Fraser Basin Council

Flood Mitigation Planning in BC's Lower Mainland

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Institute for Catastrophic Loss Reduction | April 20, 2018

Lower Mainland Flood Management Strategy

Presentation Outline:

1. Intro to Fraser Basin and Fraser Basin Council
2. Context – the region & regional flood hazards
3. Regional Flood Strategy – Who, What, Where, When, Why and How?
4. Phase 1 Results
5. Phase 2 – Key Components & Activities
6. The Environment and Climate Change
7. Recap and Outstanding Issues

1. Introduction to the Fraser River and Fraser Basin Council

Fraser Basin Council

- Fraser River flows ~1400 km from Mt Robson to Vancouver
- Area is about 220,000 km^2
- Nongovernmental organization with a mandate to advance sustainability
- 38-member Board of Directors comprised of the four orders of government, private sector and civil society interests
- Impartial role as convener of inclusive and constructive dialogue
- Role to assist in resolution of complex, inter-jurisdictional sustainability issues (e.g. flood hazard management)
- Three priority areas:
  1. Climate Change and Air Quality
  2. Healthy Watersheds and Water Resources
  3. Sustainable Communities and Regions

2. Context

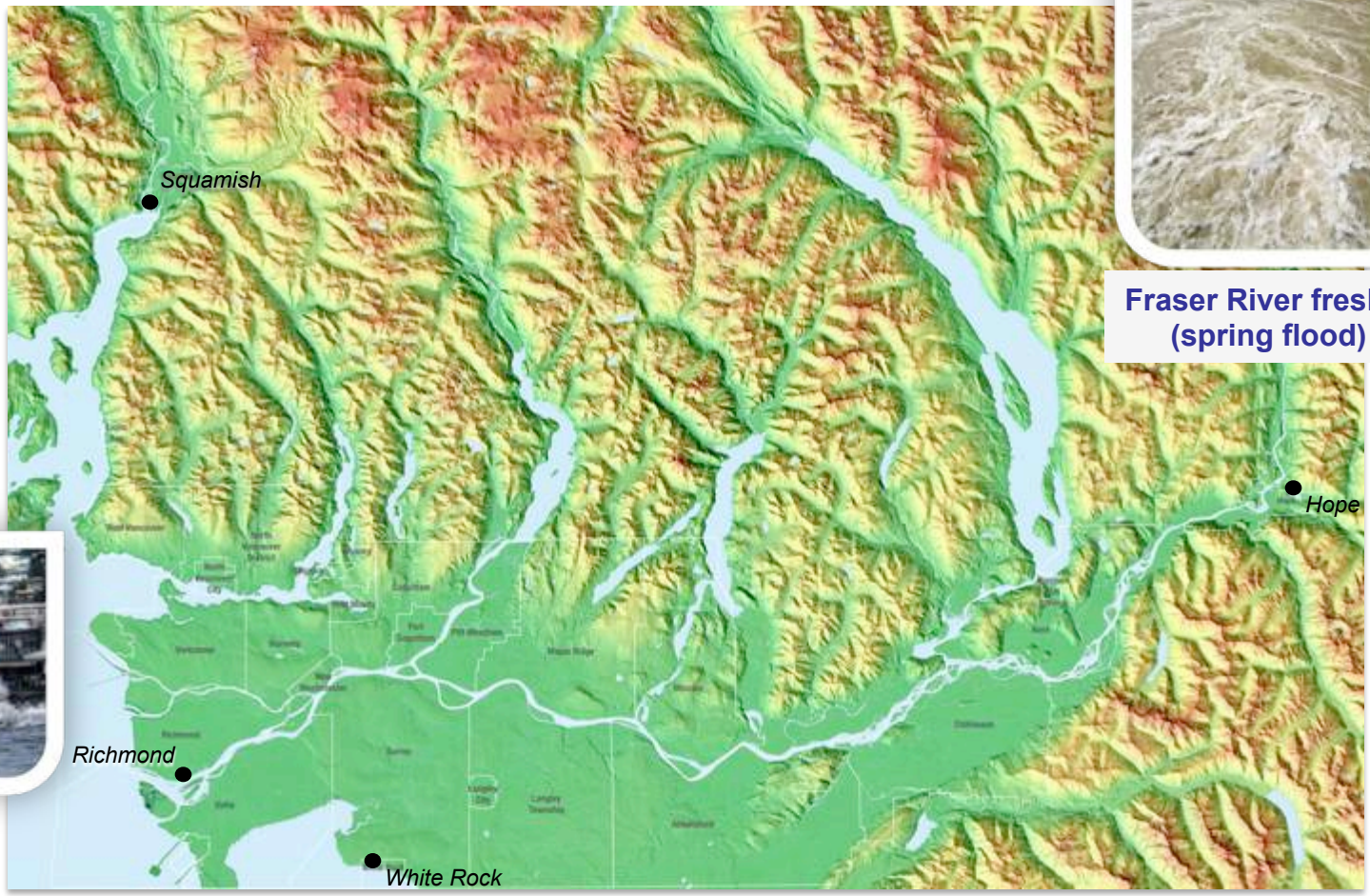
Recent History

Lead-up to the regional strategy – a chronology:

- Joint Program Committee established in 1998
- Numerous technical projects, practitioners' network, forum for dialogue & exchange
- 2006 Lower Fraser Hydraulic Model and new design flood profile
- 2007 freshet
- SLR studies and 2012 Cost of Adaptation report
- 2013 consultation and business plan
- 2013 Alberta and Ontario floods
- Several coastal flood events in BC
- Support and funding for a regional strategy

BC's Lower Mainland

Fraser River freshet (spring flood)



Coastal storm surge (winter flood)

Lower Mainland Flood Hazards

- **Fraser River flood (spring)**
  - Large snowpack (esp. Upper Fraser and Nechako regions)
  - Rapid snowmelt (sustained warm period)
  - Rain during the freshet
- **Coastal flood (winter)**
  - Storm surge due to low pressure system
  - High winds increasing waves
  - Coinciding with high tides
- **Climate change**
  - Likely to increase magnitude and frequency of the above

Flood Hazards and Climate Change in the Lower Mainland

Climate change anticipated to significantly change flood risk:

- Sea level is projected to rise on average by 0.5 m by 2050, by one metre by 2100, two metres by 2200 . . .
- Increased intensity and frequency of storm surges
- Hydrological changes in the Fraser River Basin related to snowpack, rate of snowmelt and incidence of rainfall
- Larger and more frequent Fraser floods are projected for the Fraser for the year 2100
- Extreme rainfall events / atmospheric rivers?

3. Lower Mainland Flood Management Strategy – Who, What, Where, When, Why & How?

Lower Mainland Flood Management Strategy – Why & Where?

Aims to reduce flood vulnerability from:

- Fraser River freshet (spring flood)
- Coastal storm surge (winter flood
- Including consideration of climate change

and increase resilience for communities along the Lower Fraser River and south coast:

- Hope to Richmond
- Squamish to White Rock

Lower Mainland Flood Management Strategy – Who?

- **Fraser Basin Council**
  - Facilitator, coordinator, administrator
- **Partners – all orders of government, the private sector and civil society (50+)**
  - Funding, data, advice and expertise
  - Other key work in parallel

Who is collaborating?

Government of Canada

Province of BC

- Min. of Public Safety & Solicitor General (Emergency Management BC)
- Min. of Forests, Lands, Natural Resources & Rural Development
- Min. of Transportation and Infrastructure
- Min. of Environment and Climate Change Strategy

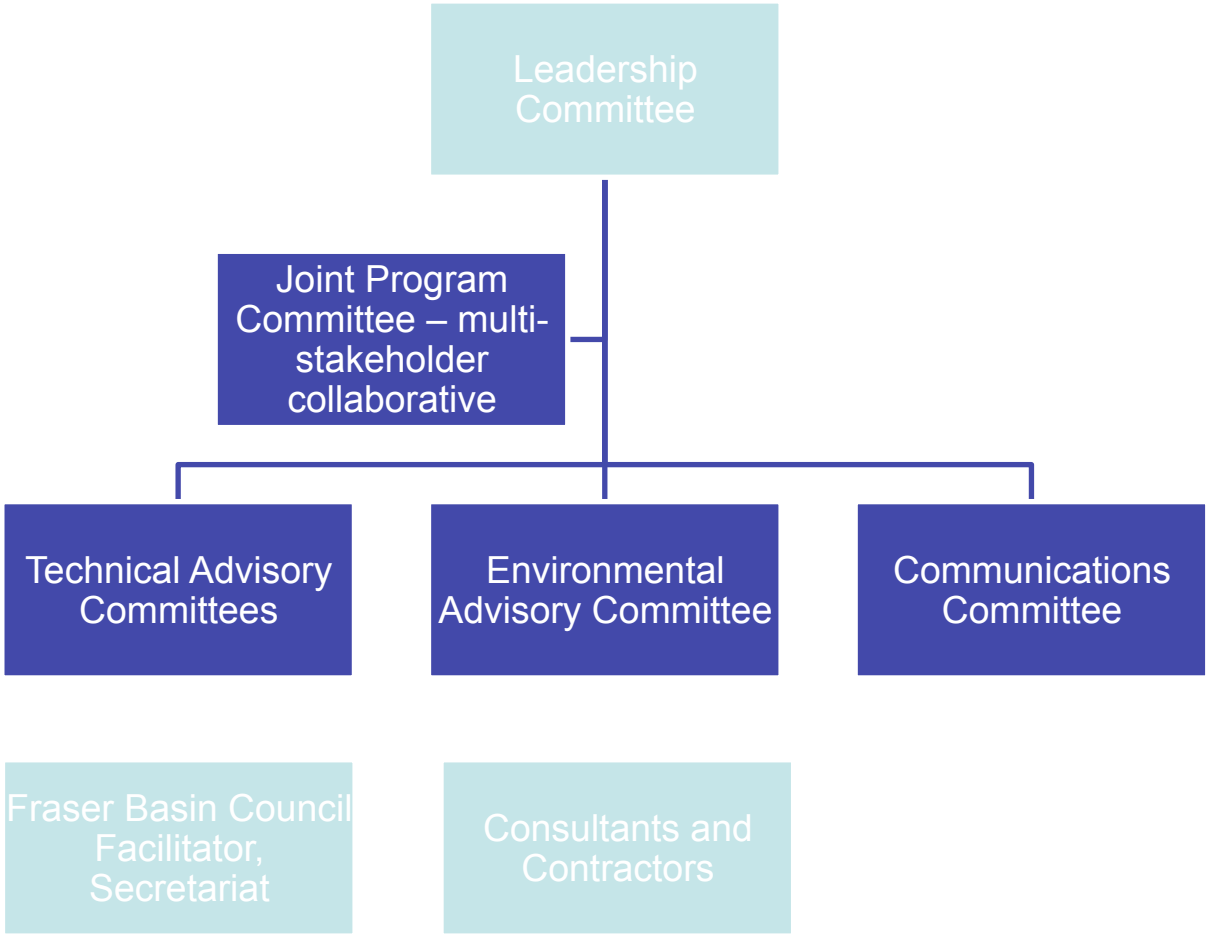
Other Regional Interests

- Greater Vancouver Gateway Council
- BC Wharf Operators Association
- Canadian National Railway
- Canadian Pacific Railway
- Insurance Bureau of Canada
- Pacific Institute of Climate Solutions
- Port of Vancouver
- Simon Fraser University (ACT)
- TransLink
- Trans Mountain
- Vancouver International Airport Authority
- Fraser Health
- BC Agriculture Council
- UBC

Who is collaborating?

- City of Abbotsford
- Village of Belcarra
- City of Burnaby
- Bowen Island Municipality
- City of Chilliwack
- City of Coquitlam
- Corporation of Delta
- Fraser Valley Regional District
- District of Hope
- District of Kent
- Township of Langley
- Village of Lions Bay
- District of Maple Ridge
- District of Mission
- City of New Westminster
- City of North Vancouver
- District of North Vancouver
- City of Pitt Meadows
- City of Port Coquitlam
- City of Port Moody
- City of Richmond
- District of Squamish
- City of Surrey
- City of Vancouver
- Metro Vancouver
- District of West Vancouver
- City of White Rock

Process and Committee Structure – How?



Why a Regional, Collaborative Approach?

- Regional consensus = compelling case for action
- Enhanced communications and consensus building
- Sharing information and lessons learned among peers
- Implementing projects of regional benefit
- Recognizing regional inter-dependencies
- Strategically filling knowledge gaps
- Leveraging a cost-shared approach

Lower Mainland Flood Management Strategy – When?

Phased approach:

- Consultation and Business Plan (2013)
- Improving Knowledge Base
  - Phase 1 (2014-2016)
- Building the Strategy
  - Phase 2 (2017 – 2019)
- Implementation
  - Phase 3 (2020 and beyond)

Phase 1 of the Strategy (2014-2016) – What?

Building a better understanding:

- Flood hazards
- Flood vulnerabilities
- Flood protection infrastructure, policies and practices

Phase 2 of the Strategy (2016-2019) – What?

Developing a regional action plan:

- National, provincial, regional, local priorities
- Recommended management options for diverse local circumstances
- Recommendations for secure, sustainable funding
- Through technical analysis in parallel with engagement, dialogue, consultation, and consensus building

➢ **Phase 3 – Implementation**

4. Phase 1 Results

Phase 1 Results – Analysis of Flood Scenarios (approx. 1:500 or 0.2% AEP)

- **Two Coastal Flood Scenarios (still water level)**
  - Scenario A – Present Day (3.4 m)
  - Scenario B – Year 2100 (4.4 m)

- **Two Fraser River Flood Scenarios**
  - Scenario C – Present Day (17,000 cms) – 1894 flood of record
  - Scenario D – Year 2100 (19,900 cms) – moderate CC effects


Lower Mainland Flood Management Strategy
Coastal Flood Scenarios Map
A Map Showing Estimated Flood Extents for:
Scenario A (Present Day)
Scenario B (Year 2100)
– Further Extent of Flooding
Existing Waterways
First Nations Reserves & Treaty Lands
Municipal Boundaries (white line)
Highways
Rail & Shipping Connections
For more detail, including some essential facilities located in floodplain areas, see regional and subregional maps in the report Regional Assessment of Flood Vulnerability.
These maps will also be posted separately at floodstrategy.ca.
Note on Map: All maps prepared for this project are for general illustrative purposes at a regional scale. They are not floodplain maps and do not have official designation of floodplains. For this reason, they should not be used for site-specific flood management planning. See the full vulnerability assessment report for more detailed maps and explanation on use.
Fraser Basin Council
Electoral Area A
West Vancouver
North Vancouver District
North Vancouver City
Belcarra
Anmore
Coquitlam
Port Moody
Port Coquitlam
Pitt Meadows
Burnaby
New Westminster
Richmond
Surrey
Delta
Langley City
White Rock


Lower Mainland Flood Management Strategy
Fraser River Flood Scenarios Map
A Map Showing Estimated Flood Extents for:
Scenario C (Present Day)
Scenario D (Year 2100)
– Further Extent of Flooding
Existing Waterways
First Nations Reserves & Treaty Lands
Municipal Boundaries (white line)
Highways
Rail & Shipping Connections
N
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Fraser Basin Council

Phase 1 Results – Regional Assessment of Flood Vulnerabilities

4 major flood scenarios assessed:

- 2 coastal & 2 Fraser River – Present Day & 2100

Flood-related direct losses & indirect economic losses related to:

- People and communities
- Residential, commercial and public/ institutional buildings
- Select infrastructure
- Cargo shipping delays and agriculture

Regional Assessment of Flood Vulnerabilities

Estimated people impacted

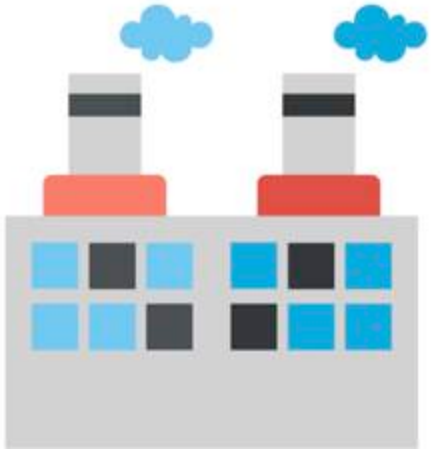
- Population displaced, shelter, emergency services, social hardship
- Municipalities (partially to totally inundated)
- First Nations communities and lands

	A	B	C	D
Total population seeking shelter	238,000	261,000	266,000	311,000
# of Municipalities	15	15	17	17
# of First Nations	4	5	22	23
# of Reserve / treaty lands	7	9	43	47

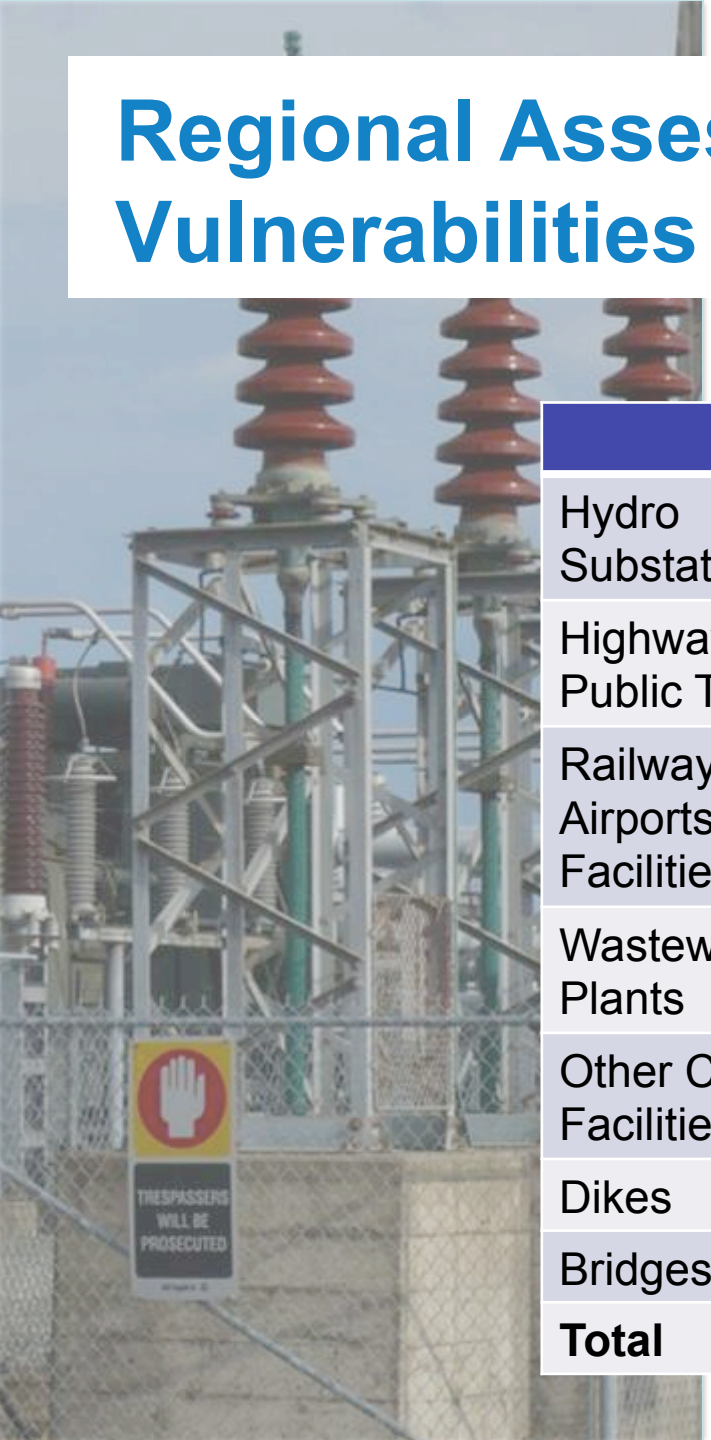
Regional Assessment of Flood Vulnerabilities

Estimated building-related losses

	A	B	C	D
Residential	$5.6 B	$7.1 B	$2.6 B	$6.6 B
Commercial	$6.3 B	$8.6 B	$3.8 B	$7.6 B
Industrial	$1.6 B	$2.6 B	$1.6 B	$2.9 B
Public/Inst'l	$0.7 B	$0.9 B	$0.9 B	$1.2 B



Regional Assessment of Flood Vulnerabilities



Estimated infrastructure losses

	A	B	C	D
Hydro Substations	$209 M	$407 M	$253 M	$330 M
Highways, Public Transit	$709 M	$764 M	$681 M	$791 M
Railways, Airports, Marine Facilities	$158 M	$203 M	$200 M	$216 M
Wastewater Plants	$66 M	$110 M	$176 M	$198 M
Other Critical Facilities	$284 M	$325 M	$393 M	$435 M
Dikes	$34 M	$34 M	$36 M	$36 M
Bridges	$0	$0	$3 B	$3 B
Total	**$1.4 B**	**$1.8 B**	**$4.6 B**	**$5.0 B**

Flood Vulnerabilities – Who Pays and How?

$20-$30+ Billion for a regional scale Fraser River or coastal flood

- Private insurance (residential, commercial, industrial)
- Federal and Provincial governments – DFA
- Businesses, organizations and citizens that are self-insured (without insurance / not eligible for DFA)
- Disruption to businesses, critical infrastructure, essential services, employment, international trade
- We will all pay - We won't know how much, nor the distribution of costs until after the event

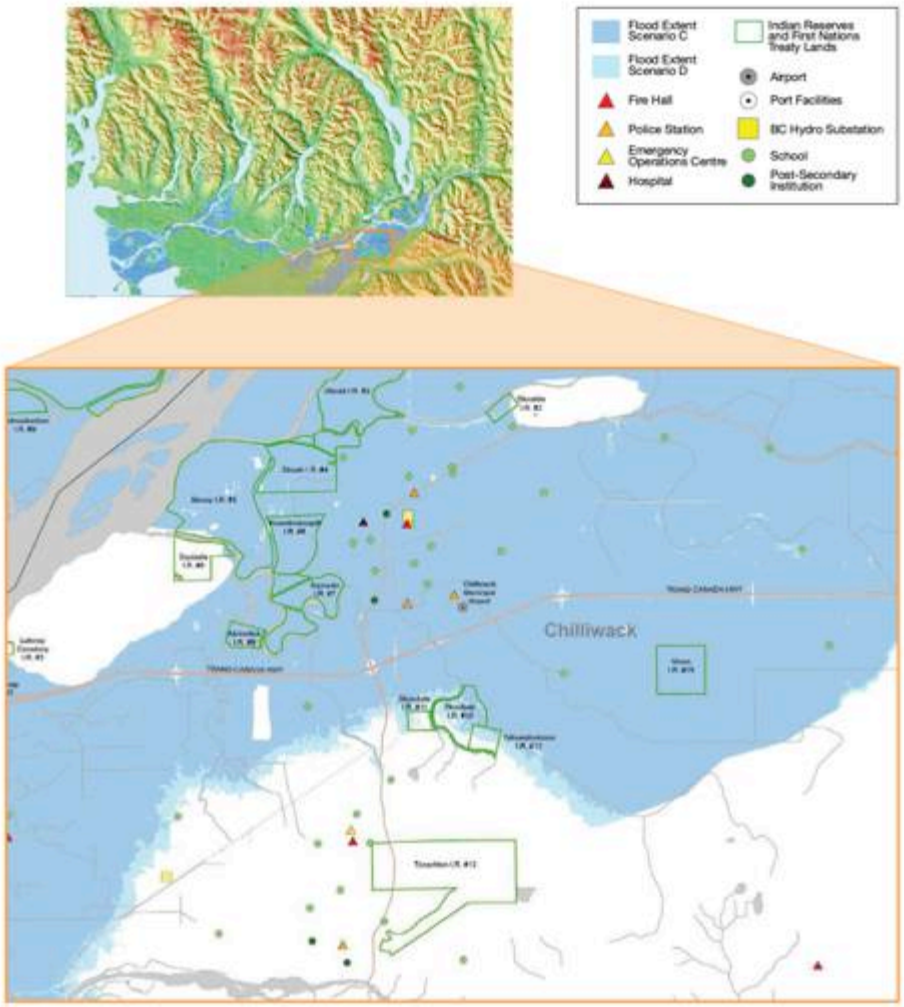
Regional Assessment of Flood Vulnerabilities

Inter-dependencies – Infrastructure damage and disruption (e.g. hydro) impacts other infrastructure, services, people and businesses (supply chains, cargo shipping, etc.)

Regional significance – infrastructure vulnerability makes flood risk a regional issue

- Everyone in the region will likely be impacted one way or another from a large flood

Flood Extent Mapping

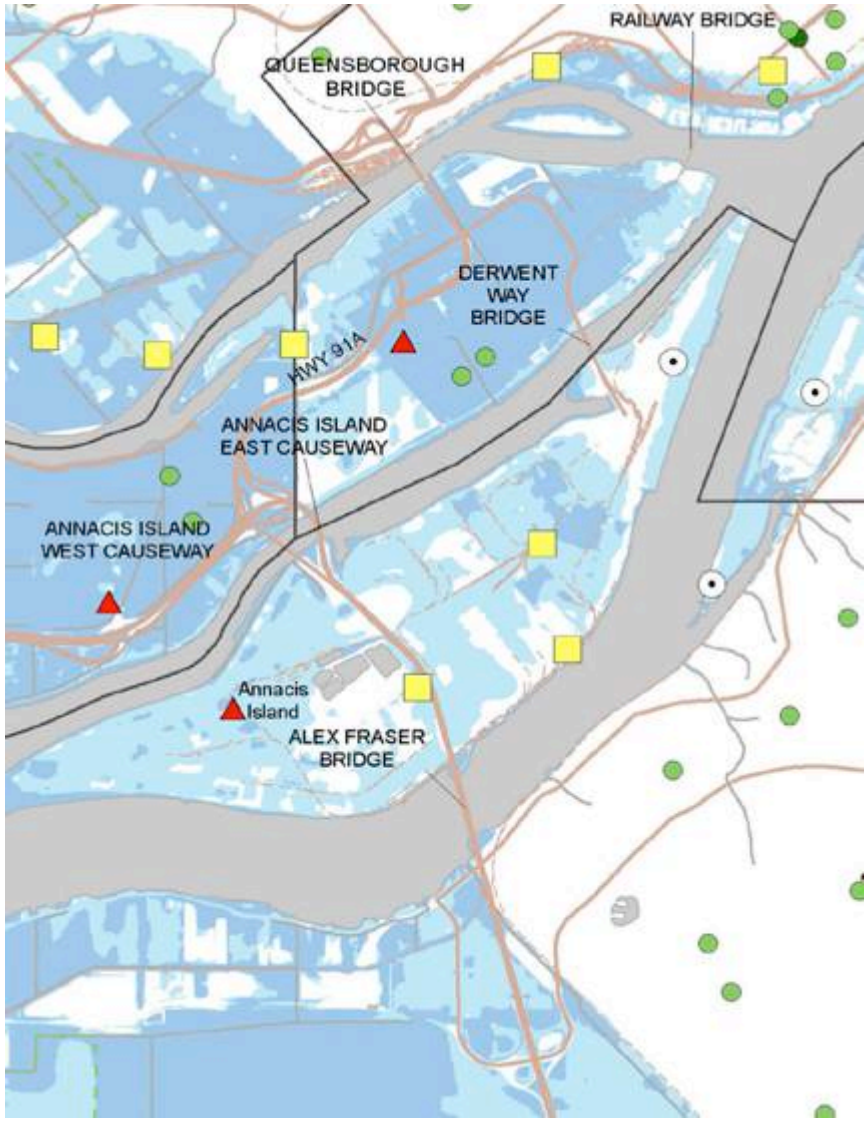


Map 2: Extent of Flood under Fraser River Flood Scenarios (Present Day and Year 2100)

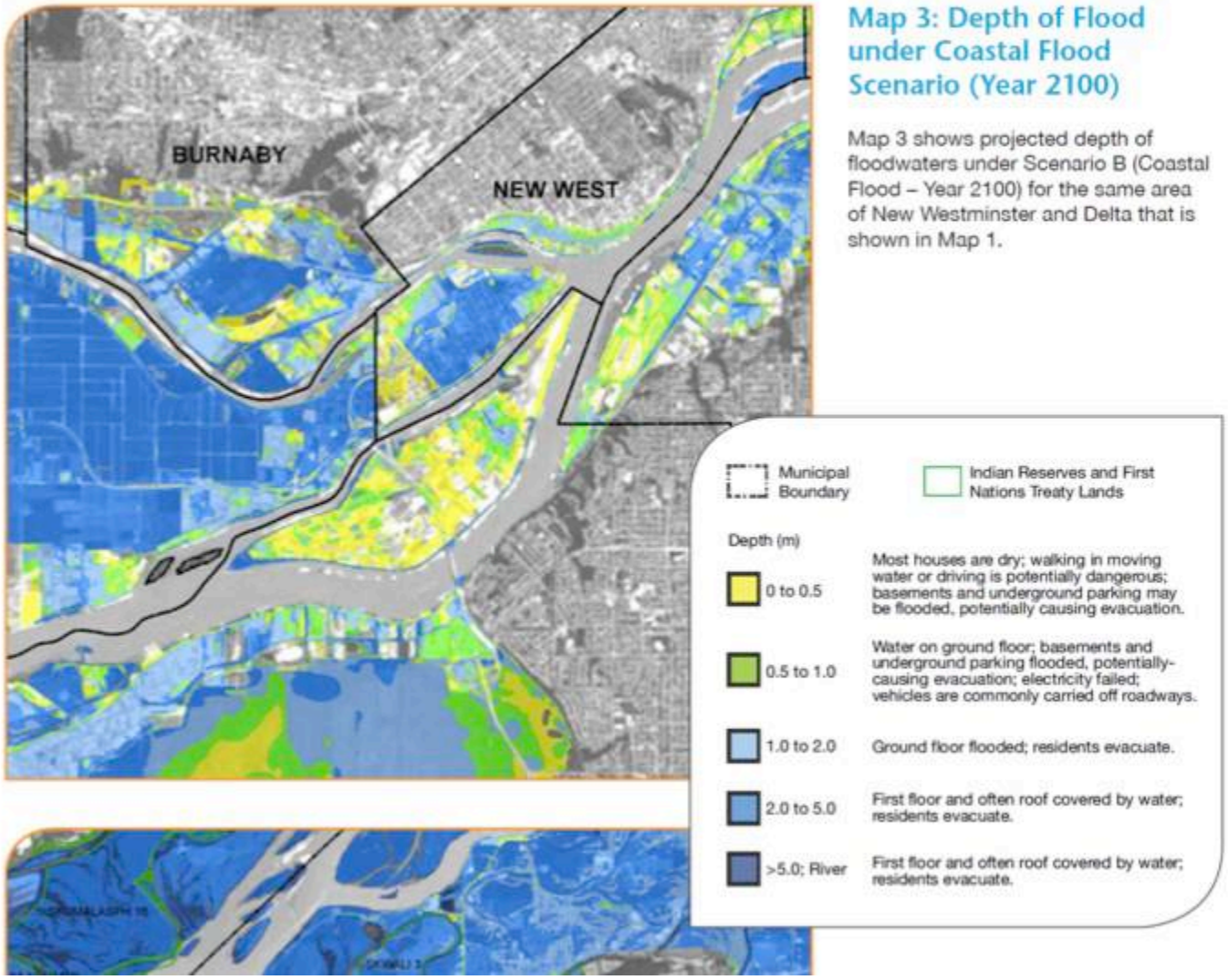
Flood Extent Mapping

Includes locations of critical facilities such as:

- Fire, police and EOCs
- Hydroelectric Sub-stations
- Airport & port facilities
- Hospitals
- Schools



Flood Depth Mapping



Map 3: Depth of Flood under Coastal Flood Scenario (Year 2100)

Map 3 shows projected depth of floodwaters under Scenario B (Coastal Flood – Year 2100) for the same area of New Westminster and Delta that is shown in Map 1.

Phase 1 Results – Lower Mainland Dike Assessment

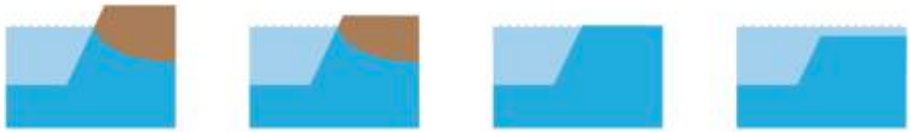
Dike integrity depends on many factors. The assessment covered:

- Dike crest height
- Geometry
- Geotechnical stability during floods & earthquakes
- Erosion protection
- Control of vegetation/ animal encroachments
- Appurtenant structures on dikes
- Administrative arrangement including secured rights of way and inspection practices

Lower Mainland Dike Assessment

Assessment results:

- 71% of assessed dikes are vulnerable to failure by overtopping



- Only 4% of assessed dike segments meet current provincial standards for dike crest height – includes 0.6 m of freeboard above water surface elevation of design flood event

Lower Mainland Dike Assessment

- Majority of assessed dikes in Lower Mainland (69%) were scored as Poor to Fair
- 18% scored Unacceptable to Poor
- 13% as Fair to Good
- Most were reconstructed in 1970s and 1980s
- Standard has been updated through more accurate flood modelling

5. Phase 2 – Key Components and Activities Underway

Phase 2 – Key Components and Activities Underway

- First Nations Engagement and Participation
- Vision
- Floodplain Modelling and Mapping
- Environment
- Seismic Resiliency
- Regional Priorities
- Flood Mitigation Options
- Funding and Decision-Making

First Nations Participation

Some Examples

Seek First Nations representation on the Joint Program Committee and Leadership Committee

Develop information materials for First Nations about flood hazards, mitigation and climate adaptation

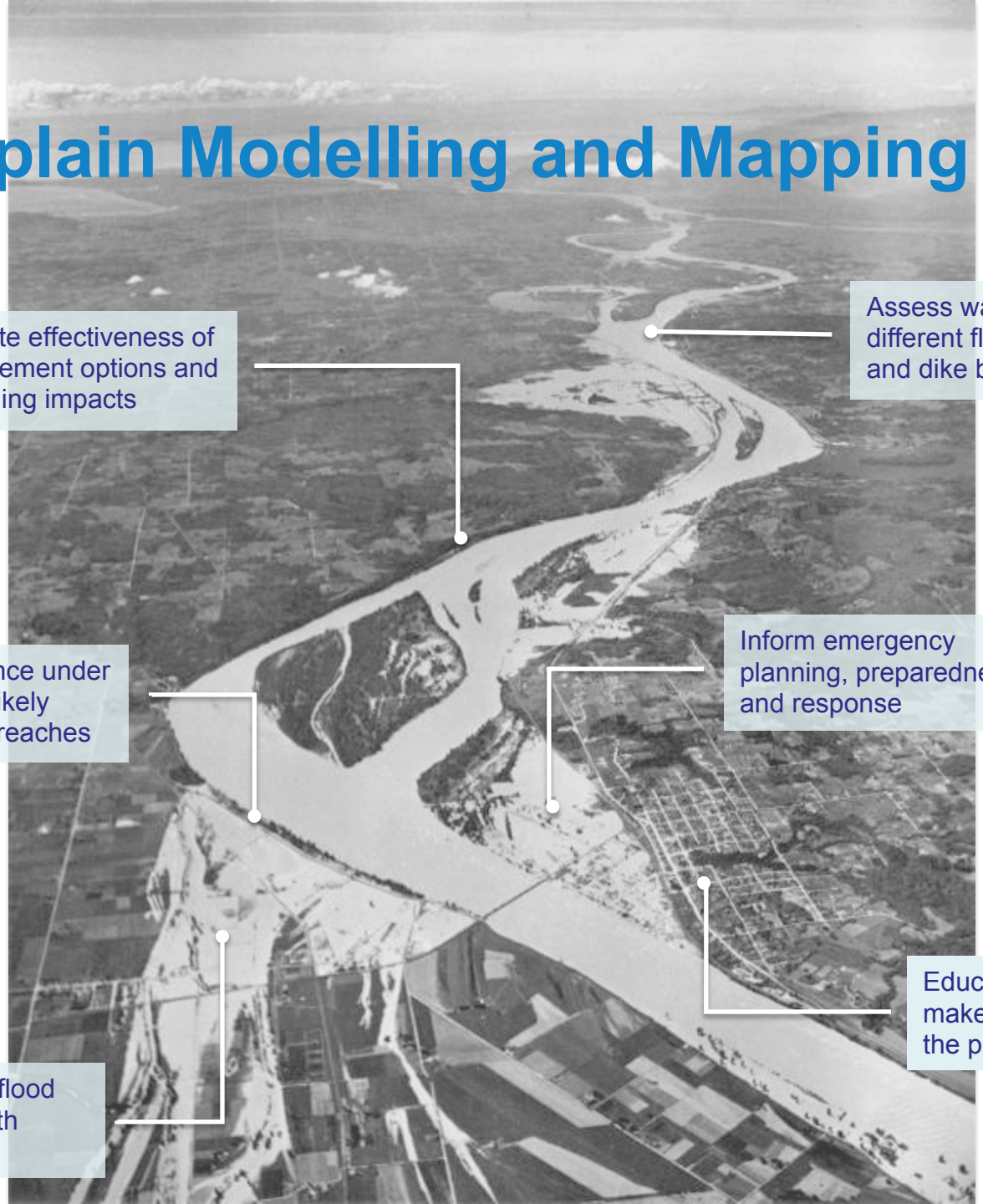
Collaborate with First Nations organizations to explore and implement options with First Nations participation

Meet with First Nations, Tribal Councils and record input and advice

Design and facilitate workshops to raise awareness, facilitate dialogue, and solicit input

Support and participate in Sub-Regional Meetings and Initiatives

Floodplain Modelling and Mapping Project



Assess water levels under different flood frequencies and dike breach scenarios

Evaluate effectiveness of management options and cascading impacts

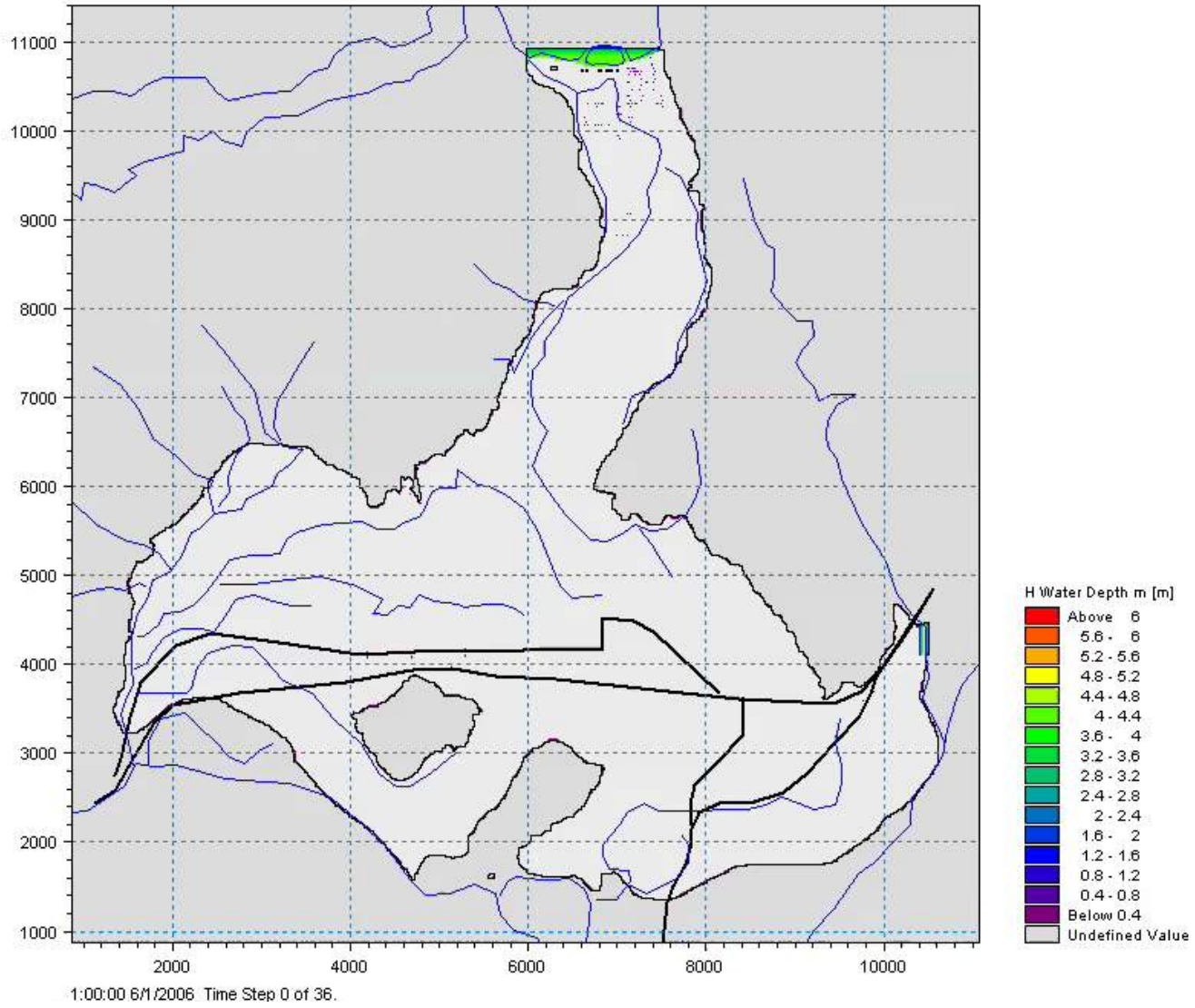
Inform emergency planning, preparedness and response

Assess dike resilience under scenarios and the likely sequence of dike breaches

Education tool for decision-makers, stakeholders and the public

More accurate flood extent and depth estimates

Floodplain Modelling and Mapping – Kent-Agassiz



Identifying Priorities for Flood Mitigation

- Overlay maps of dike status with vulnerability
- Refine evaluation of direct damages and indirect losses associated with critical infrastructure
- Consult with all orders of government, utilities, infrastructure, private sector to identify additional priorities

Evaluating Flood Mitigation Options

Evaluate a wide range of mitigation approaches such as:

- Engineering (e.g. dike upgrades, realignment, etc.)
- Land use policies and floodproofing techniques
- Living shores, barrier islands, beach nourishment
- Managed retreat

Evaluating Flood Mitigation Options

Management options evaluated in relation to local circumstances, including:

- Flood mitigation effectiveness
- Technical feasibility
- Costs (capital & operational)
- Benefit : Cost analysis
- First Nations interests
- Environmental impact
- Public and stakeholder interests
- Assess alignment of mitigation approaches with diverse local and sub-regional circumstances

Funding and Financial Arrangements

- Strong business case for proactive / preventative approaches
- Cost-shared approach
- Regional approach
- Access current funding programs for near-term action while advancing a new program for the bigger picture
- Need sustainable funding mechanisms
- Funding role for industry, private sector, infrastructure sector?

6. The Environment and Climate Change

What about the Environment?

Integrating the environment within the Flood Strategy:

- Environmental Advisory Committee
- Collating best available data on environmental values, features and functions
- Research on environmentally sensitive approaches to flood mitigation
- Work to clarify understanding on environmental regulatory review and approval processes
- Learning events such as workshops, webinars and field tours

What about Climate Change?

- A changing climate is projected to increase the magnitude and frequency of Fraser River and coastal flooding
- BC's diking system and floodplain management policies were not designed with climate change in mind
- Increasing attention to this issue
- Provincial guidance (SLR studies, guidelines for sea dikes and SLR planning areas, cost of adaptation, SLR Primer, FHALUM guidelines amendment
- Technical analysis – "Simulating the effects of SLR and CC on Fraser River Flood Scenarios"

What about Climate Change?

For further consideration:

- Uncertainty – pick a number and start, monitor actual CC impacts, continual improvement of science and planning
- Flood protection works, land use decisions, and other policies and practices will need to evolve to keep pace with changes in flood hazards
- Need to consider longer time horizons (e.g. timing of investments to optimize effectiveness and life cycle costs)

What about Climate Change?

For further consideration:

- Transition from the status quo to climate adaptation and resilience (e.g. redevelopment cycles, infrastructure renewal cycles)
- Institutional / societal inertia (e.g. updating regulations and capacity to enable innovative solutions that are presently outside the box)
- Low risk pilot projects?
- Talk about risk tolerance
- Talk about land use change or retreat (over time)

7. Recap and Outstanding Issues

- Value in an impartial convenor / facilitator (vs. regulatory stick)
- Value in dialogue, collaboration and consensus building
- Difficult for elected leaders to solve a problem the public is not aware of
- Tough conversations to continue:
  - Agreeing on regional priorities
  - Recommended solutions
  - Funding and governance arrangements
  - Role of the private sector (insurance, infrastructure, business)
  - First Nations title and rights
  - Integrating and protecting the natural environment

Thank You! For more information:

www.floodstrategy.ca

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