Squamish, BC:
A Success Story for Integrated Flood Management Planning

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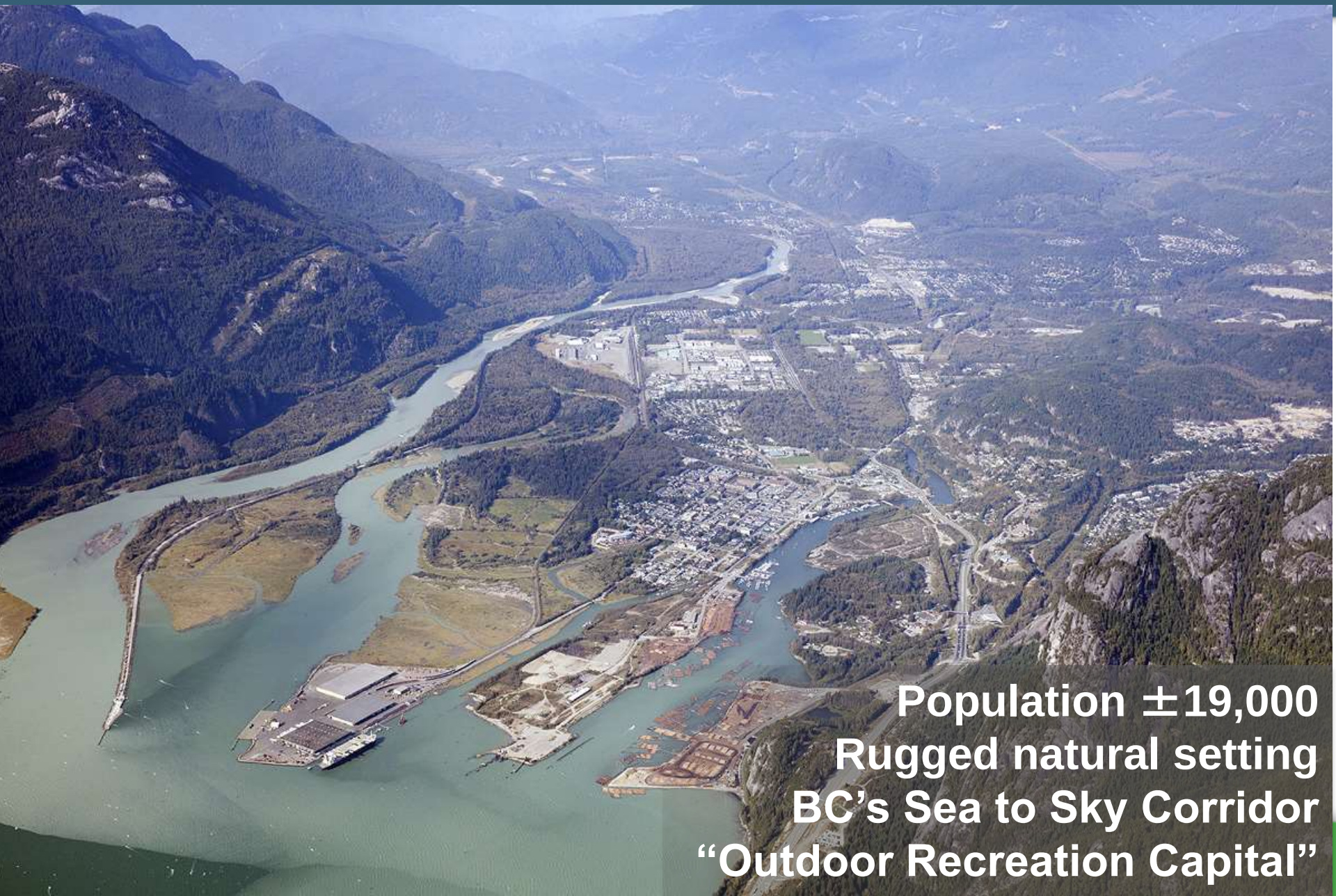
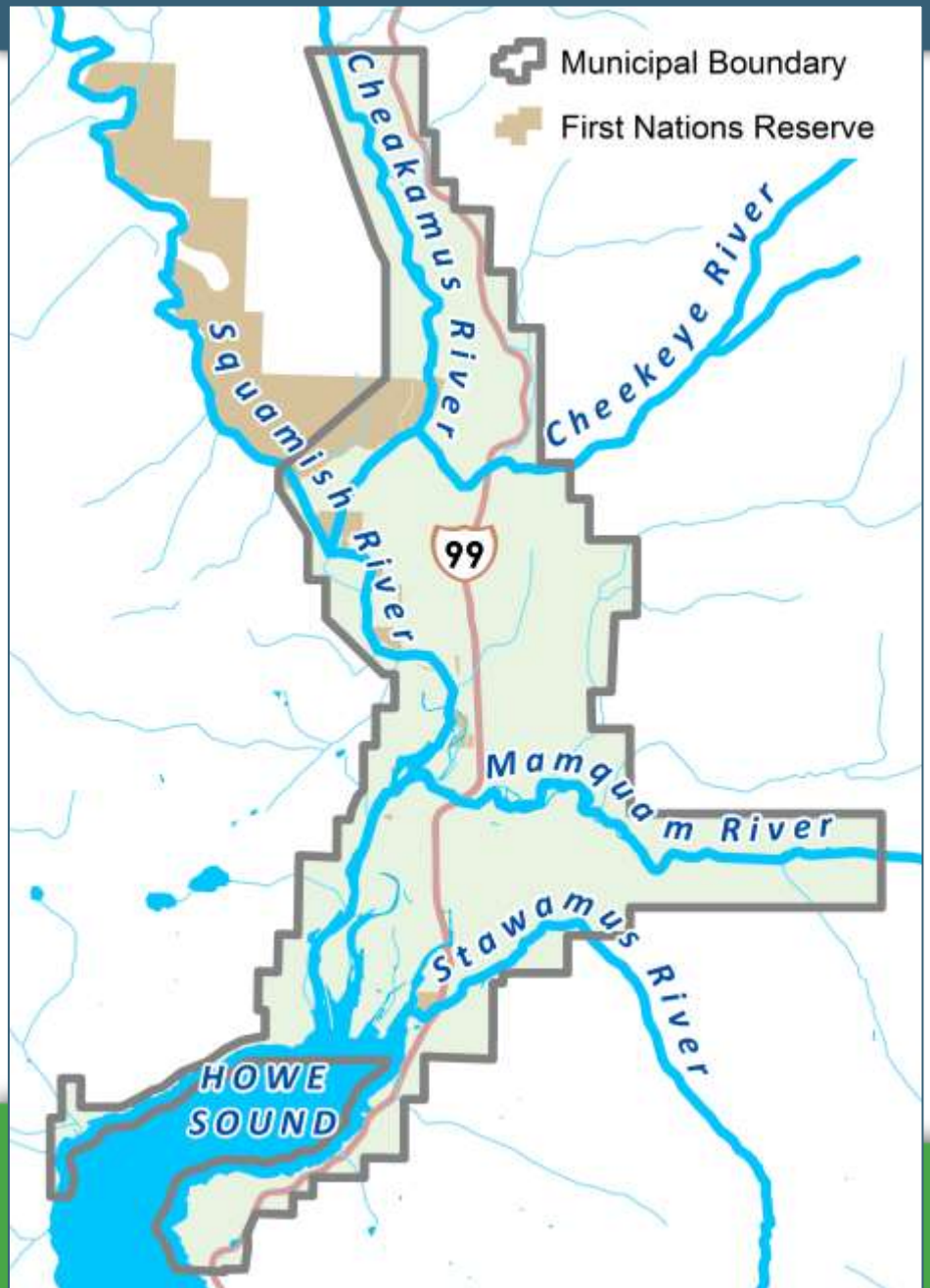
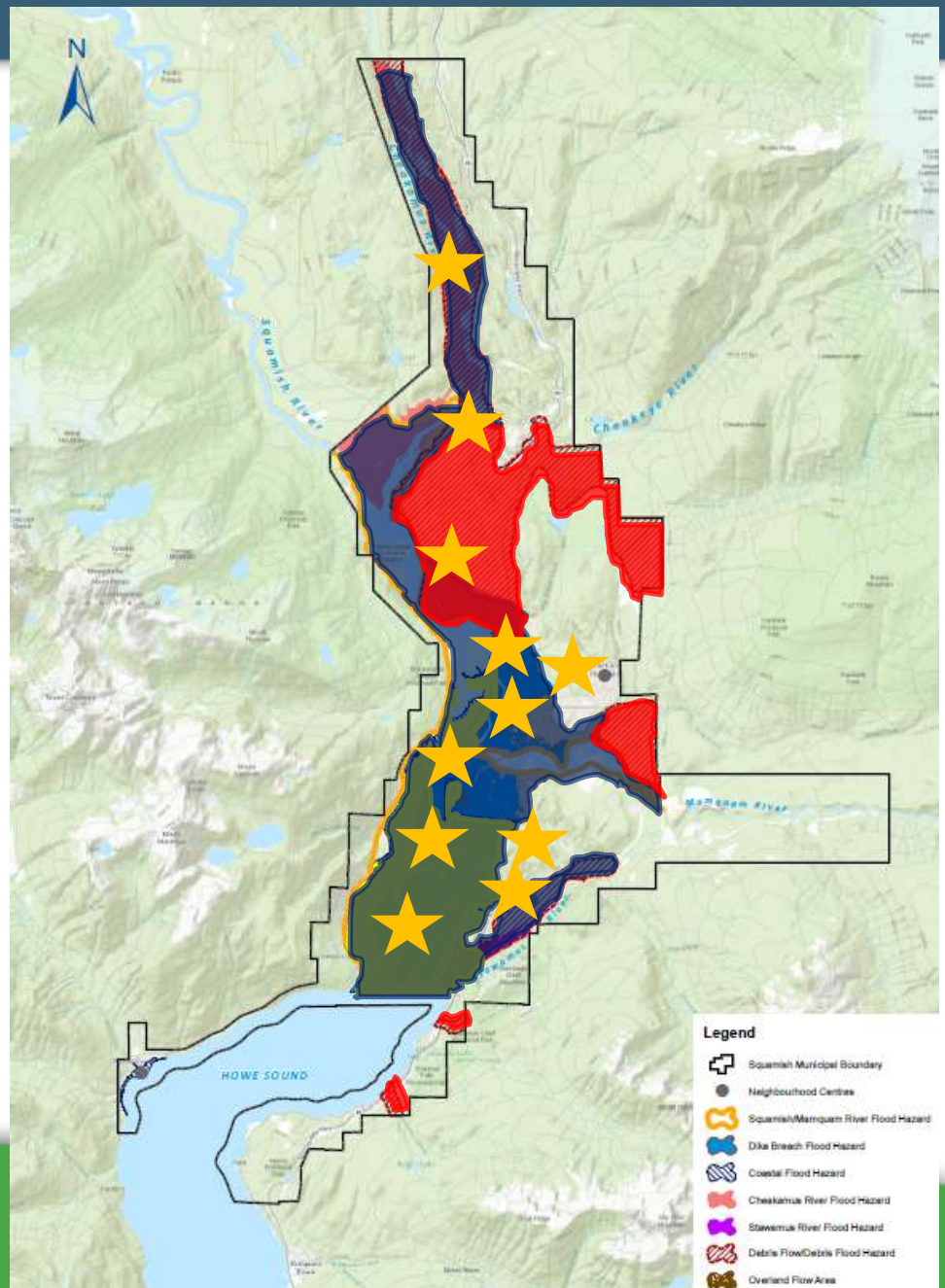
Squamish, British Columbia



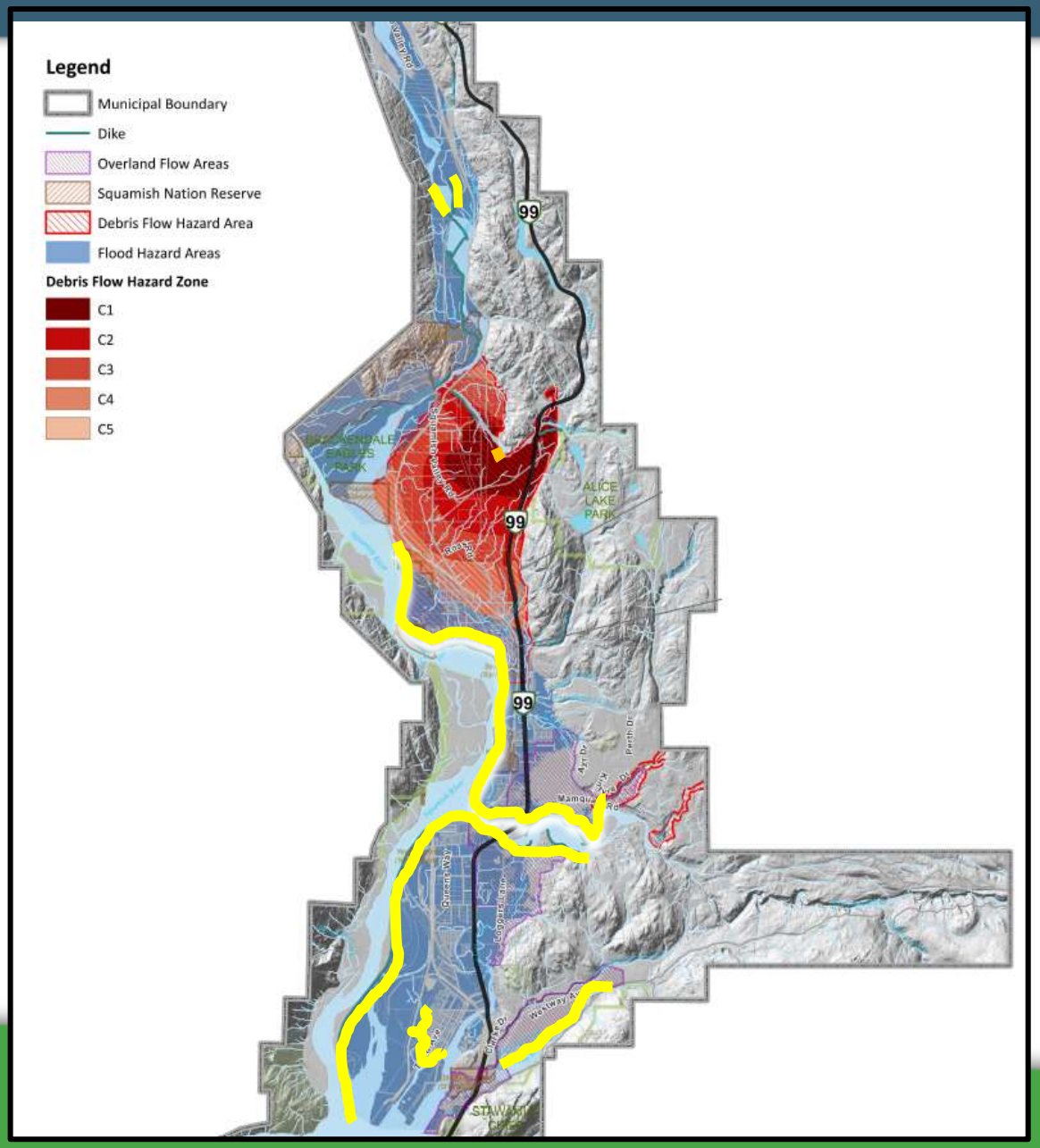
Squamish Flood Hazards





Dike Network

- > 20 km
- District responsibility
- Existing dikes are deficient
- Significant upgrades needed
- Reliability is key



Previous Flood Planning

1983
- FDRP Federal / Provincial Floodplain Mapping

1994
- Flood Hazard Management Plan
  - Policy/Updated mapping

2004
- Province delegates flood management authority
- "Poor implementation of 1994 FHMP"

2014
- Intense growth pressure
- New solutions needed

The times, they are a-changin'

- Changes in Provincial Legislation / guidelines
- Significant development / changing vision
- Improved understanding of flood hazards

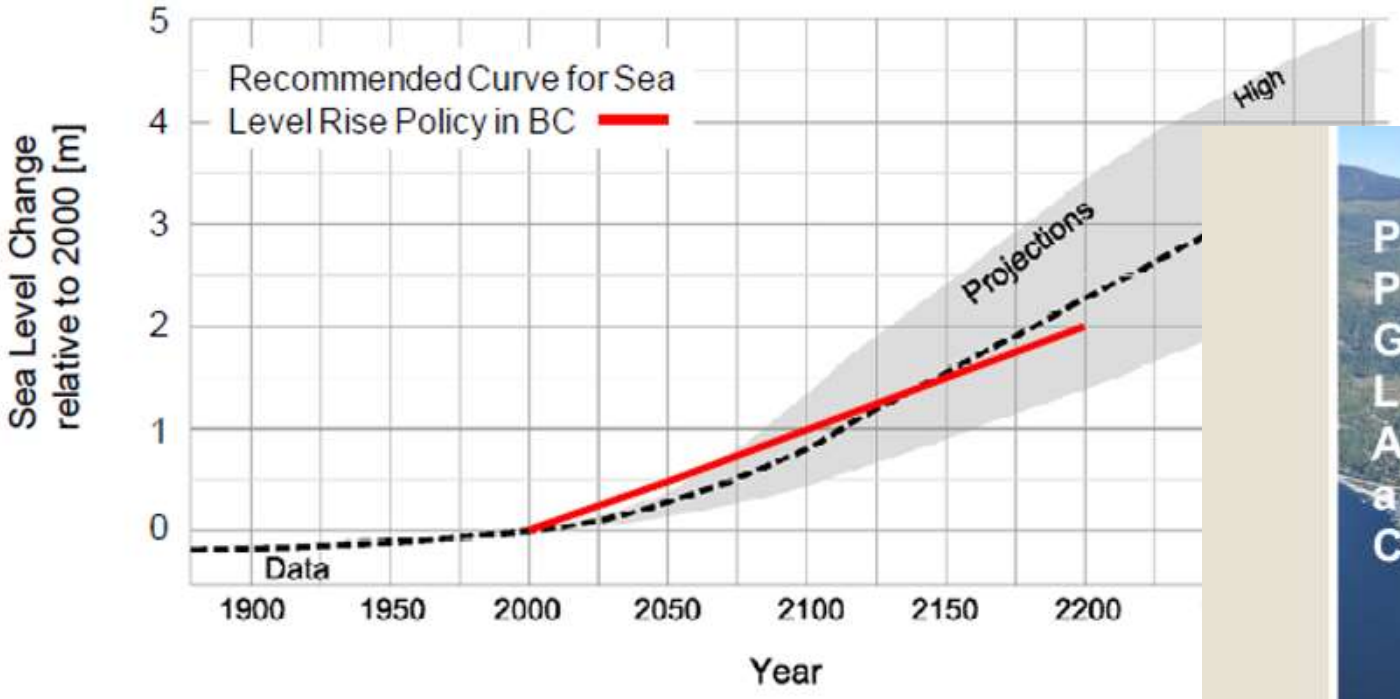
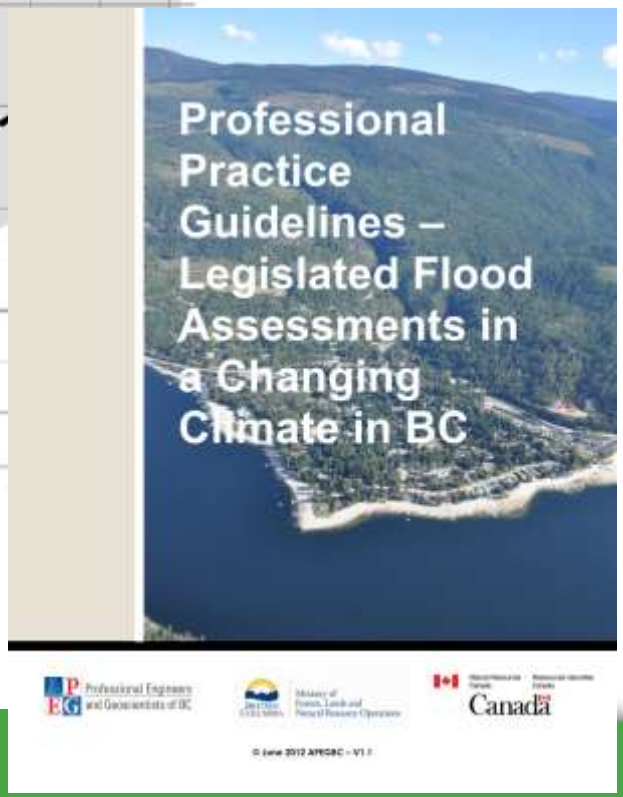
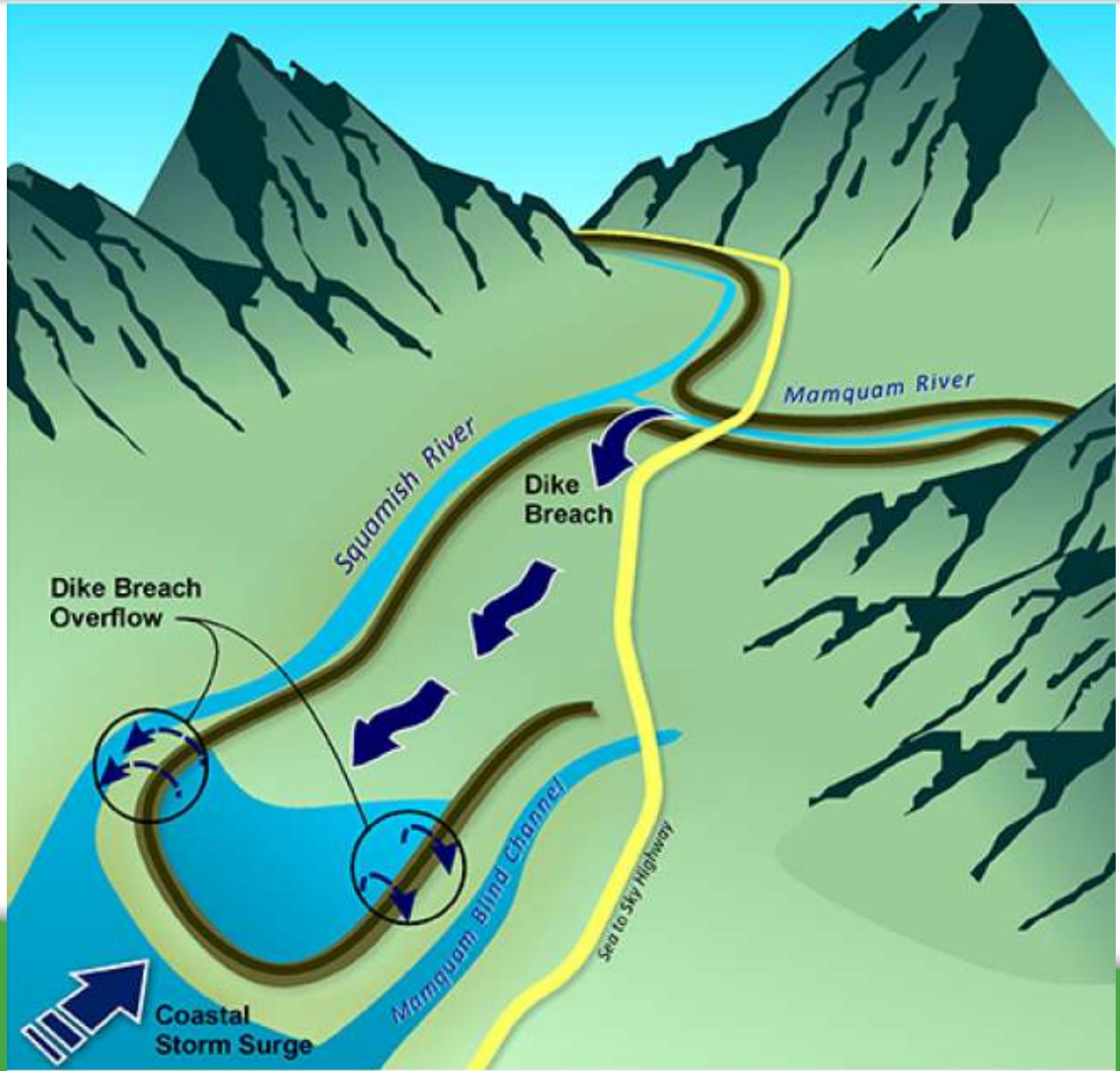


Figure 3-1: Projections of Sea Level Rise
source: Policy Discussion Paper (2010)

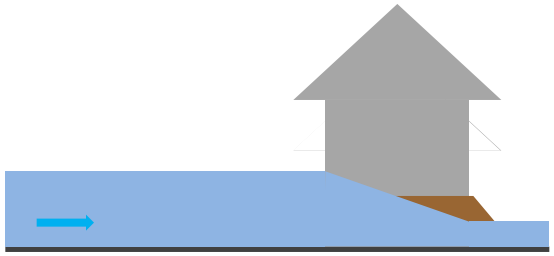


Because nothing is ever easy…



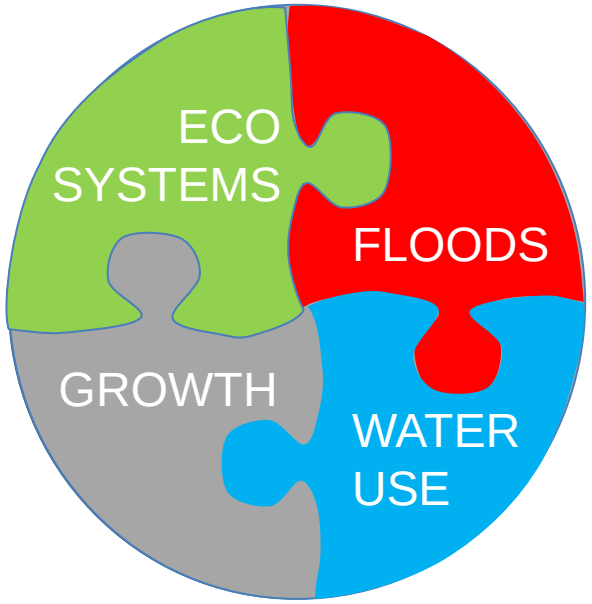
Because nothing is ever easy…

- Measures taken to mitigate risk can change the risk
- Mitigation can become a “moving goalpost”



So what does “Integrated” mean, anyway?

- **Approach / Process**
- **Multidisciplinary / Collaborative**
- **Iterative / Optimizing**
- **Adaptive / Sustainable**



- **“Systems” based process that brings together natural processes, human activities, public perception and decision-making criteria**

Hazards Consequences Mitigation Stakeholders Decisions

Simply put…

Integrated Flood Management

Equitably reduce flood risks

Identify development opportunities

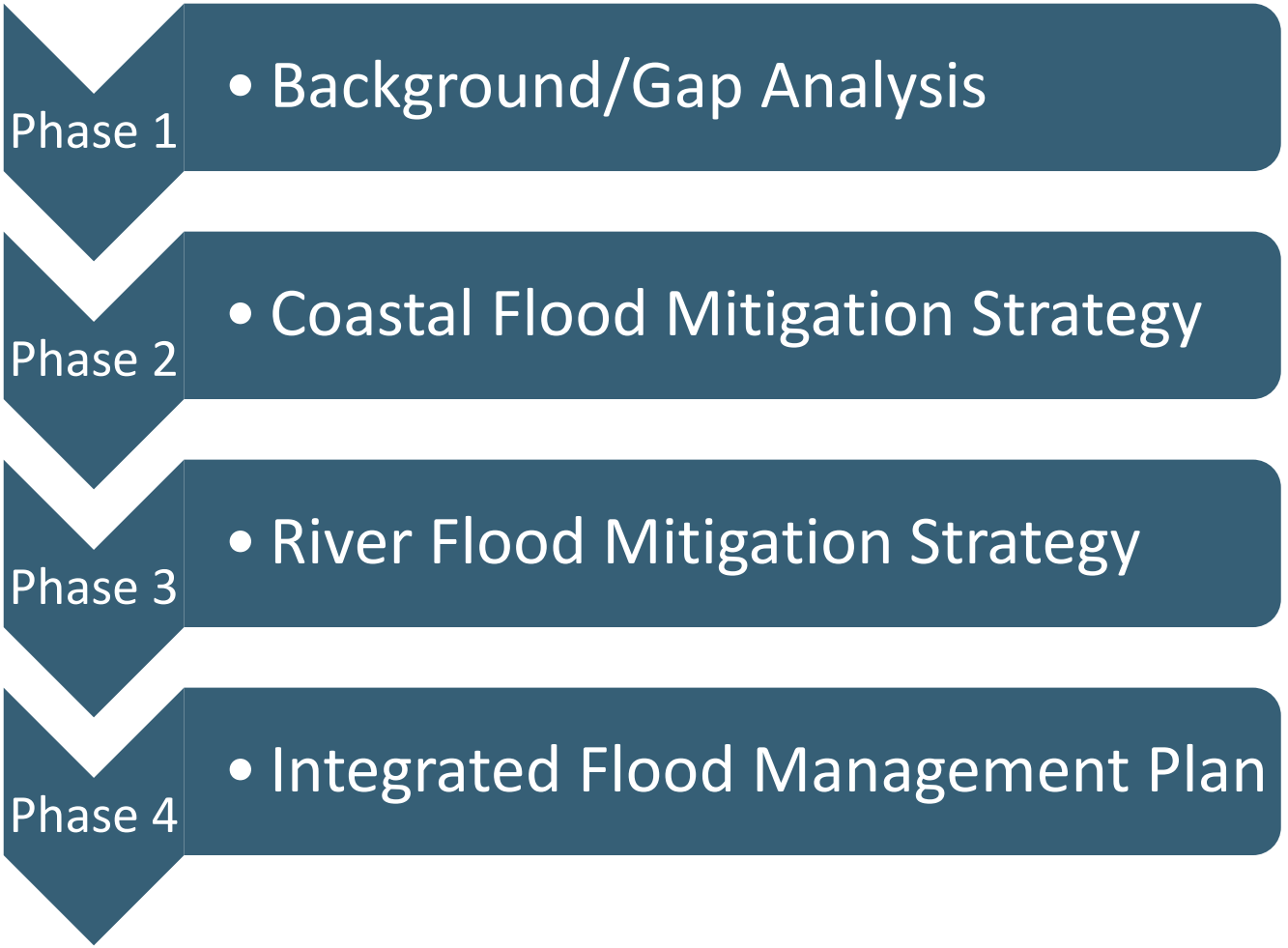
Integrated Flood Hazard Management Planning

Promote sustainable decisions

Create community-supported solutions

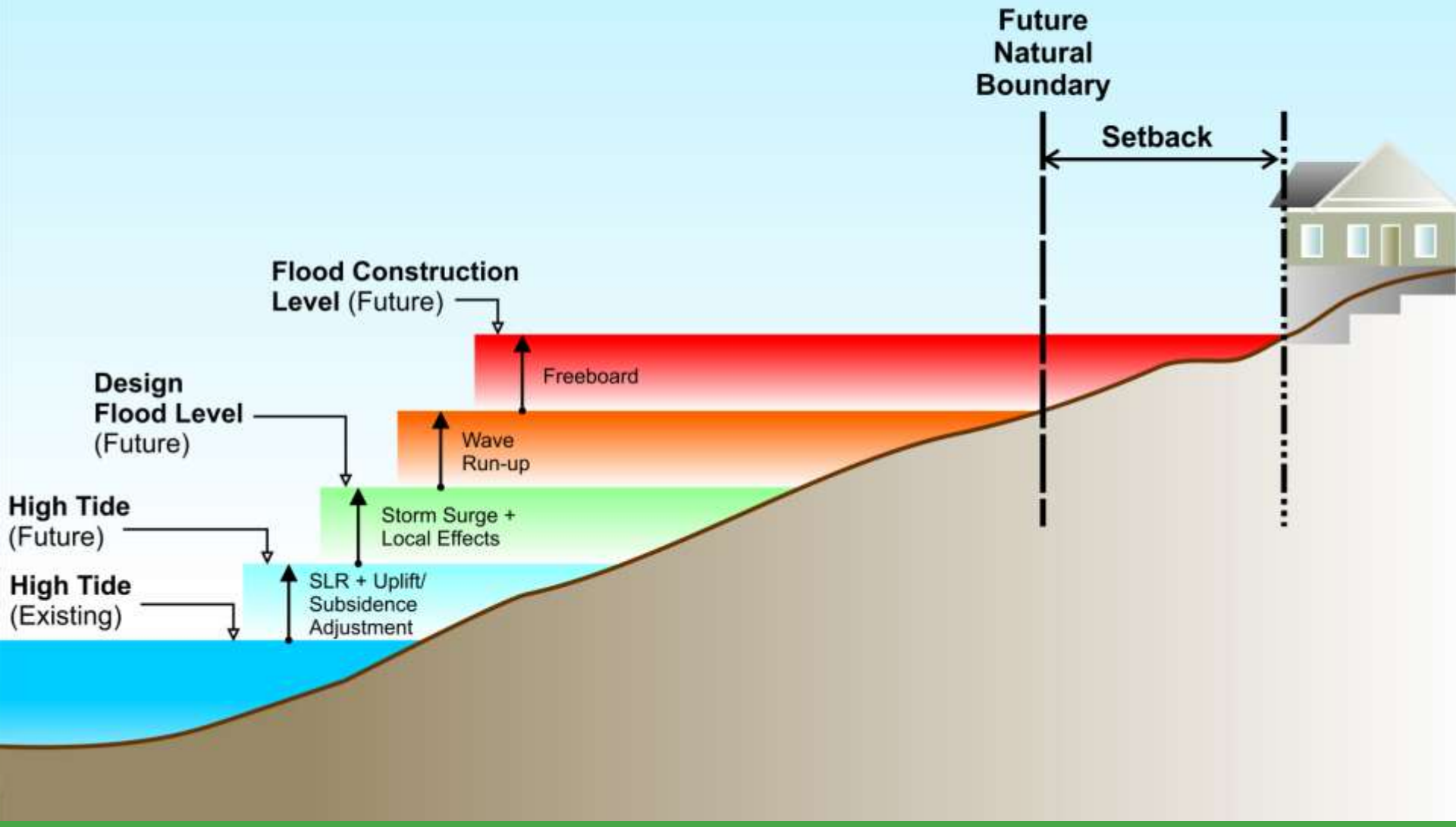
An IFHMP is born

- Began 2014
- Three years
- $500K budget
- Four phases



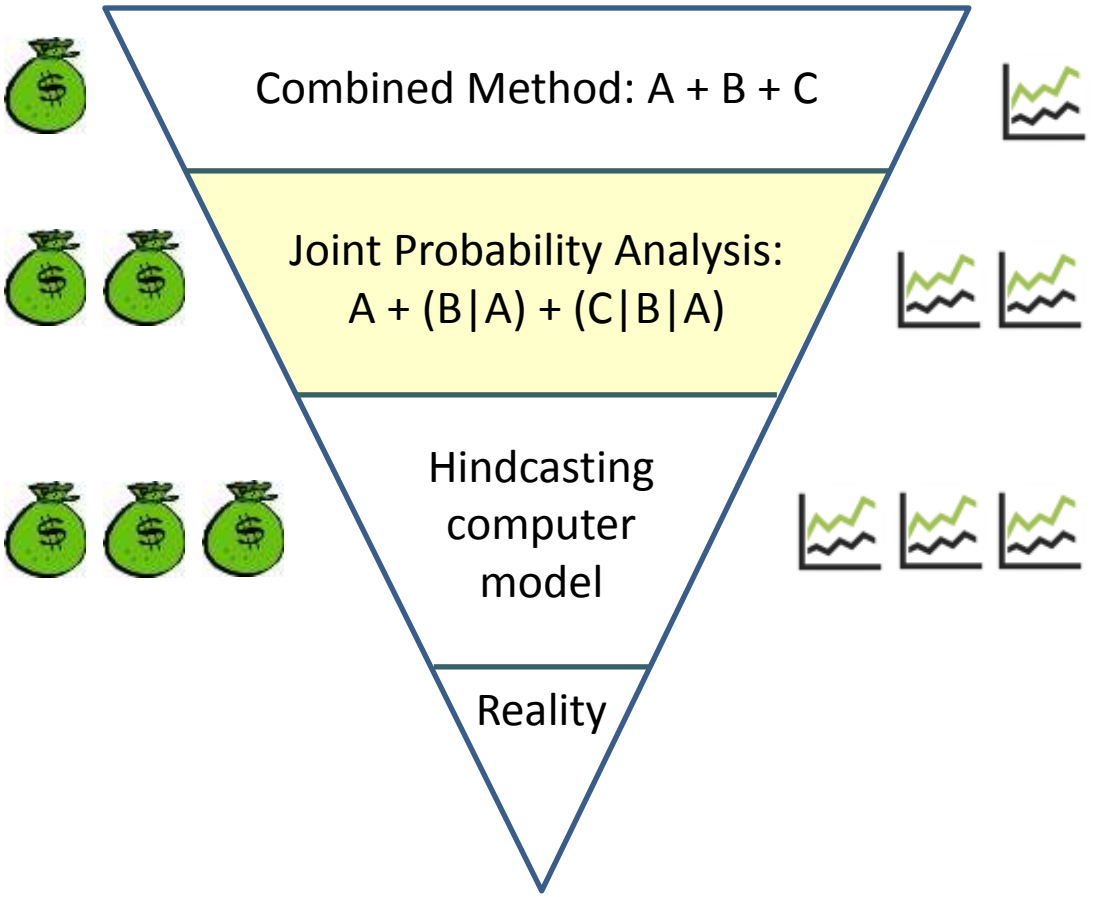
Coastal Flood Hazards

Tide, Storm Surge, SLR, and Waves



Coastal Flood Hazard Assessment

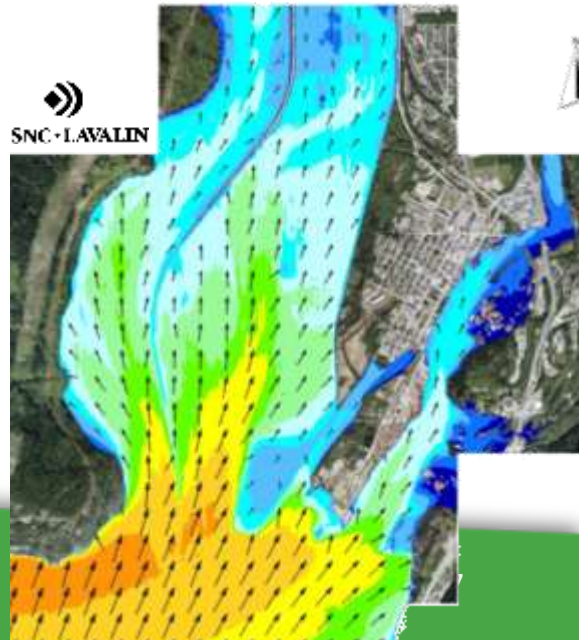
COST



DATA

Year 2100 Designated Flood Level[5]	3.99 m

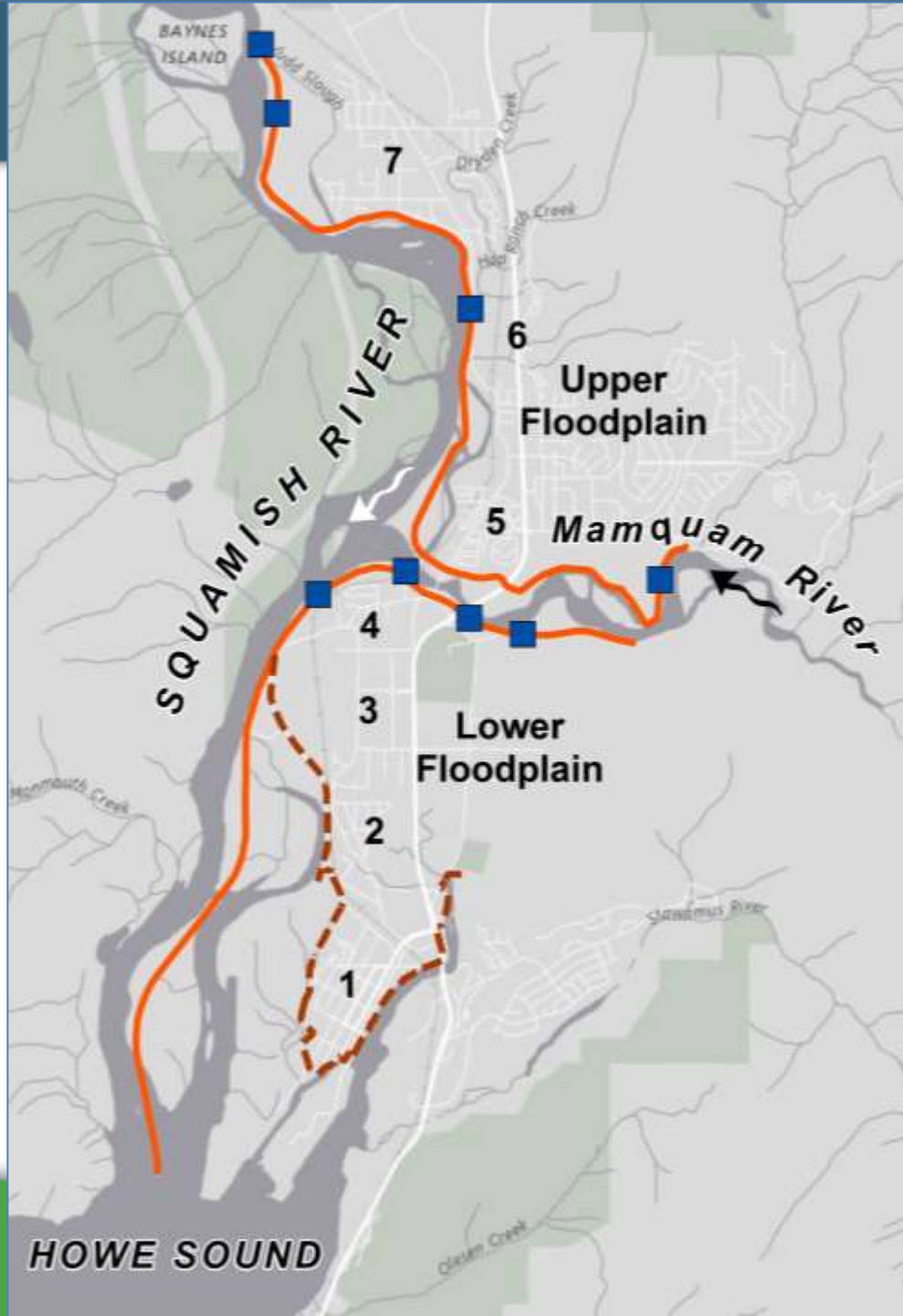
PLUS



Dike Breach Model

- Existing river model
- Assumes dikes will be raised
- Still need information for:
  - Secondary Mitigation
  - Emergency Response
  - Risk-based Decisions

- Two models: upper and lower
- Eight separate dike breaches
- Sea dike confines lower
- River dike confines upper



Dike Breach Model Construction

- Model decides how much water goes where

so

- Model must include all important behaviours

For example:

- Buildings acting as obstructions
- Flow concentration along roads
- Account for future development

For the IFHMP:

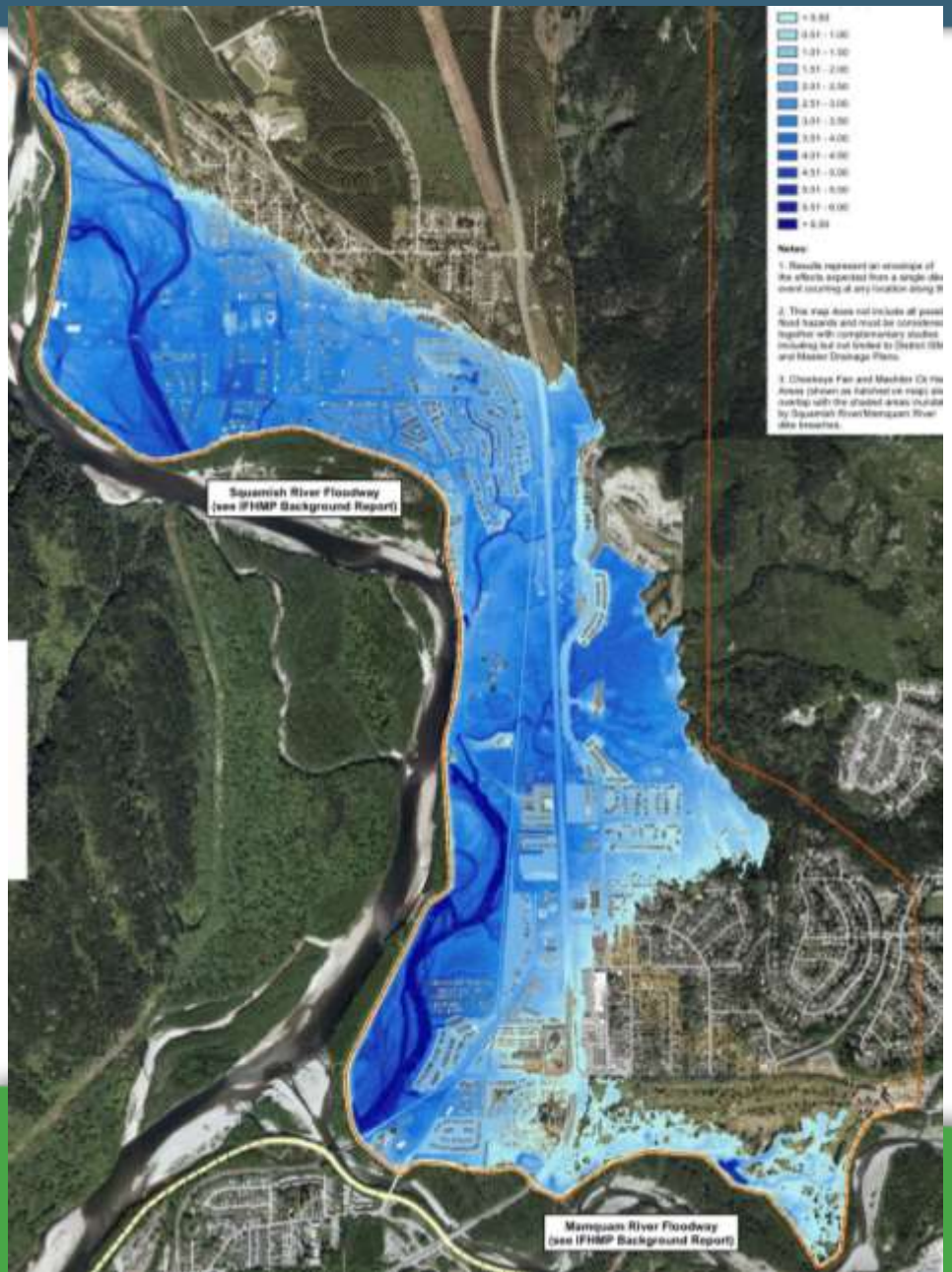
- Use a high-resolution floodplain model
- Results validated extra effort

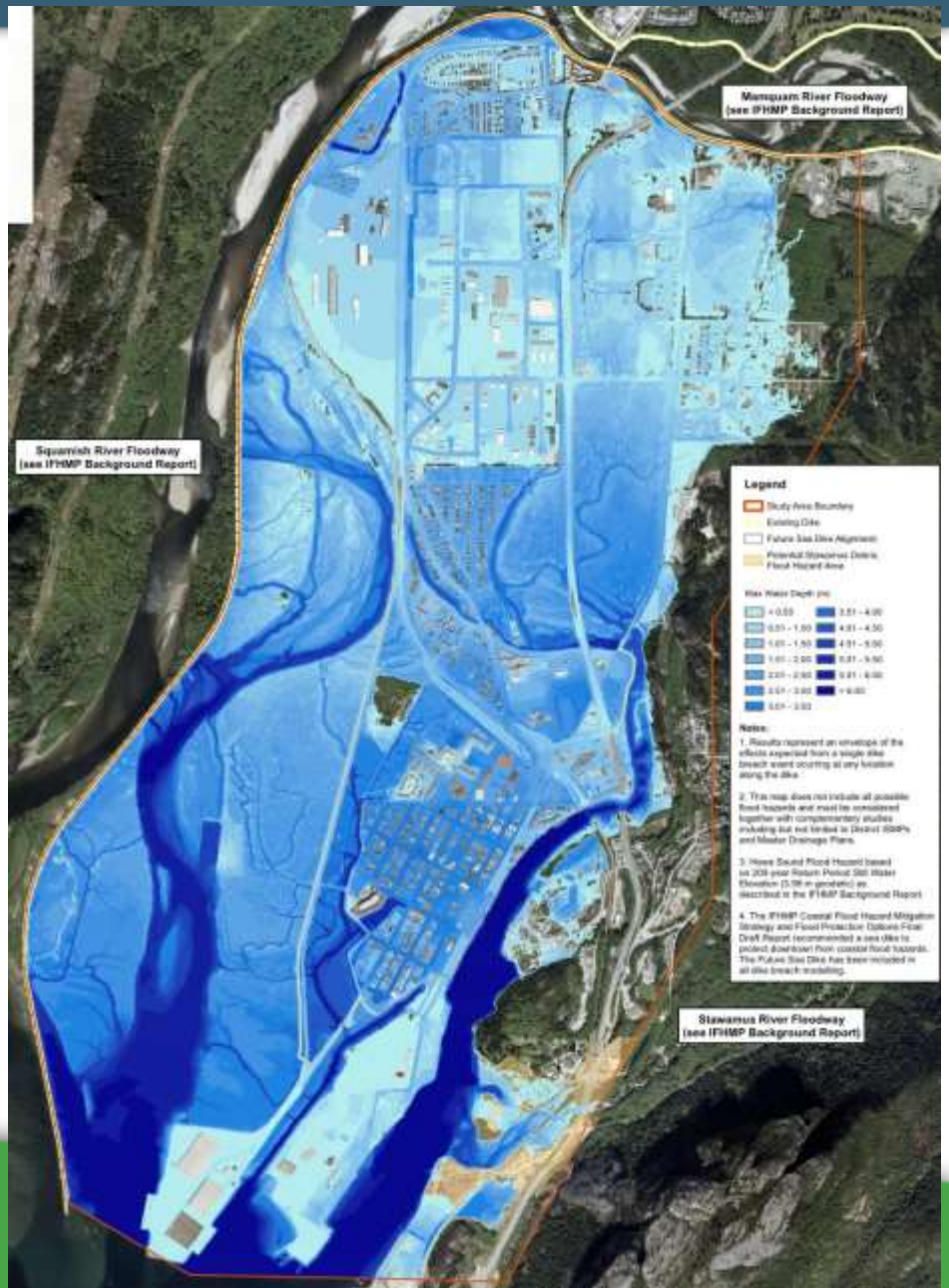
Dike Breach Model – Breach Zone

- Breach could occur at any location
- Hazards can be higher right next to dike breach
- Shouldn't be ignored
- Can't model everything

- GIS post-processing
- Approximates "breach zone":
  - water levels
  - velocities
- Based on driving head in river
- Calculated at 10 m intervals along dike

Dike Breach Model – Composite Results



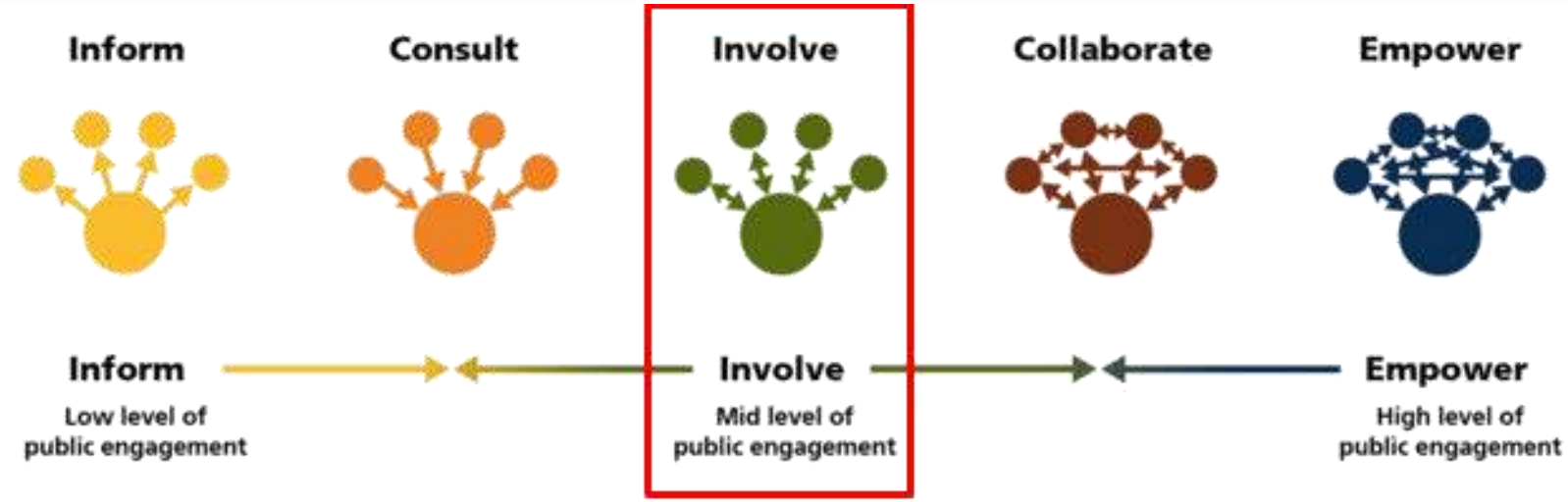


Dike Breach Consequence Assessment

Analysis focused on Consequence Assessment (not risk)

- Physical Danger
- Economic Damages
- Social Consequences
- Environmental Consequences

Community Engagement

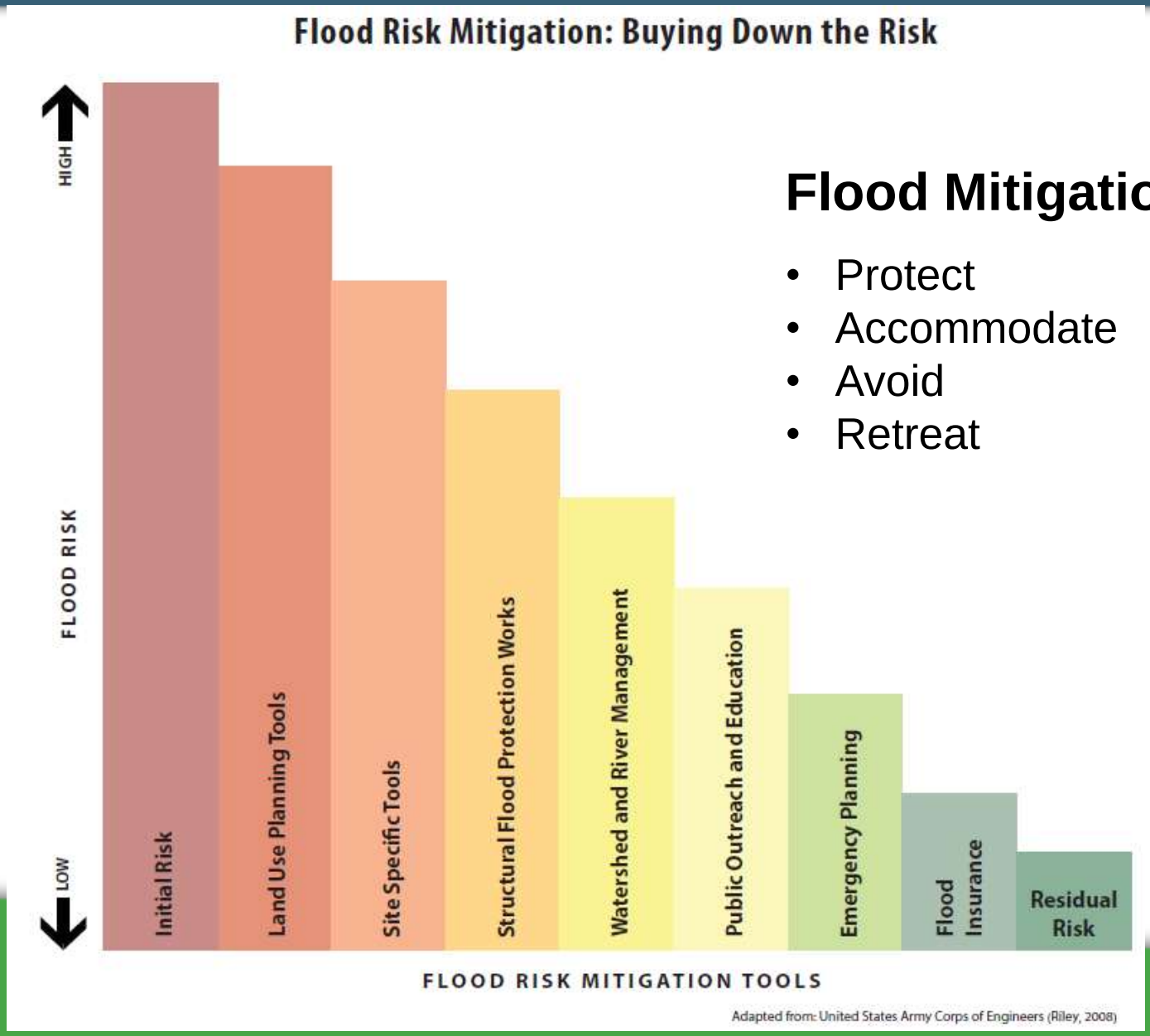


IAP2 Spectrum of Public Engagement
Adapted from City of Burlington, 2013

Open Houses, online surveys, workshops, Council meetings, TWG, Squamish Nation meetings & more

Consensus may not be possible due to conflicting objectives!

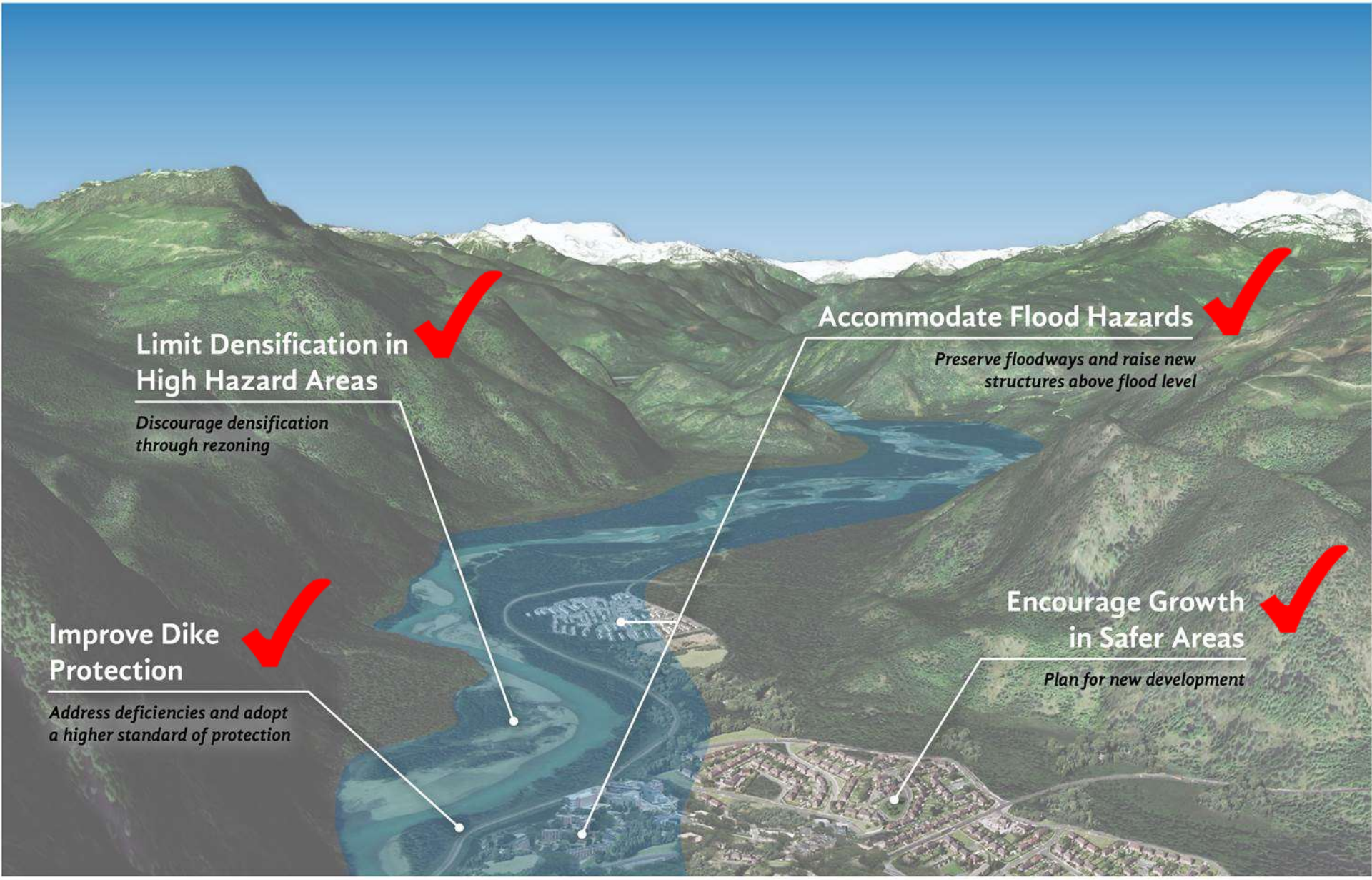
Risk Mitigation Strategies and Tools



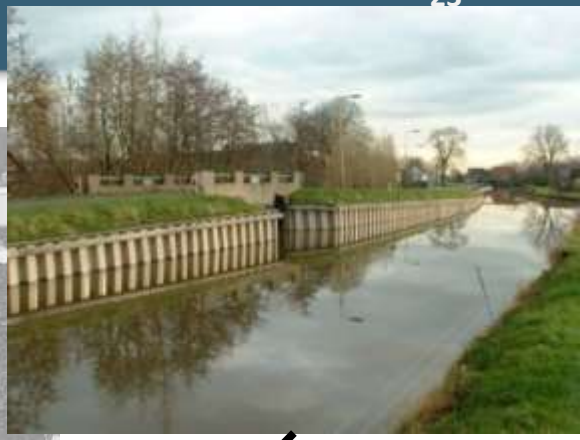
Flood Mitigation Strategies

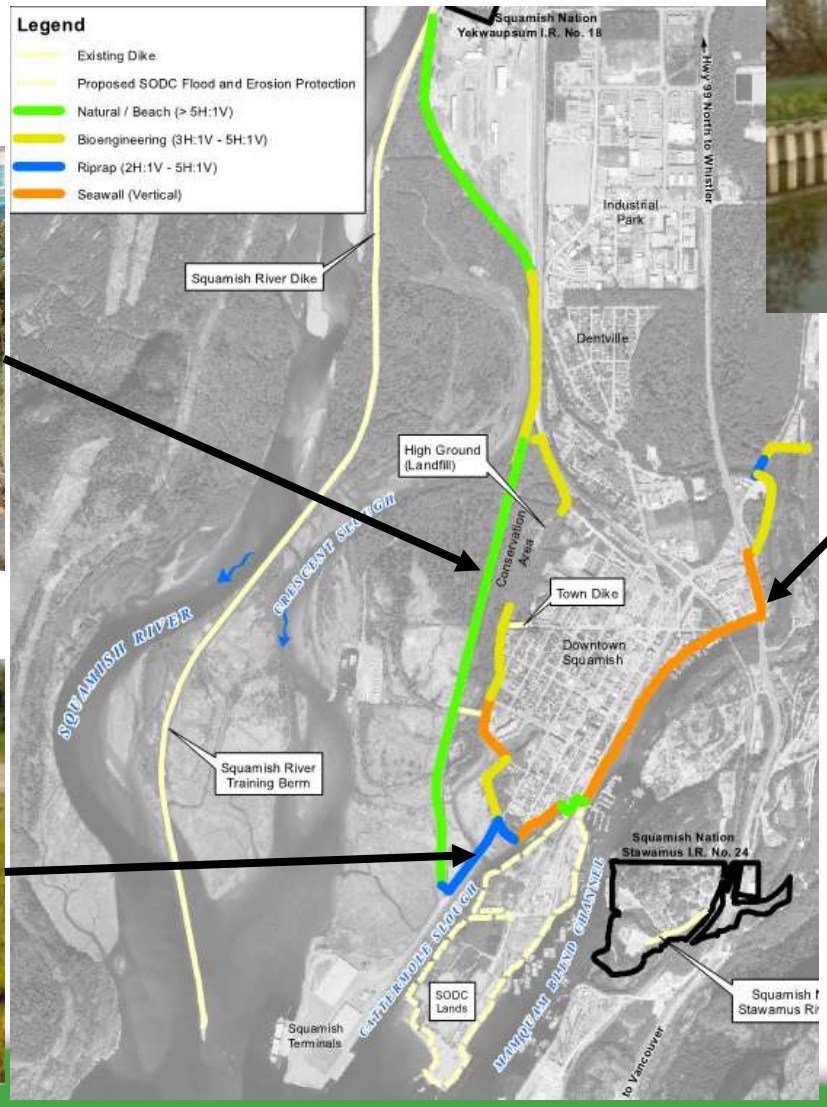
- Protect
- Accommodate
- Avoid
- Retreat

Typical Mitigation Strategies



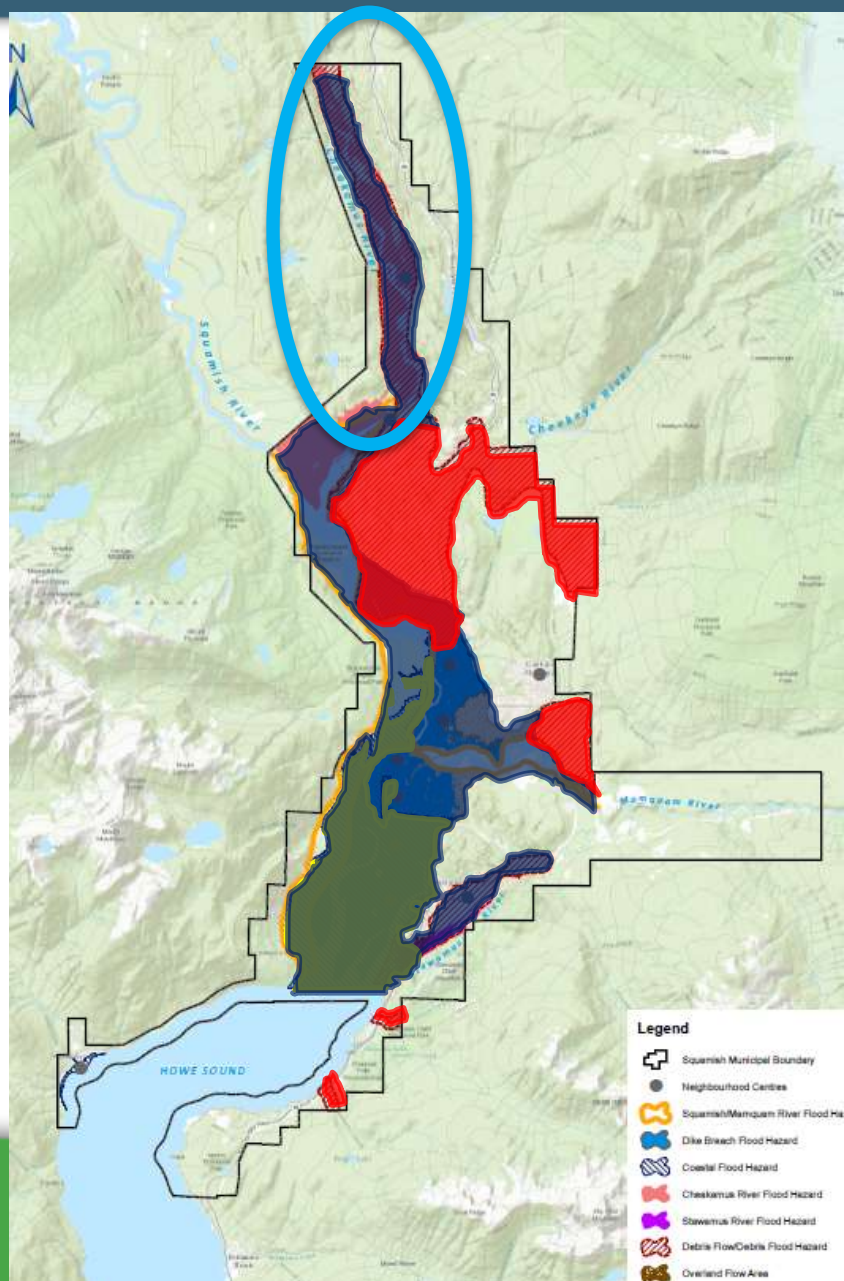
Proposed Sea Dike





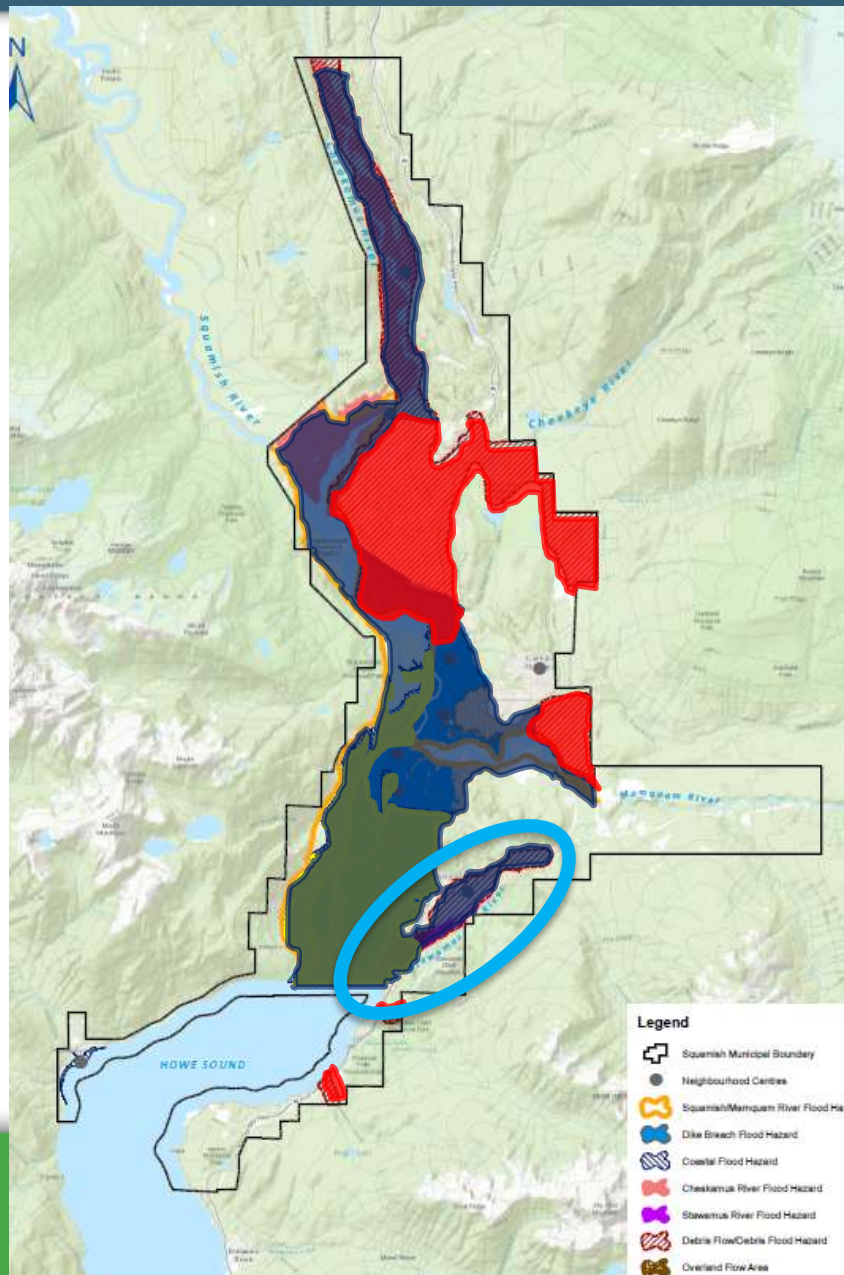
River dikes

- **No new dikes**



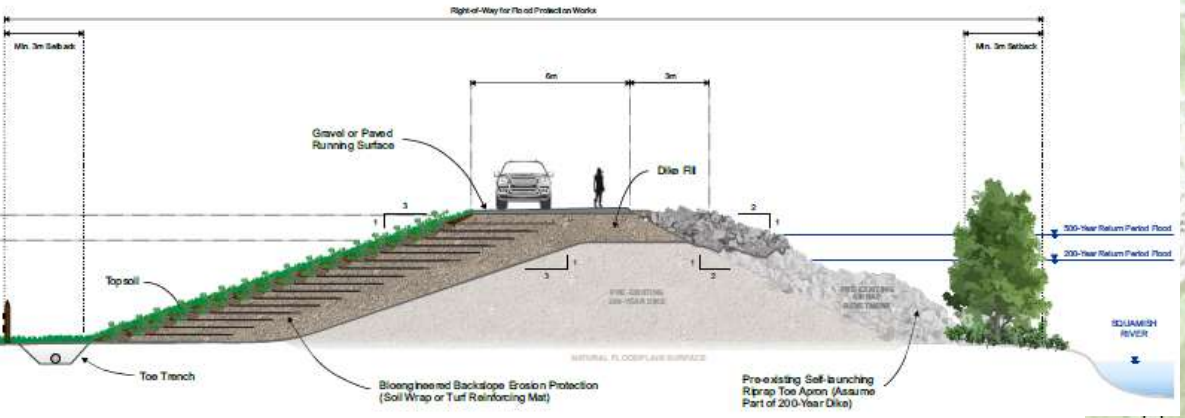
River dikes

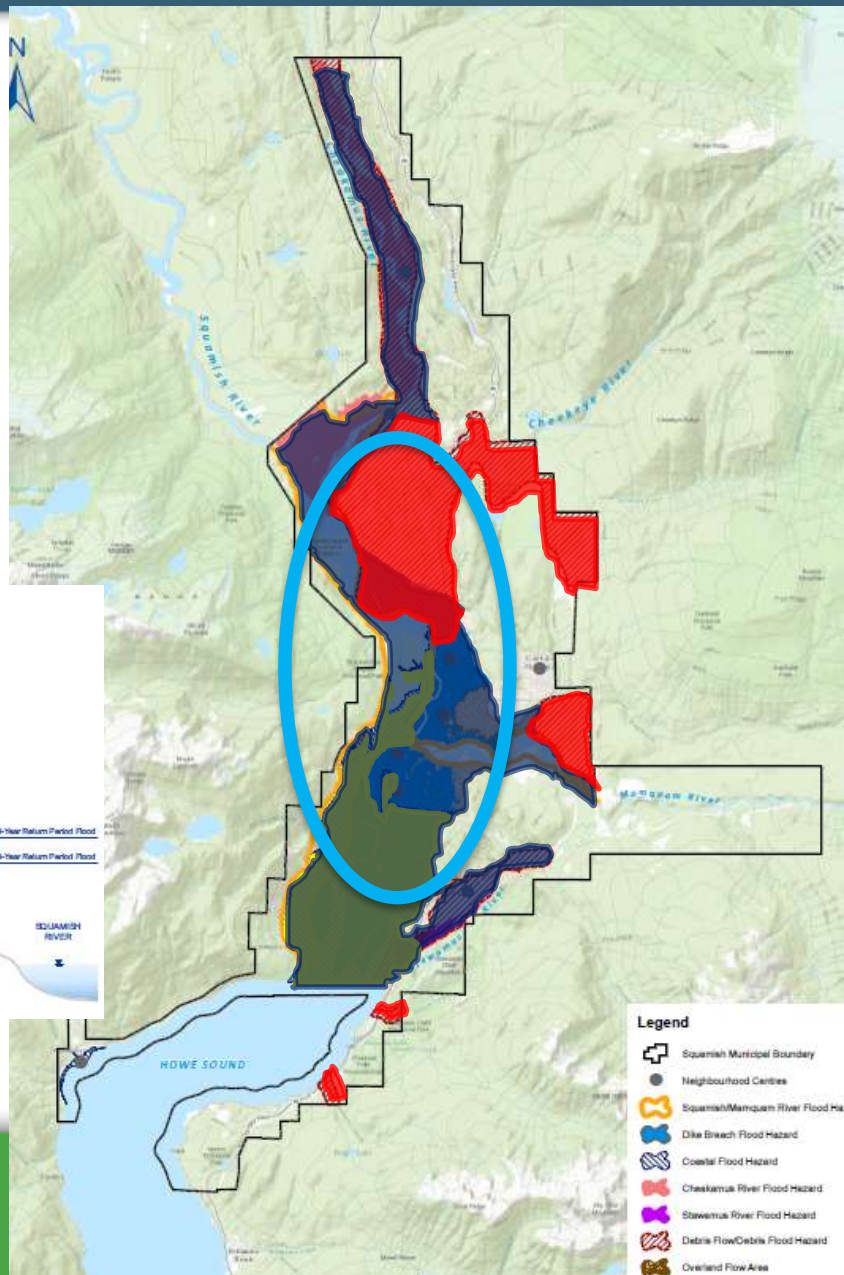
- **No new dikes**
- **Hold the line**



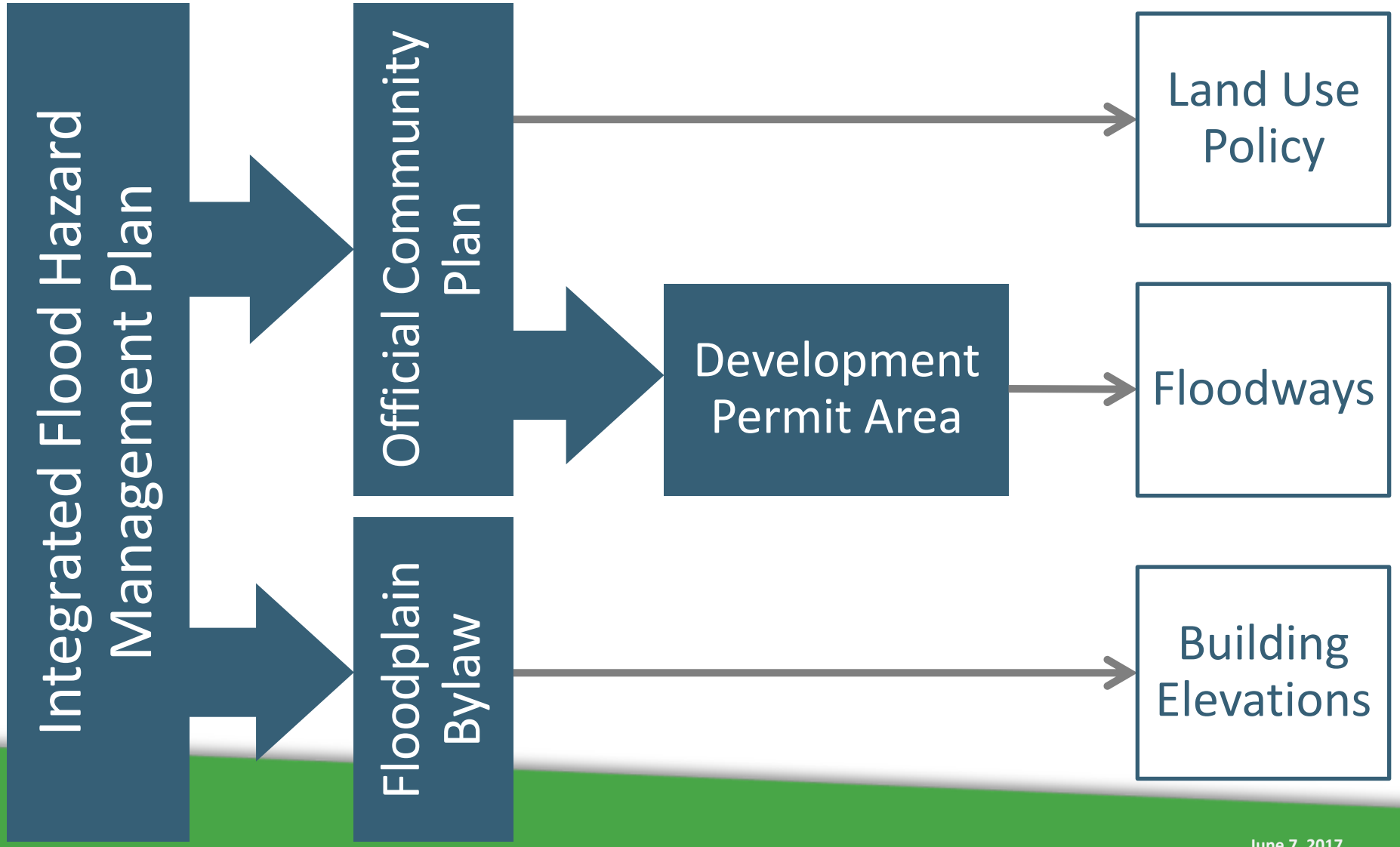
River dikes

- **No new dikes**
- **Hold the line**
- **Go big or go home**





Flood Risk Management Policy



OCP: Flood Hazard Land Use Policy

Controlled Densification Areas

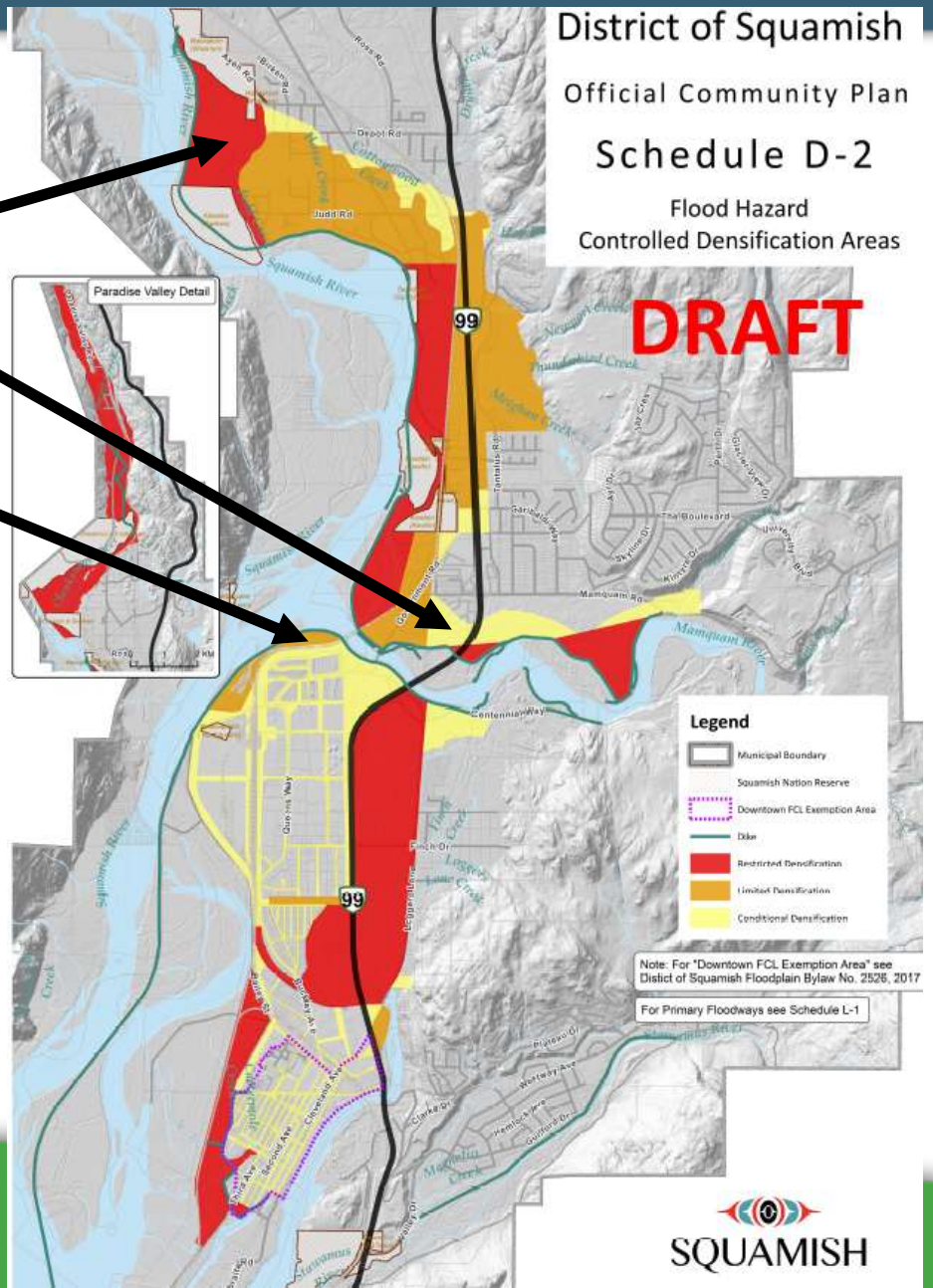
Restricted Densification Areas (red)

Conditional Densification Areas (yellow)

Limited Densification Areas (orange)

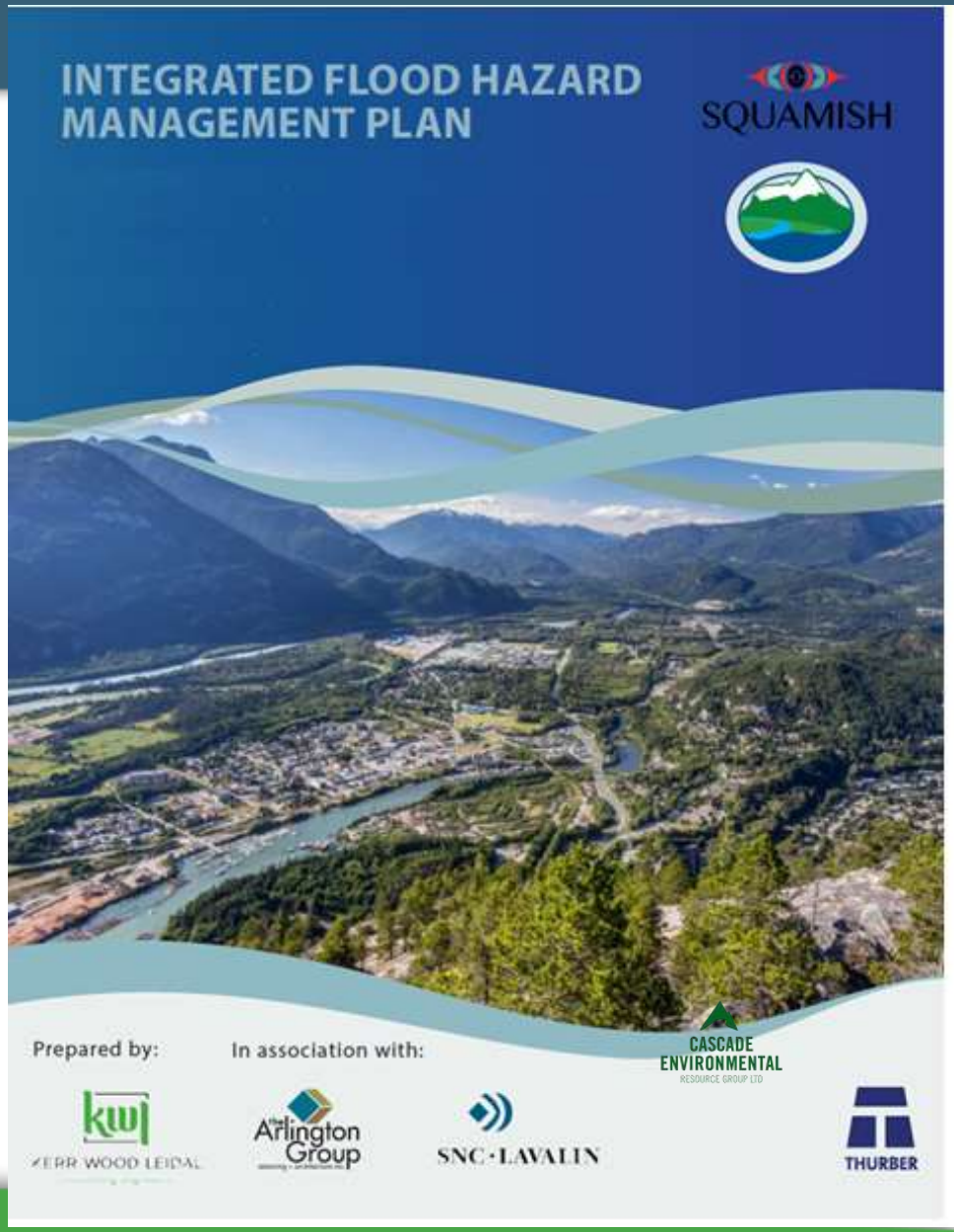
Original recommendation: all red

Council prioritized development
Major dike upgrades, less control
Good decision? Bad decision?
Their decision.



Summary

- Comprehensive plan
- Groundbreaking technical work
- Final deliverables:
  - Capital plan
  - Comprehensive policy framework



Conclusions

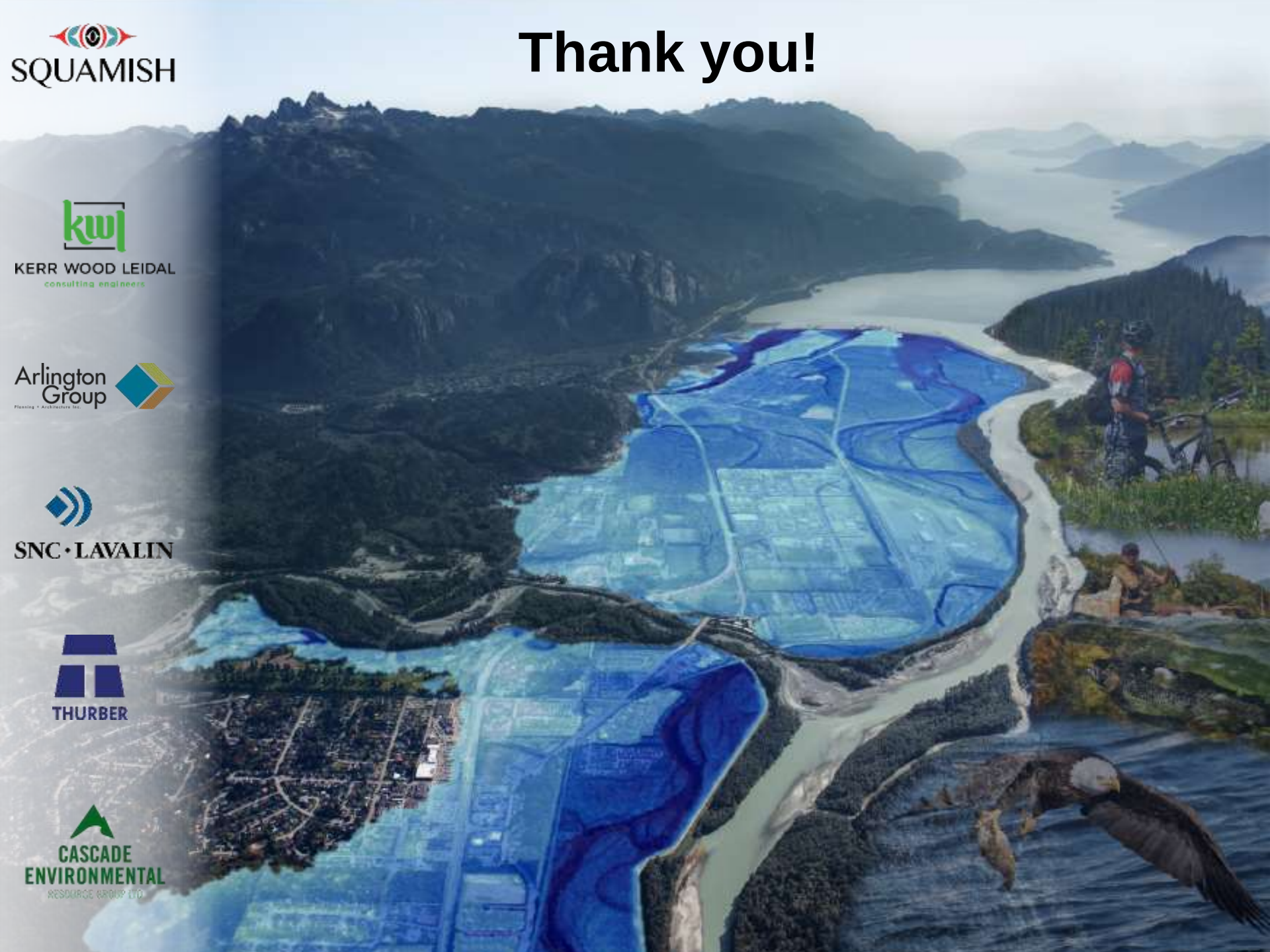
- Natural hazards don’t scale to our desired budget
- Analyze and manage risk on a “systems” scale
- Consider how hazards, development, mitigation interact
- Plan for the future to avoid moving goalposts
- Explore all practicable solutions
- Different approaches in different areas (and that’s OK!)
- Respect the value of community buy-in

Becoming IFMP / IWMP / ISMP Champions

- Difficult problems mean difficult discussions…
- Work toward consensus, but don't assume you'll get it
- There is no free lunch!

- The prize is worth the fight

Thank you!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