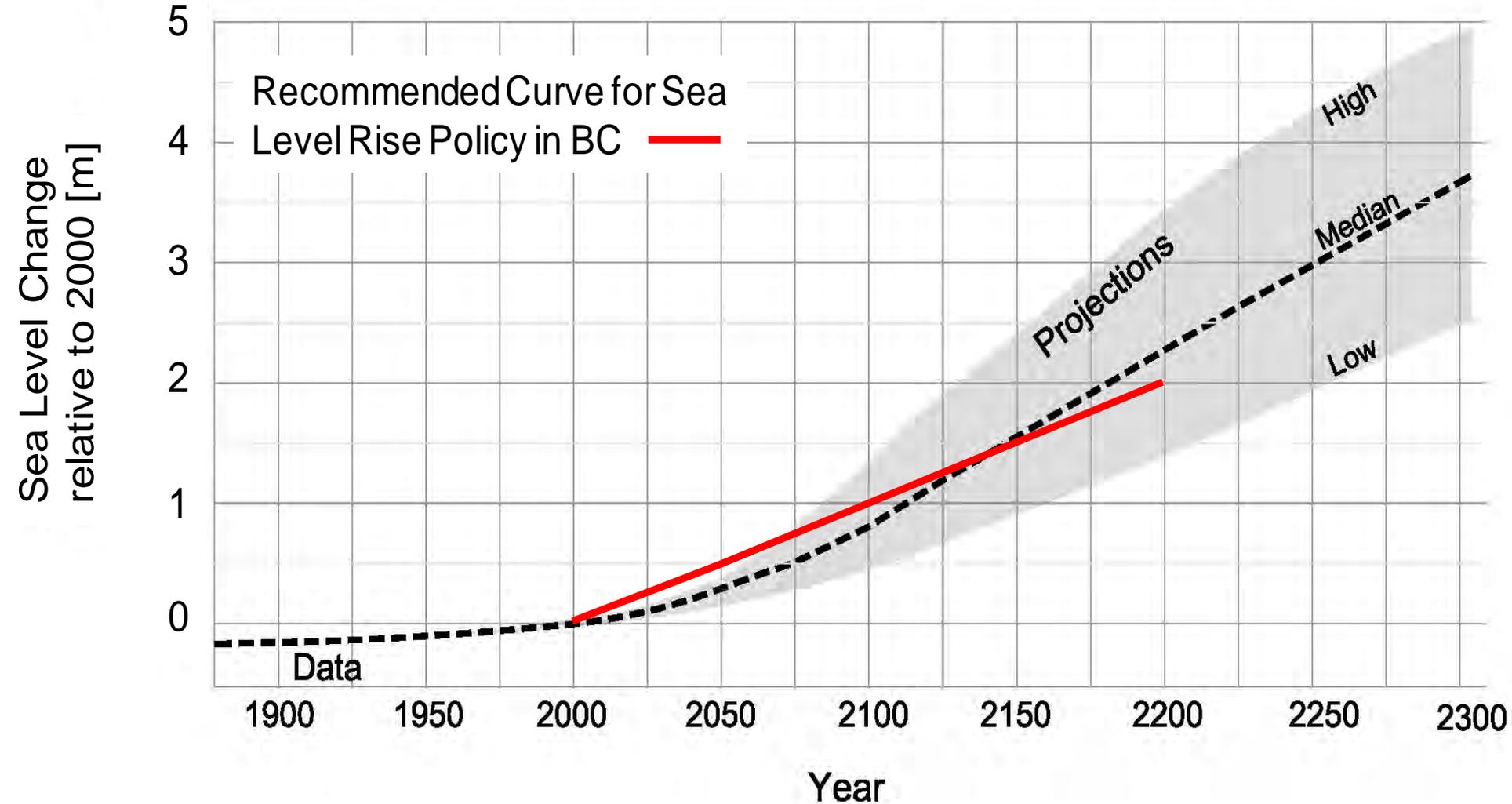


Projected Sea Level Rise

- Reports predict sea level changes for BC
- Flood frequency will increase
- Land Subsidence
- Projections to 2100 & 2200



Provincial Recommended Sea Level Rise Curve (2011)

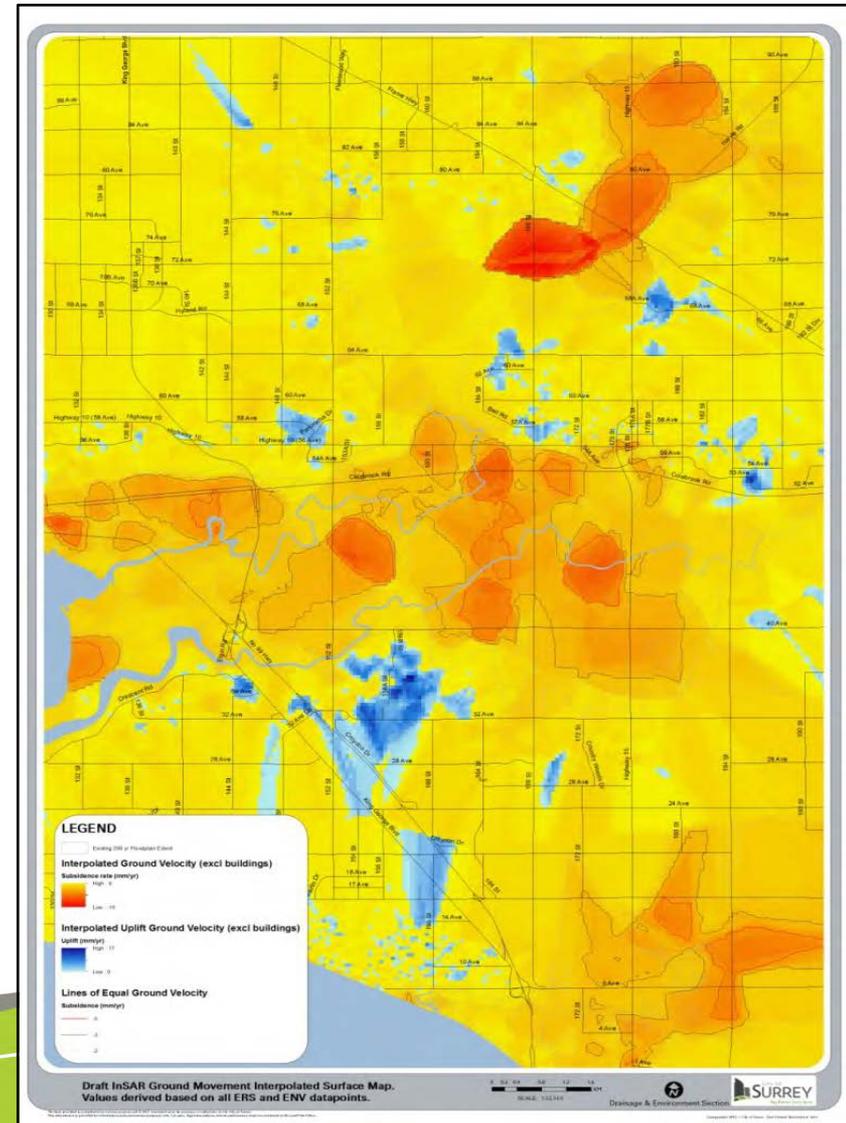


More Than Sea Level Rise

Subsidence Levels

Effects of sea level rise will be magnified through:

- Land subsidence
- Increased wave height
- Increased storm surge
- Increased precipitation



City of Surrey Actions

Priority Actions:

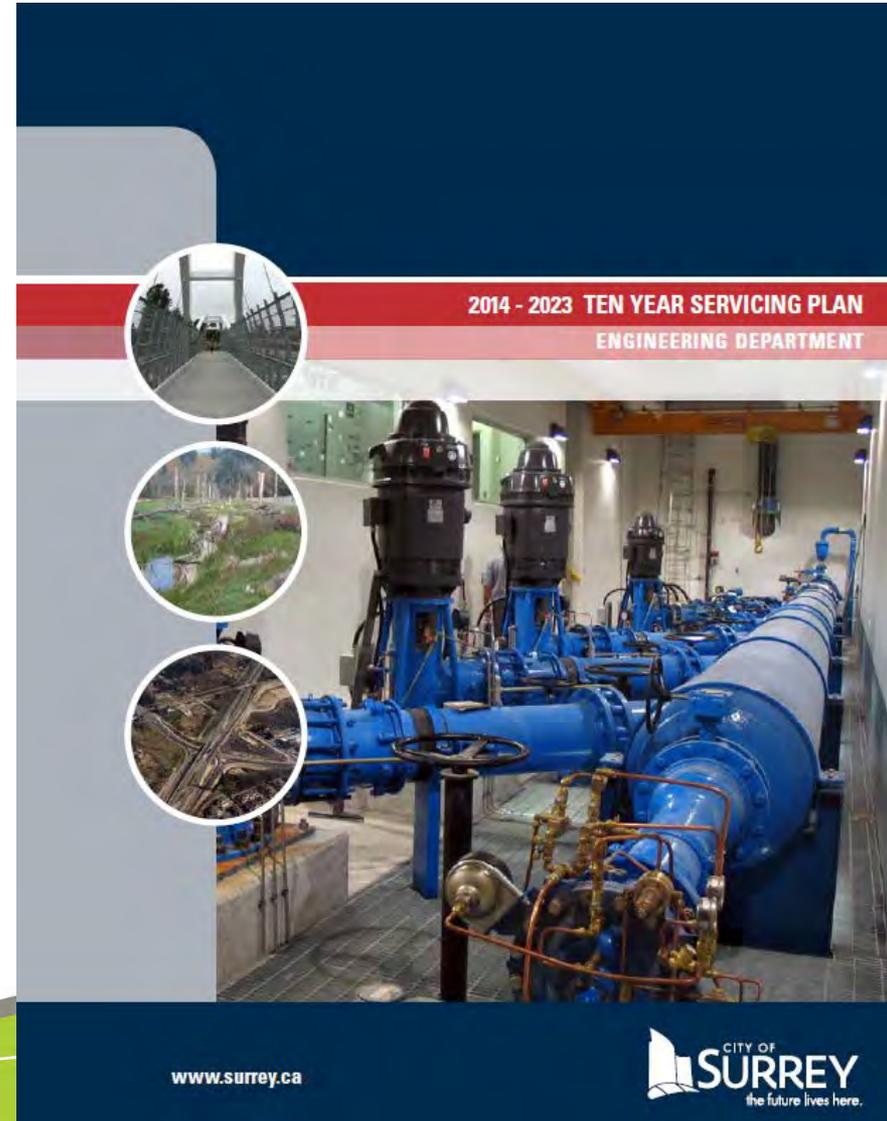
“Conduct detailed analysis on Surrey-specific climate impacts, including timelines and extent of sea level rise and its related effects on flood construction levels and floodplain designations”



Adopted Nov. 2013

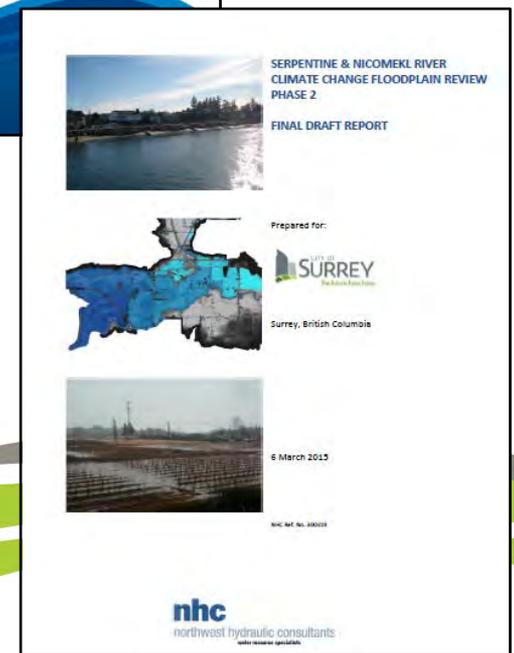
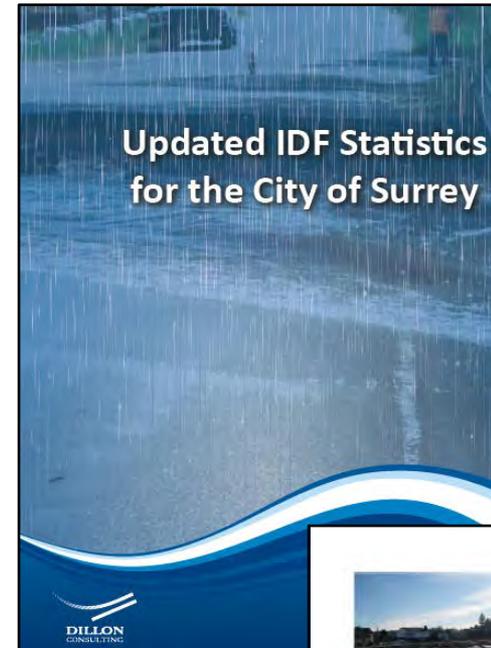
City of Surrey Actions

The 2014 - 10 Year Servicing Plan included a new component in the Drainage Utility for Climate Change investigations & strategy development.



City of Surrey Actions

- Serpentine, Nicomekl & Little Campbell Rivers Climate Change Floodplain Review – Phases 1 & 2
- Preliminary subsidence investigation
- Rainfall trending study and updated IDF curves
- Downscaling climate model to determine impacts to precipitation patterns
- Geotechnical suitability study



Serpentine, Nicomekl & Campbell Rivers Climate Change Floodplain Review - Phases 1 & 2



Serpentine, Nicomekl & Campbell Rivers Climate Change Floodplain Review - Phases 1 & 2

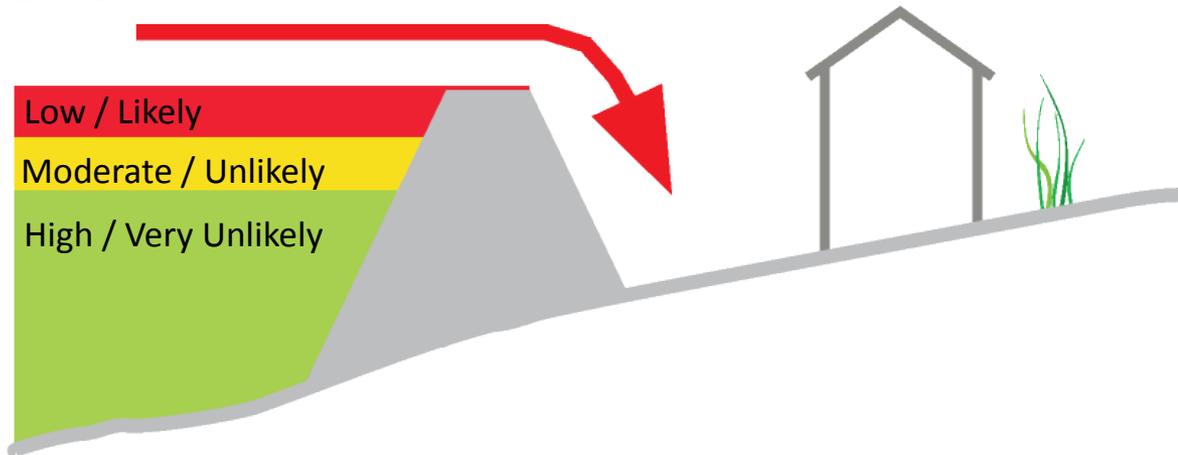
Study Results:

- All coastal dykes will be too low.
- Many sections of dykes along the Serpentine & Nicomekl Rivers will be too low.
- By 2100, of 24 bridges on the rivers, 5 will be completely submerged & 10 will be partially submerged – none have been designed for these scenarios.



Serpentine, Nicomekl & Campbell Rivers Climate Change Floodplain Review - Phases 1 & 2

Dyke Integrity / Likelihood of Breach under extreme water levels



Infrastructure Impact from 200 yr. return Water Level

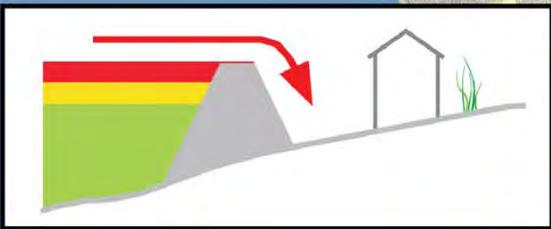
Sea Dams: Dry Compromised Wet
 Bridges: Dry Compromised Wet



2015



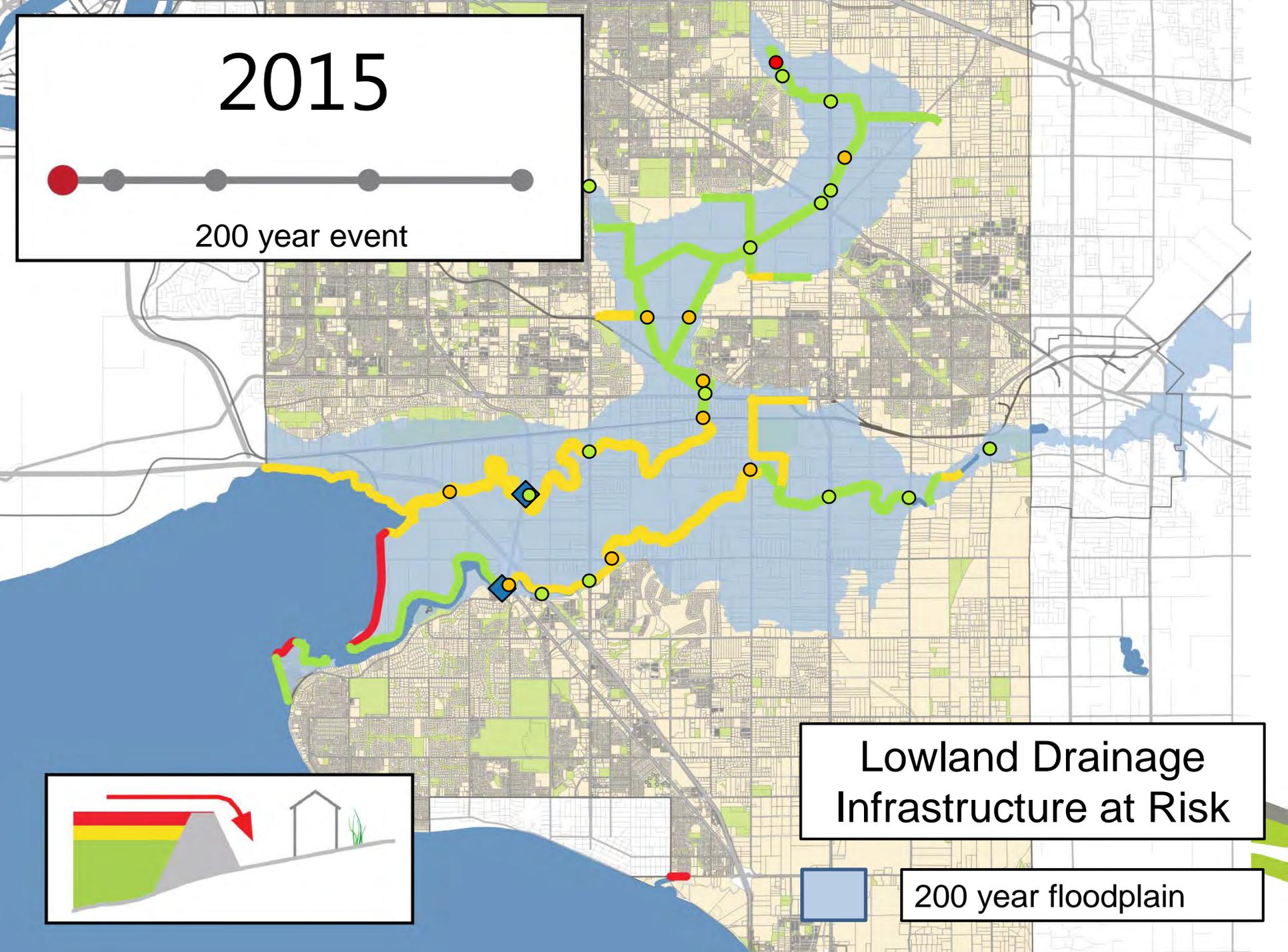
200 year event



Lowland Drainage Infrastructure at Risk



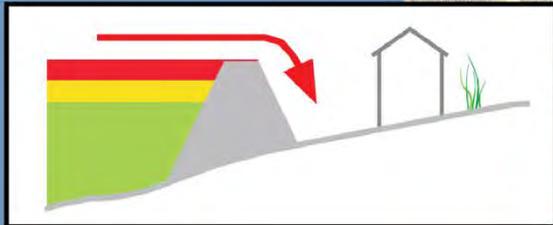
200 year floodplain



2020



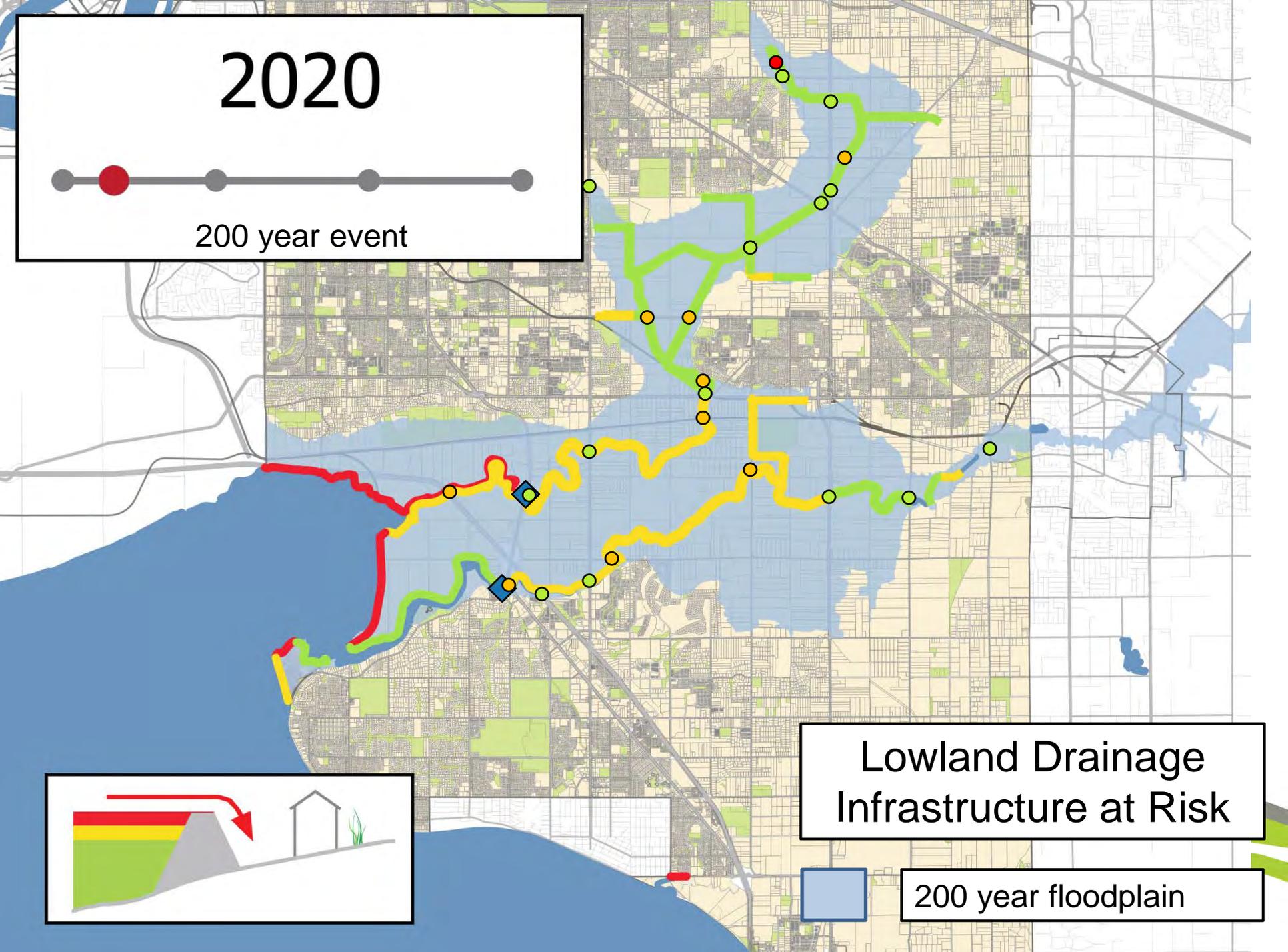
200 year event



Lowland Drainage
Infrastructure at Risk



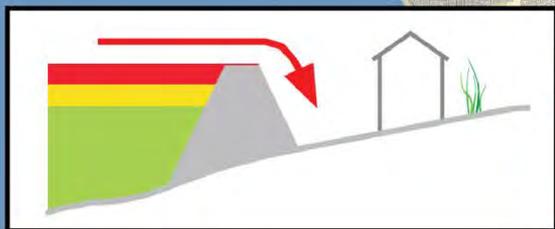
200 year floodplain



2040



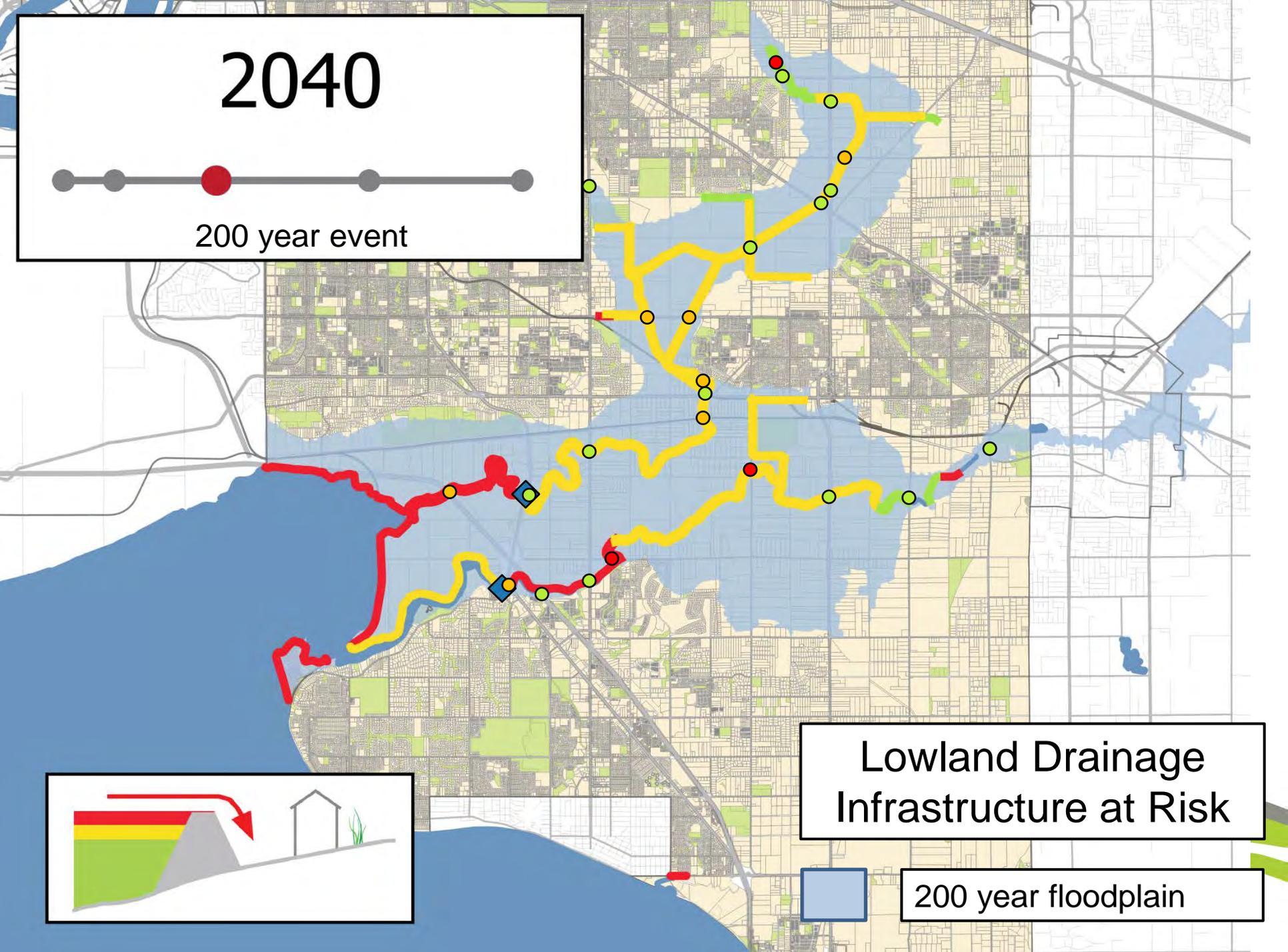
200 year event



Lowland Drainage Infrastructure at Risk



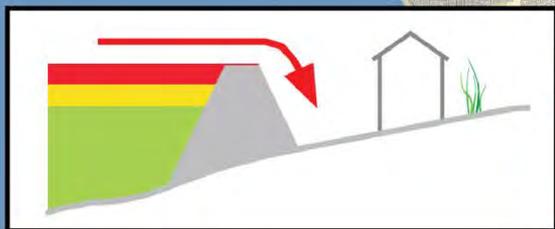
200 year floodplain



2070



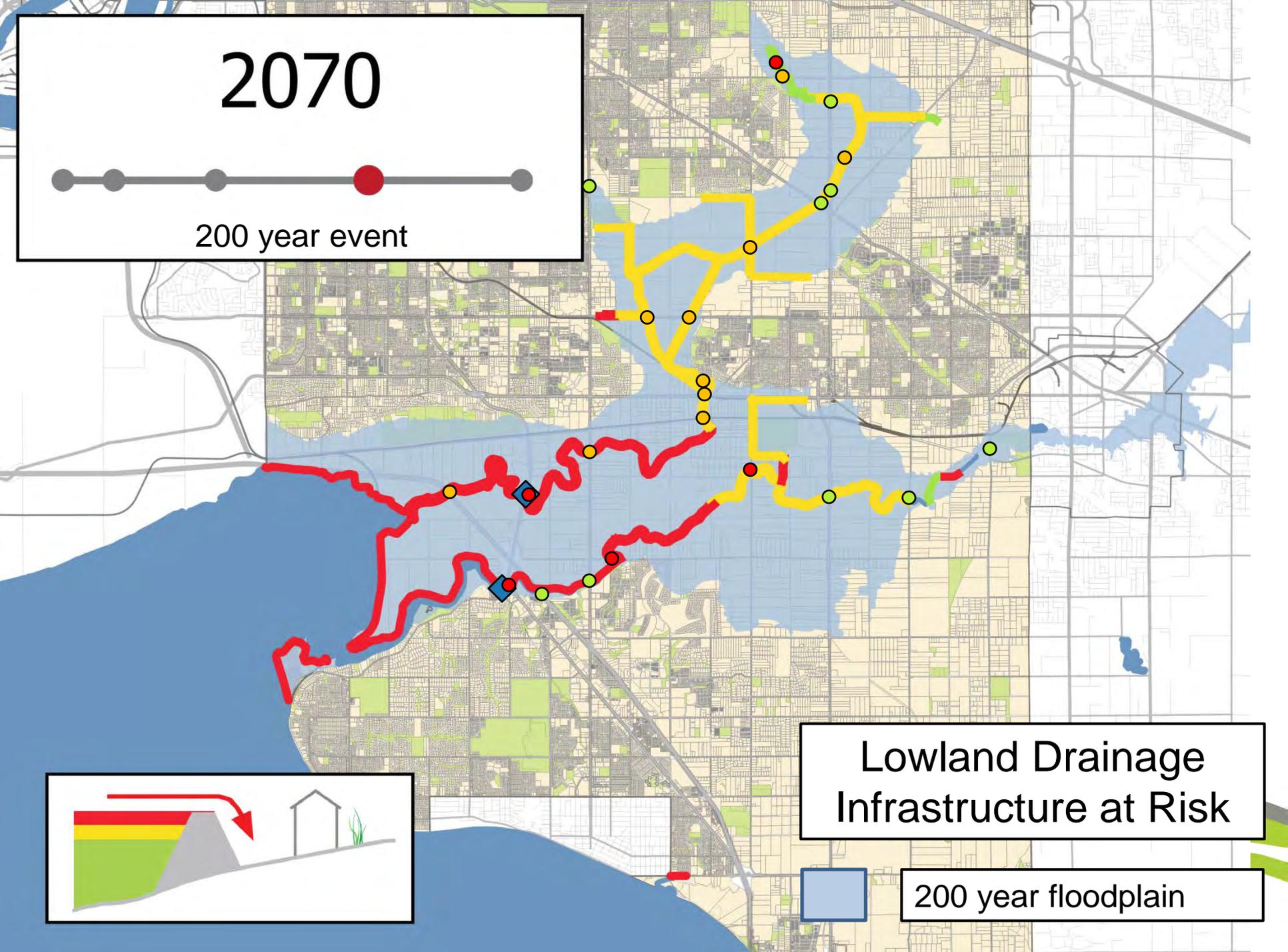
200 year event



Lowland Drainage
Infrastructure at Risk



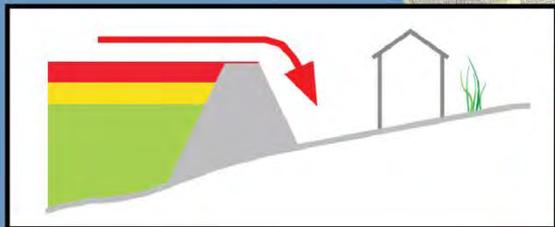
200 year floodplain



2100

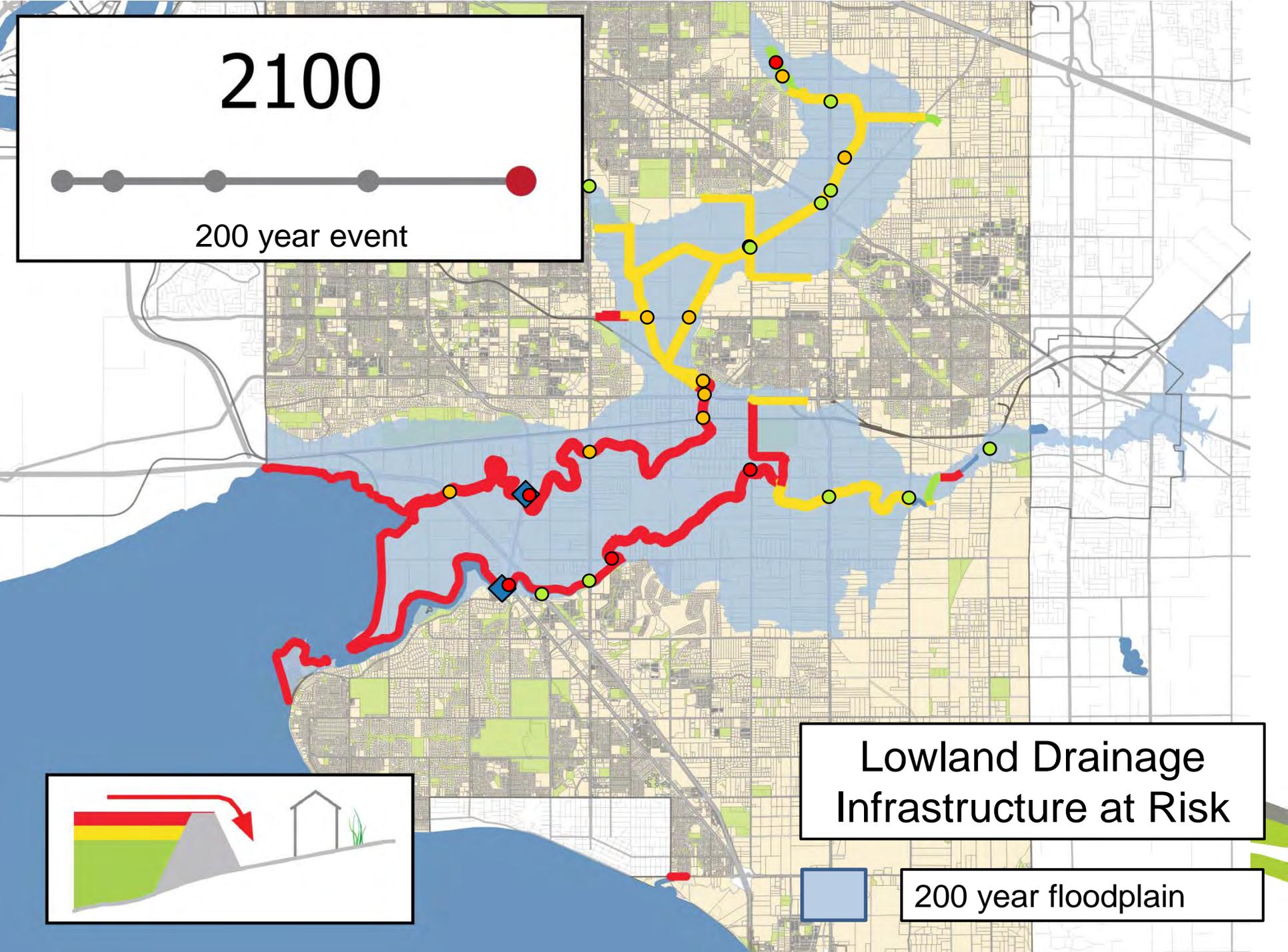


200 year event



Lowland Drainage
Infrastructure at Risk

200 year floodplain

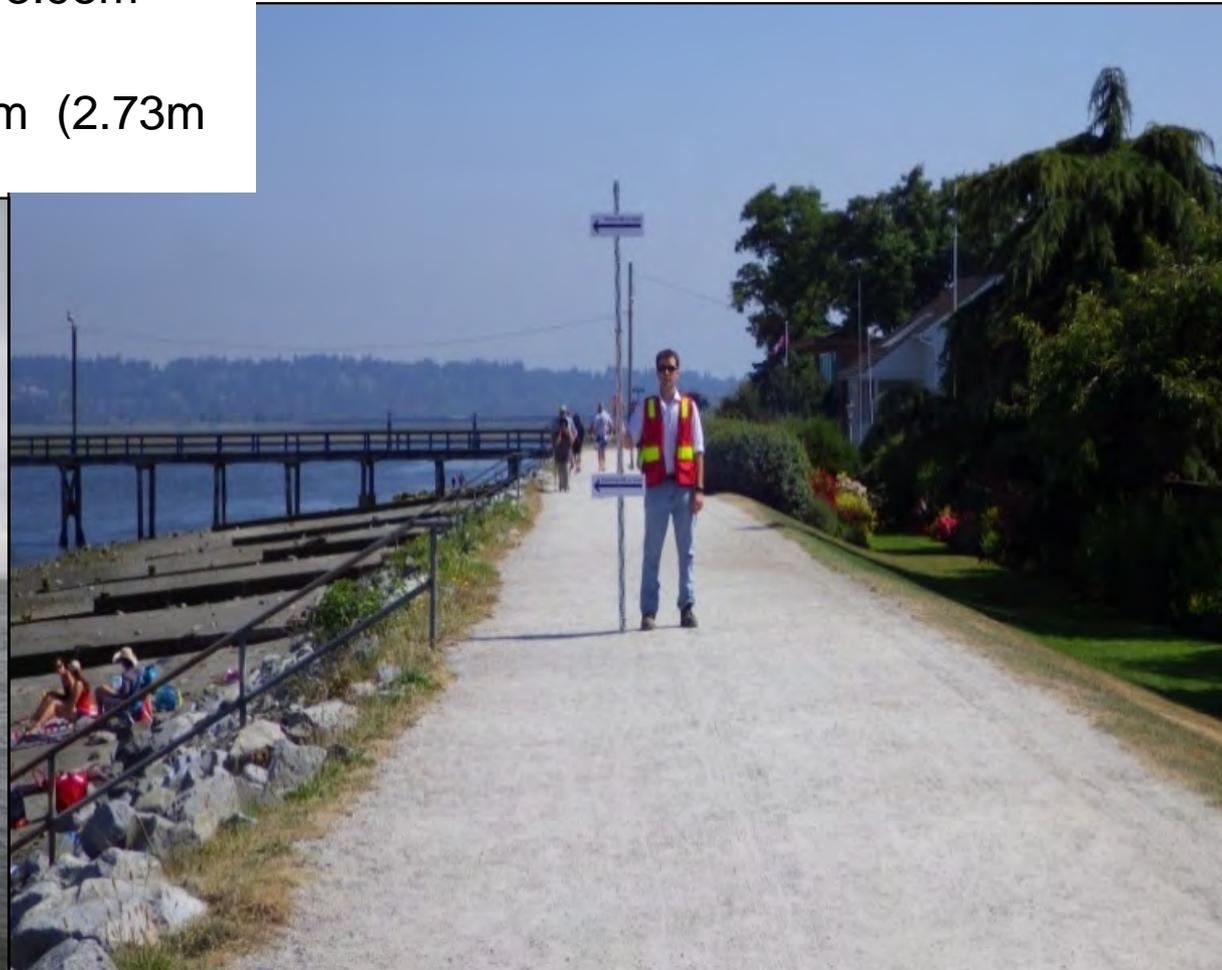


Sea Level Rise Impacts

2015 to 2100 results – Crescent Beach

Semi-exposed area to Bay

- Existing elevation = 2.90m
- New 2015 target elevation = 3.95m (1.05m increase)
- 2100 target elevation = 5.63m (2.73m increase)



Sea Level Rise Impacts

2015 to 2100 results – Colebrook West

Exposed area of the Serpentine River

- Existing elevation = 3.15m
- New 2015 target elevation = 3.87m (0.72m increase)
- 2100 target elevation = 6.76m (3.61m increase)

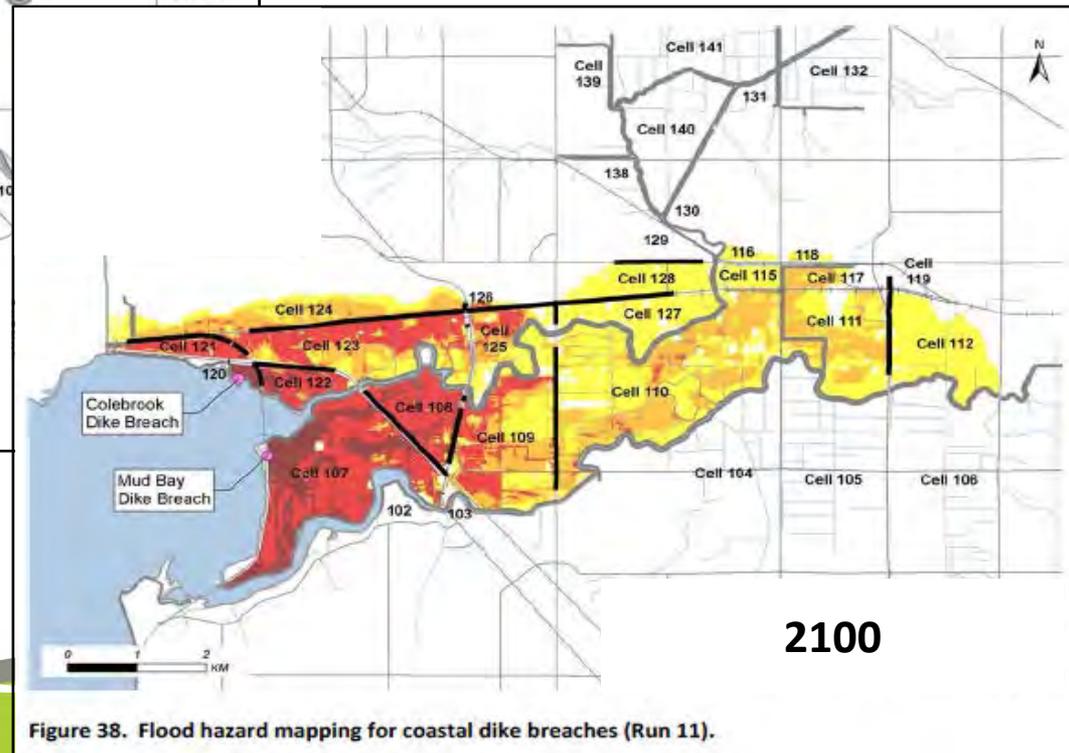
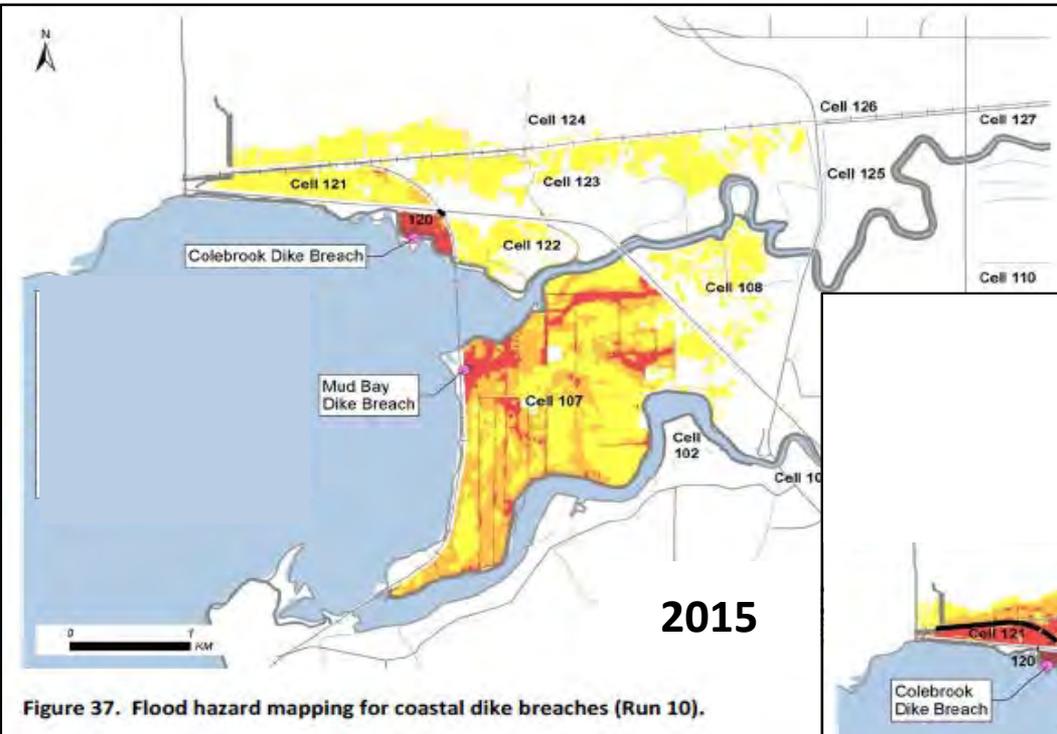


Sea Level Rise Impacts

Colebrook / Mud Bay Example

(Dyke Breach Hazard 200 Year Event)

-  Significant flood hazard
-  Extreme flood hazard
-  Road &/or rail flooded



Regional Flood Strategy Fraser Basin Council

The Joint Program Committee of the Fraser Basin Council is looking at developing a regional approach to flood management.

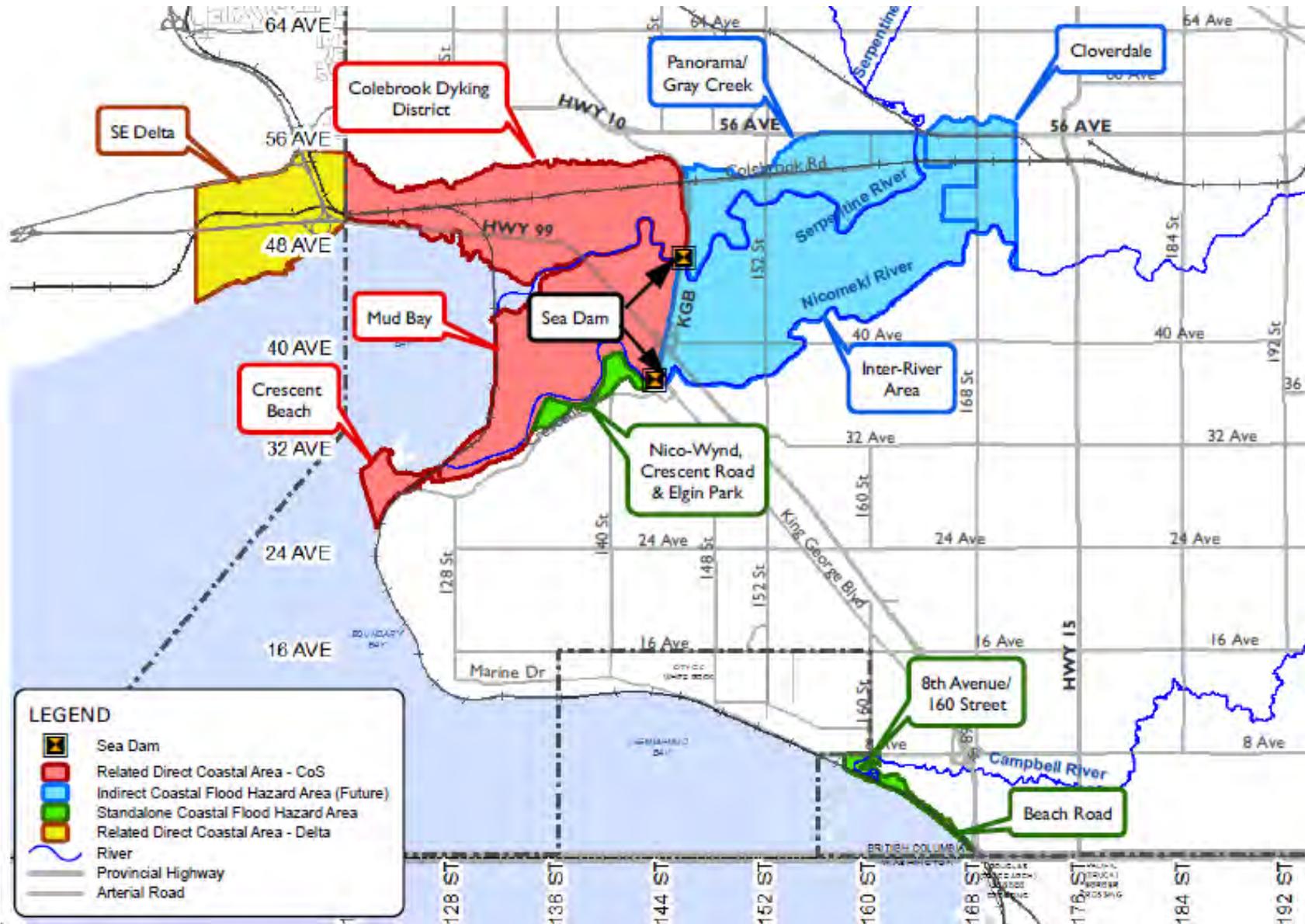
Phase 1 has begun to investigate the risk, vulnerabilities and consequences of a large flood event including effects of sea level rise.

- Results to be released shortly

Phase 2 will entail the development of a regional strategy and potential funding.



Locations



Recent Issues

Nico-Wynd\Elgin Park



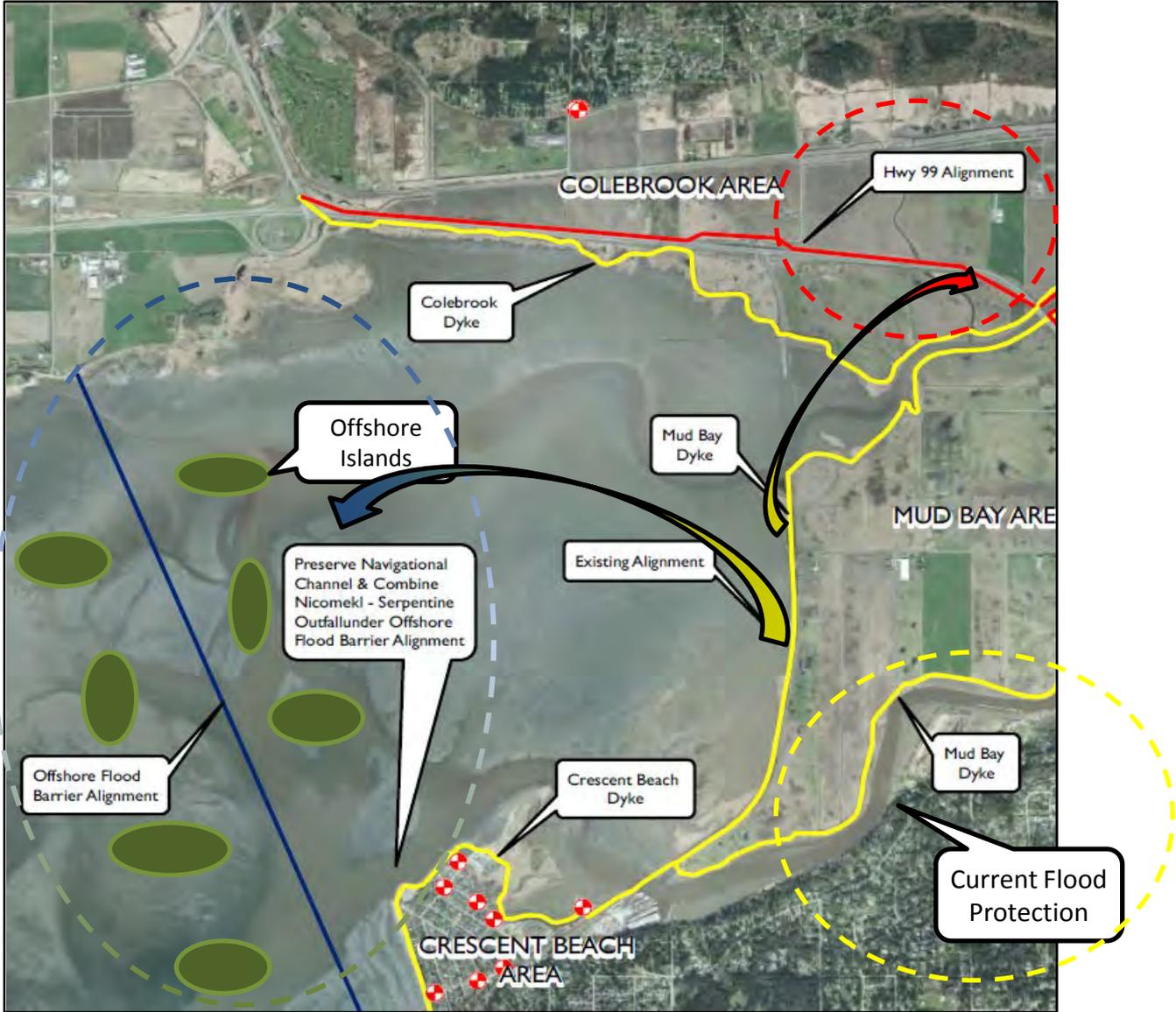
Colebrook Dyke



Adaptation Pathways



Crescent Beach Context



Development of a Coastal Strategy Timeline

2016

- Establish intradepartmental steering committee to assist in the development of potential mitigation strategies.
- Initiate development of preferred pathway strategies for coastal areas to mitigate flood hazard
- Initiate preferred pathway evaluation criteria
- Update Council on consultation process by years end
- Revisit Flood Protection Elevation Requirements for Hazard Area Development Permits (Crescent Beach & South Westminster)

Other City Planning Activities in Crescent Beach

City of Surrey's Planning Department and Transportation Department will be consulting with the community in a separate process on the following issues:

- Updating the Crescent Beach Land Use Plan
- Access and traffic management

Development of a Coastal Strategy Timeline

2017

- Evaluate draft flood mitigation approaches
- Identify potential funding partners
- Link with Regional Flood strategy

2018

- Present preferred Coastal Strategy for Council's consideration.
- Secure funding partners for Coastal Strategy.



Next Steps in Coastal Strategy

- Consulting team is being selected
- Public participation will resume in Fall
- More opportunities will be available to participate through meetings and open houses



Questions



Matt Osler, Project Engineer

MFOsler@surrey.ca

604-591-4657