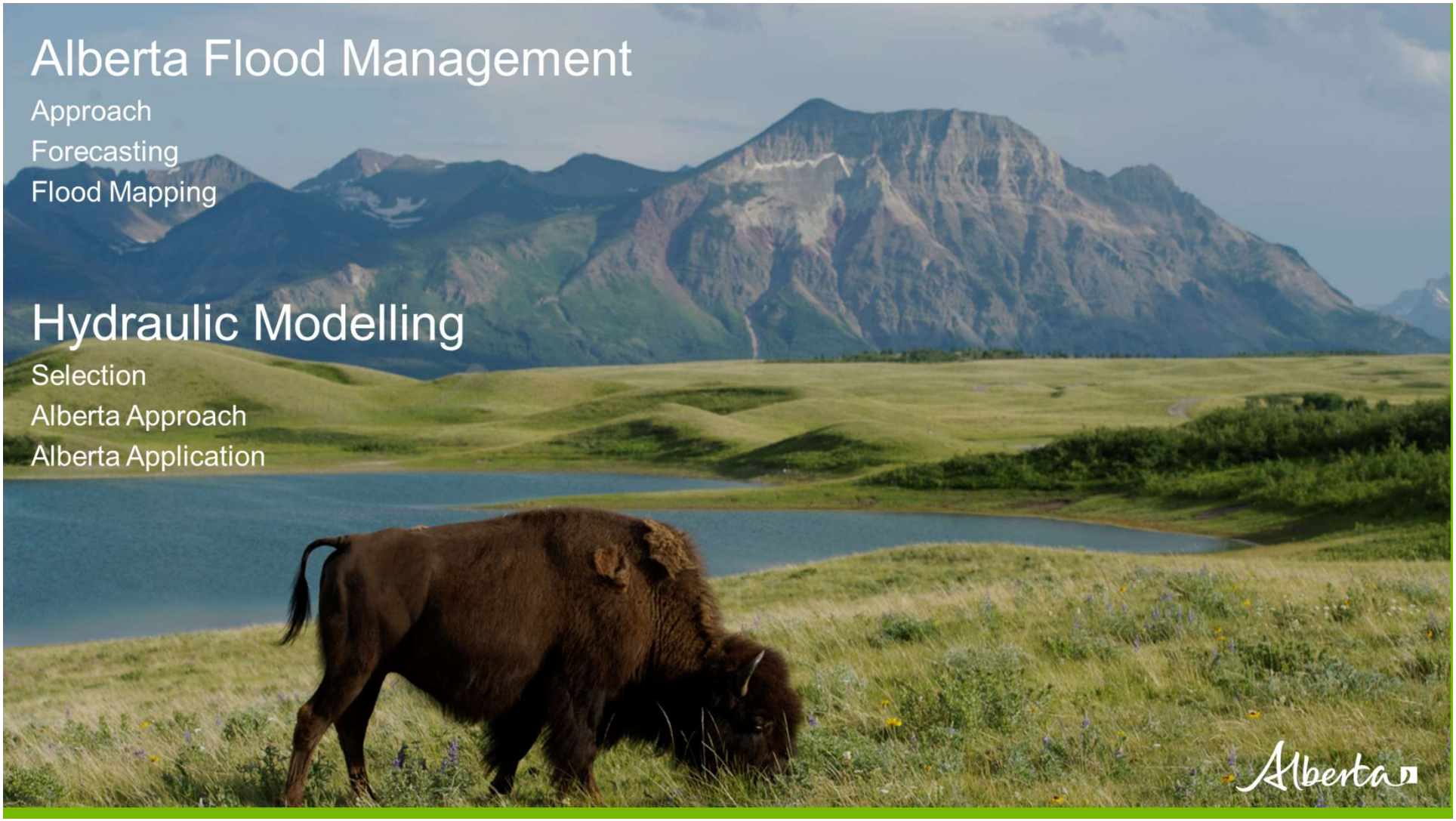
2019 Ontario Technical Transfer Workshop

2D or not 2D

and Other Musings from Alberta

Bryce Haimila, B.Sc., CFM
River Engineering and Technical Services
Alberta Environment and Parks

Alberta


Alberta Flood Management
Approach
Forecasting
Flood Mapping
Hydraulic Modelling
Selection
Alberta Approach
Alberta Application
Alberta

Alberta Flood Management

Approach

Approach

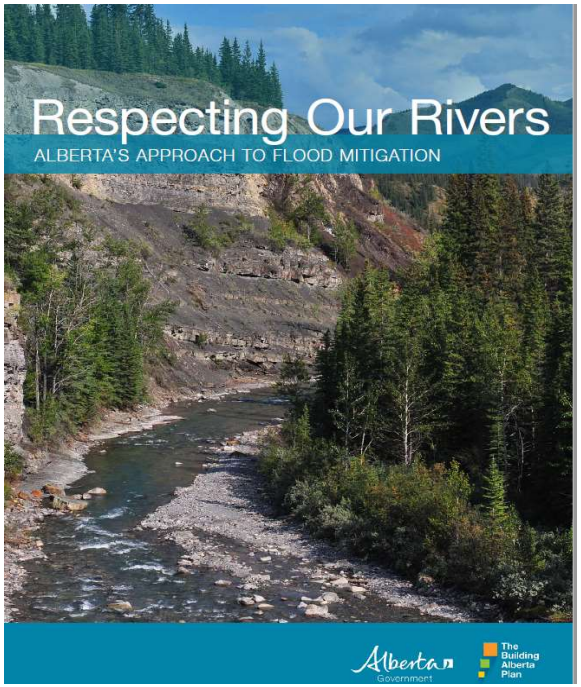
“Respecting Our Rivers”

Watershed Management

- Connect to other water initiatives

Flood Management

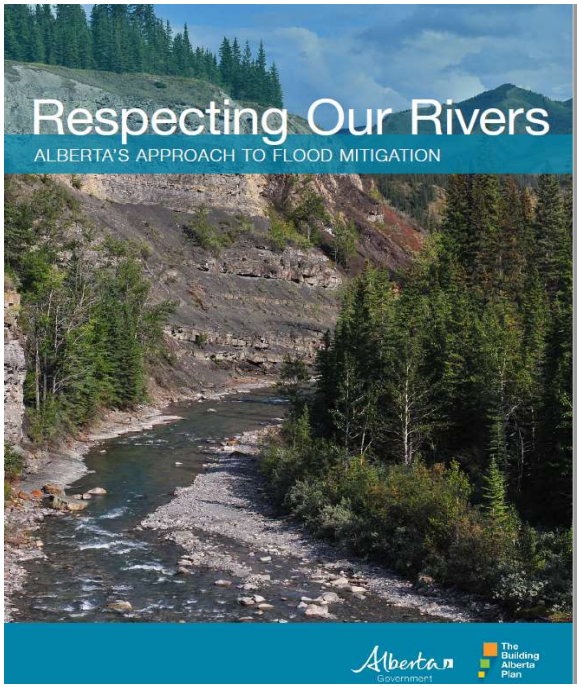
- Policy Development
  - Strategies
  - Legislation/Regulation
  - Guidelines



Alberta

Approach

“Respecting Our Rivers”



Actions

- Floodway re-location
- Grant program for small scale structural
- Planning for large scale structural
- Program reviews and adaptation
- Forecasting
- Flood Mapping

Alberta

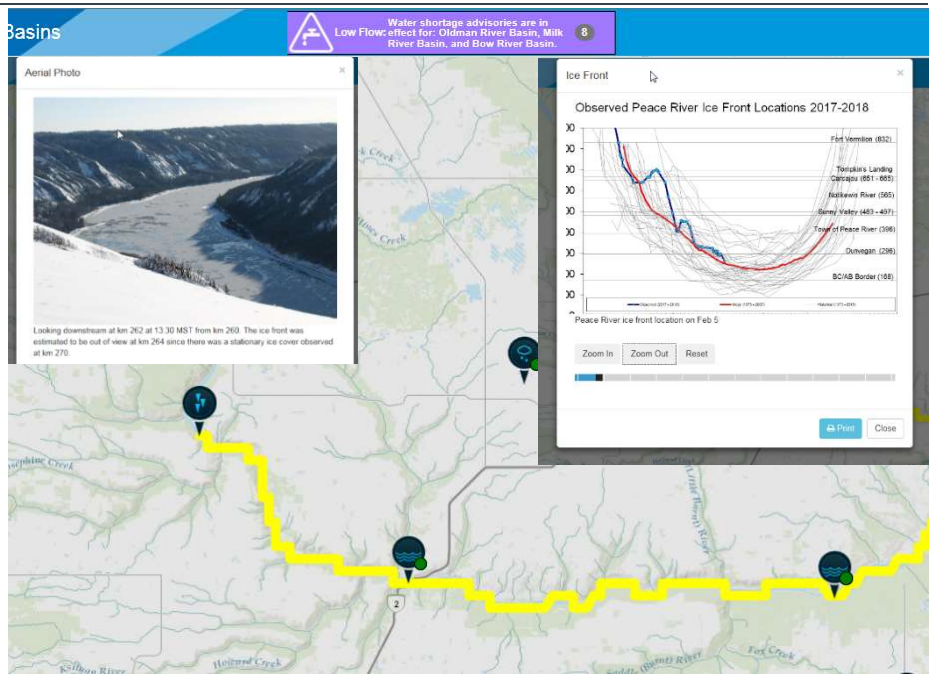
Alberta Flood Management

Forecasting

Forecasting Update

Website

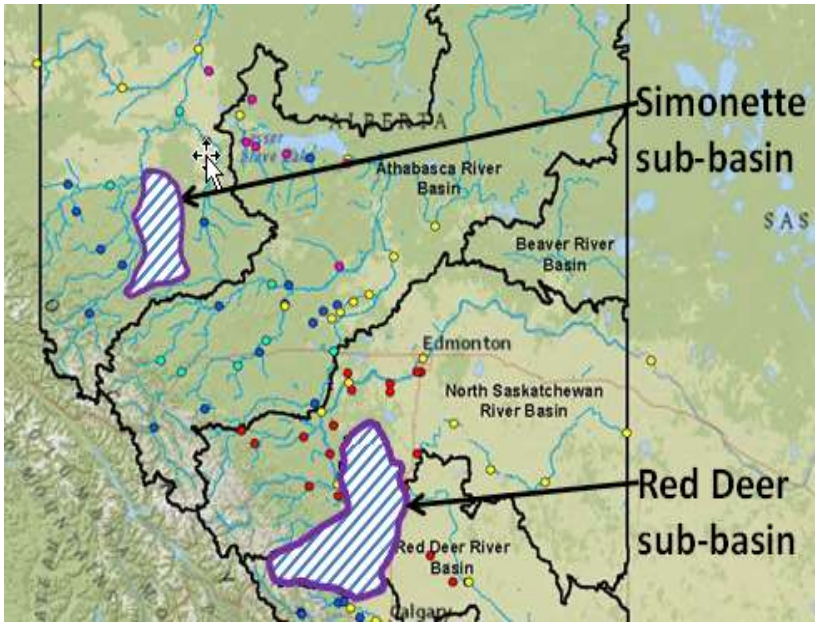
- rivers.alberta.ca
- Integrate Advisory Creator into website functions
- Archive ice observation reports



Forecasting Update

New Runoff Models

- Phase 1
- Phase 2
  - Models tested - NWS Suite, HEC-HMS, HFAM, Raven, Mike-Hydro, MESH
- Phase 3
  - Models to be tested - MIKE-SHE, HBV, WaSIM or UBCWM or HYPE
- Phase 4
  - SSARR comparison, decision, initiate model change process - possible 5-10 year timeframe



Forecasting Update

New Platform

- Phase 1
  - 3 platforms reviewed
  - Deltares Delft FEWS selected
- Phase 2
  - Training and Design
  - By March 2020
- Phase 3
  - Run in parallel during transition

Alberta

Alberta Flood Management

Flood Mapping

History

History

Pre-FDRP

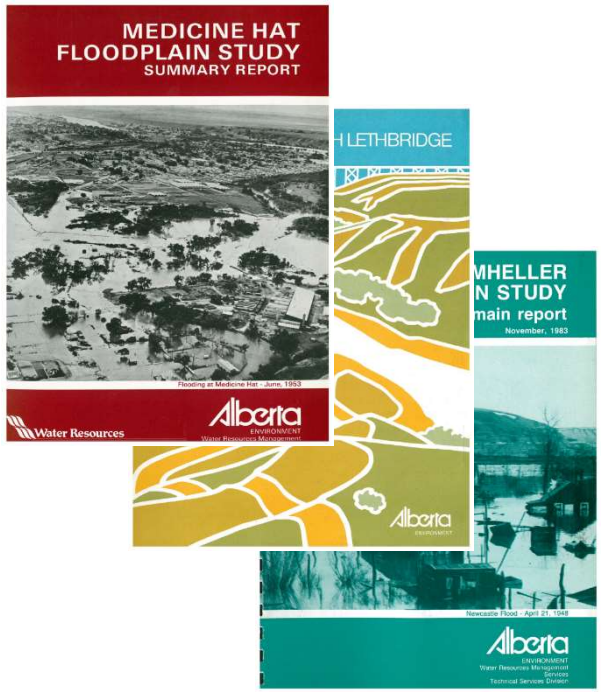
- 1970s

FDRP

- Alberta joined in 1989
- Standards set

FHIP

- After 1999, provincial Flood Hazard Identification Program
- Previous standards generally kept



Alberta Flood Management

2013 Flood

2013

OVER 14,500
HOMES DAMAGED

80
SCHOOLS DAMAGED

10
HEALTH FACILITIES DAMAGED

30
COMMUNITIES IMPACTED

985
KM
ROADS CLOSED

3,000
BUSINESSES AFFECTED

100,000
PEOPLE EVACUATED

Alberta

2013

River Data Collected

- High Water Marks
  - Hundreds surveyed
- Aerial Flood Photography
- Regular photography

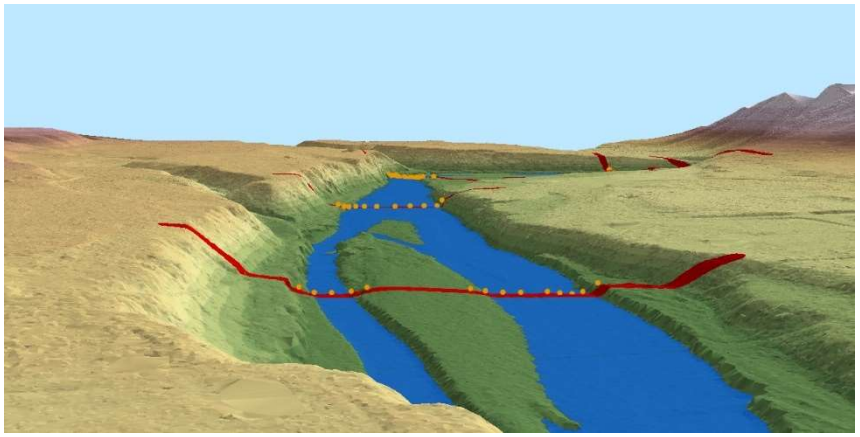
Alberta Flood Management

Flood Mapping
Standards and Products

Standards and Products

Topography

- LiDAR +/- 0.15 m vertical at 95%
- Control survey to confirm LiDAR
- LiDAR owned by province, free to all
- River Survey +/- 0.05 m



Aerial Imagery

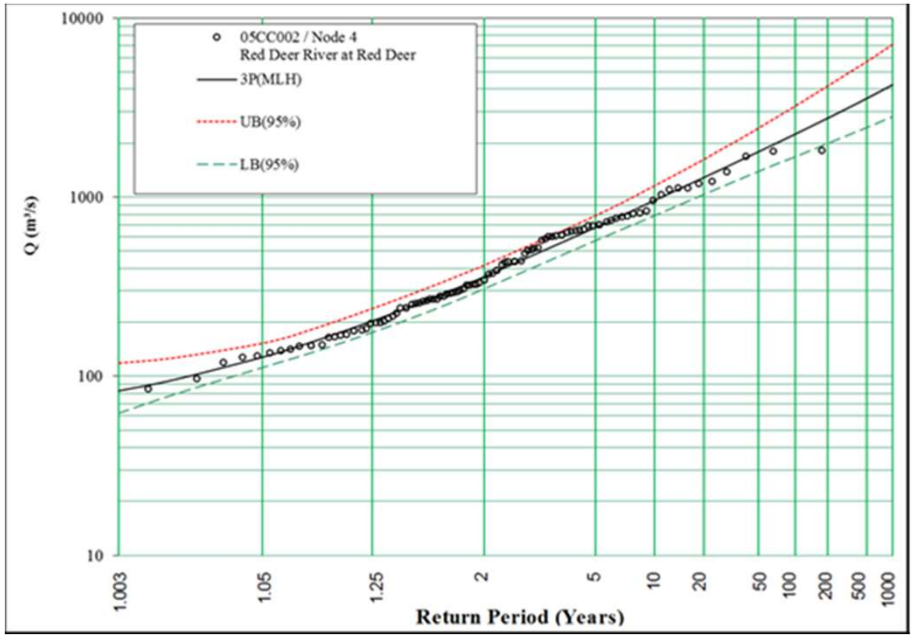
- 30 cm resolution

Alberta

Standards and Products

Hydrology

- Statistical analysis of recorded data
- Assess natural and regulated
- Bulletin 17B/C – method of including large historical events
- Climate change considerations
  - Currently qualitative

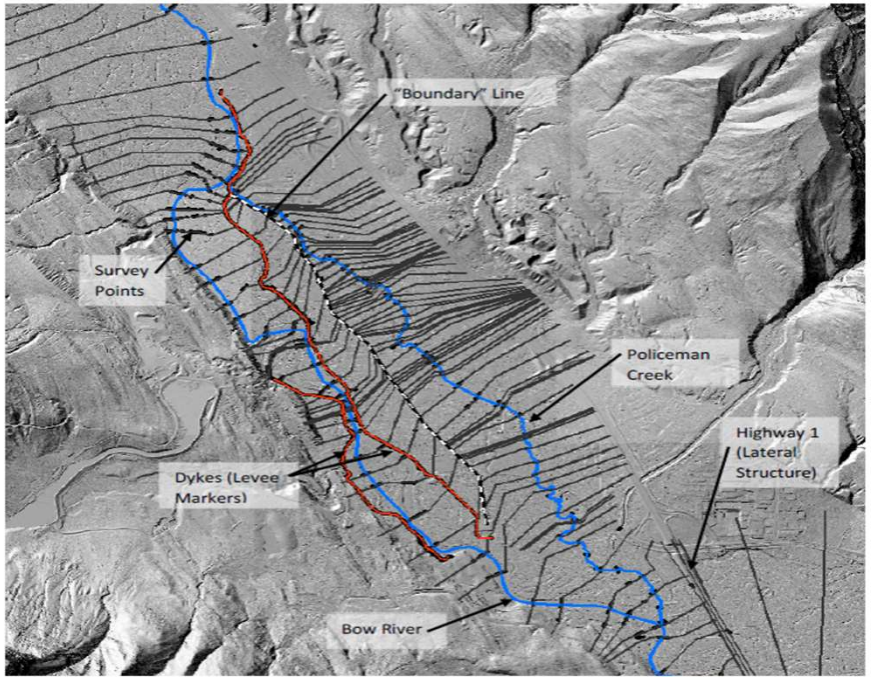


Standards and Products

Hydraulics

- Typically 1D HEC-RAS
- 1D occasionally informed by 2D modelling

More on this later!



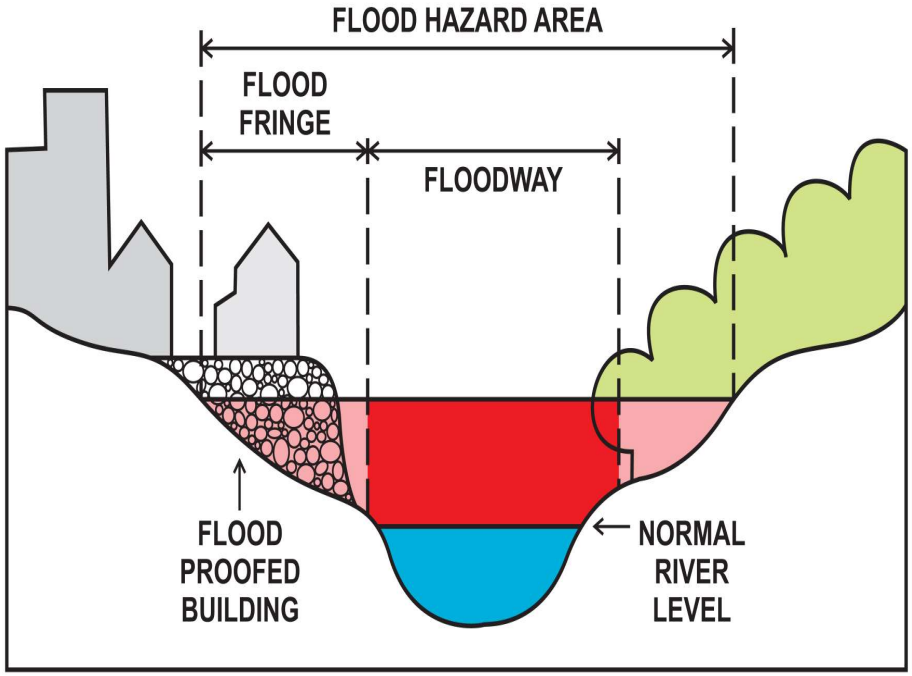
Standards and Products

Flood Hazard Map

- Mechanism of flooding can be ice or open water
- 1% flood (100-year, 1:100)
- Two-zone
- Design flood levels use “encroached to floodway” levels
- Encroachment criteria

  - 1 m depth and 1 m/s velocity

  - 0.3 m maximum rise threshold (not forced)

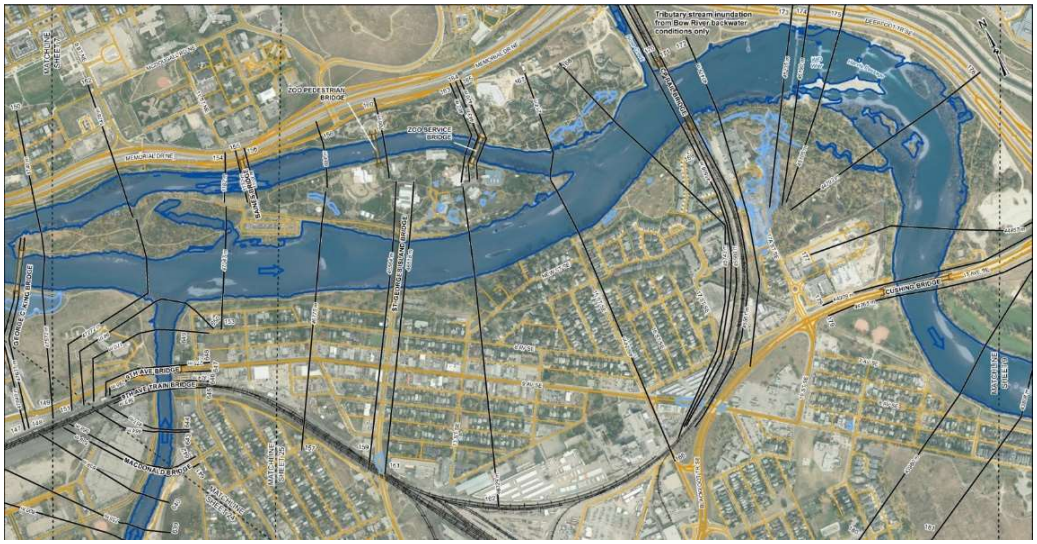


Standards and Products

Inundation Maps

- Previously 3 scenarios
  - 10, 50 and 100 year

- Now 13 scenarios
  - 2, 5, 10, 20, 35, 50, 75, 100, 200, 350, 500, 750, 1000 year



Alberta

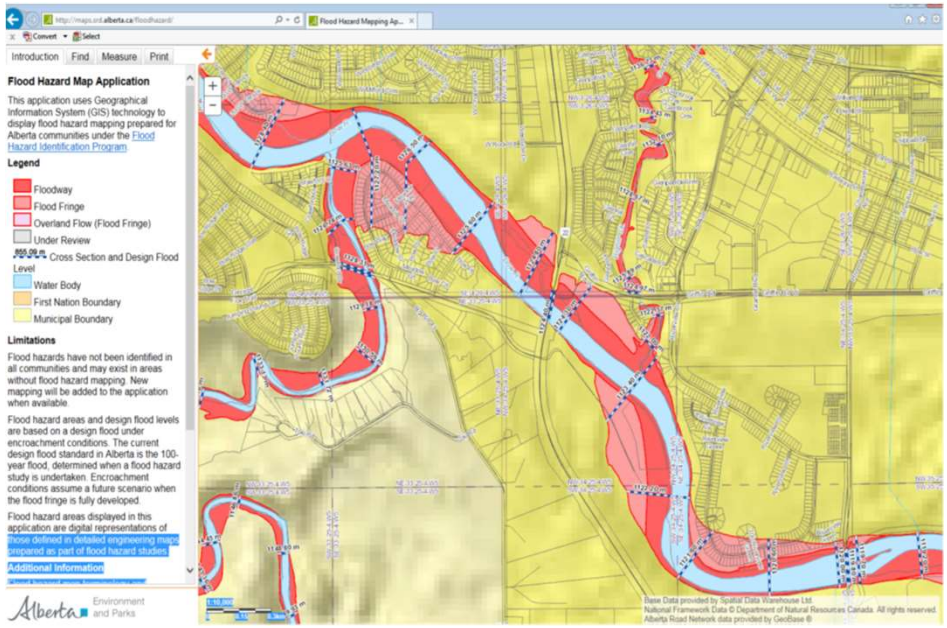
Standards and Products

Flood Hazard Map

- Floodway – red
- Flood fringe – pink
- Elevations at cross sections

Website

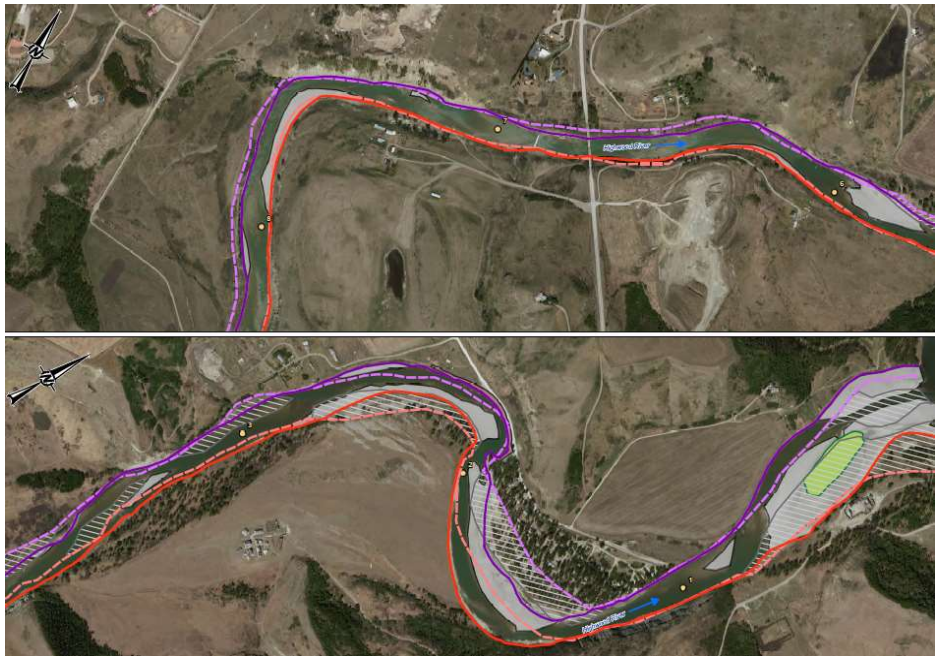
- http://maps.srd.alberta.ca/FloodHazard/
- Interactive GIS based
- Link to technical reports
- Program information
- Study progress reports



Standards and Products

Channel Stability

- Historical aerial photo comparison
  - 1951 dashed vs. 2016 solid

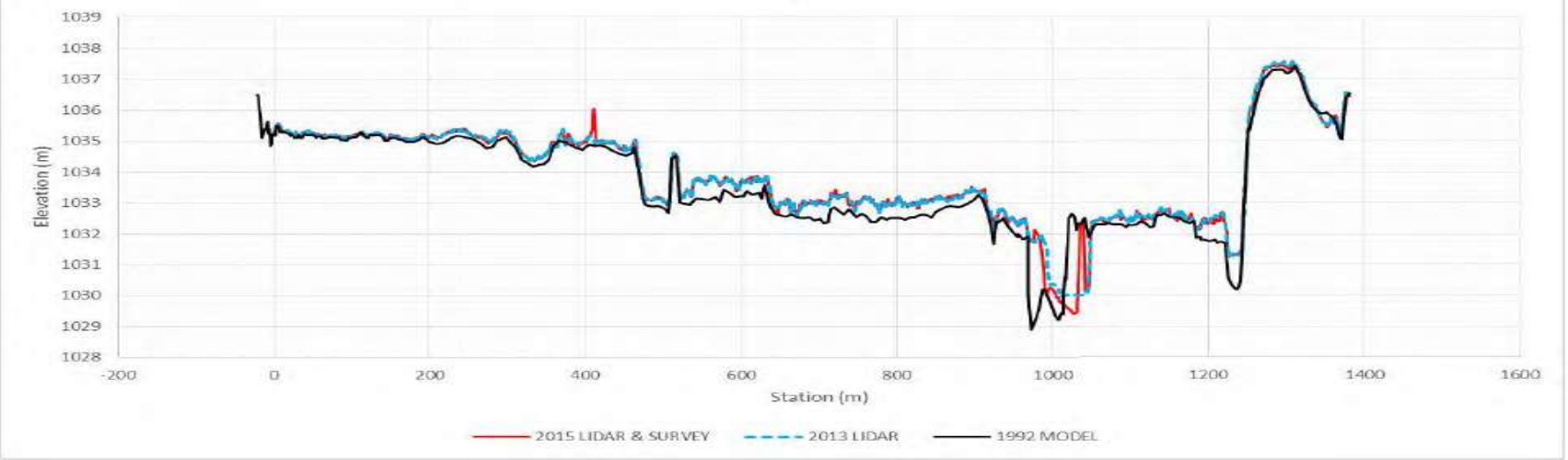


Alberta

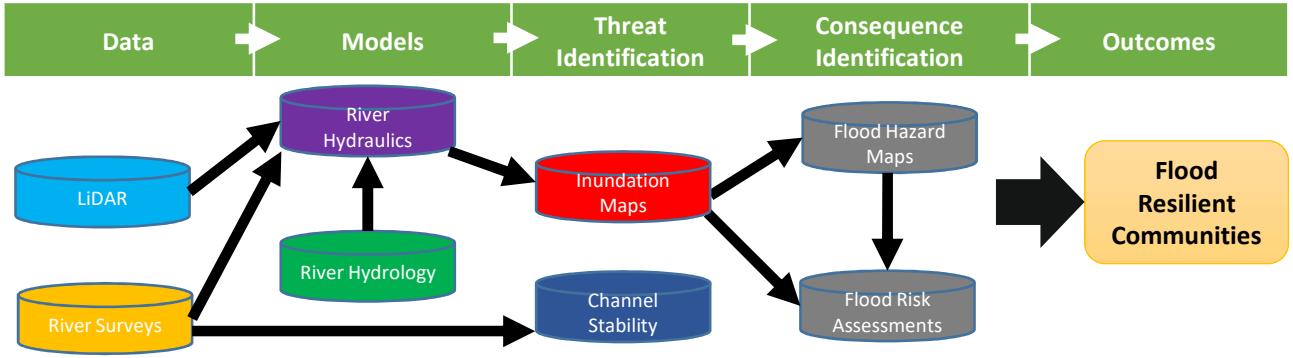
Standards and Products

Channel Stability

- Historical cross section comparison



Uses



Provincial	-high quality LiDAR available for all purposes	-assess Water Act approvals -assess flood mitigation options -input into other modelling (environmental, etc.)	-emergency preparedness plans -emergency response during flood (POC) -illustrates provincial flood forecasts	-flood payout eligibility (DFAA/DRP) -regional plans -provincial assets in safer locations -floodway dev. regulation -floodway relocation program -flood mitigation design (ACRP)	-safer people, property -environmental health (riparian areas) -reduction of flood related liability & costs (DRP) -informed decision makers -floodproofed government buildings
Municipalities, Indigenous Communities	-high quality LiDAR available for all purposes	-assess impacts of future river works, flood mitigation design, other infrastructure	-emergency preparedness plans -emergency response during flood	-land use bylaws -area structure plans -riparian integrity (within floodway zone)	-safer people, property -environmental health (riparian areas) -reduction of flood related liability & costs
Public, NGOs, consultants	-high quality LiDAR available for all purposes	-can be used to assess impacts of future river works or flood mitigation design	-informs landowners of various flood possibilities	-informs landowners of development possibilities -enables safer development	-safer, informed people and property

24

Alberta Flood Management

Flood Mapping

New Work

New Work

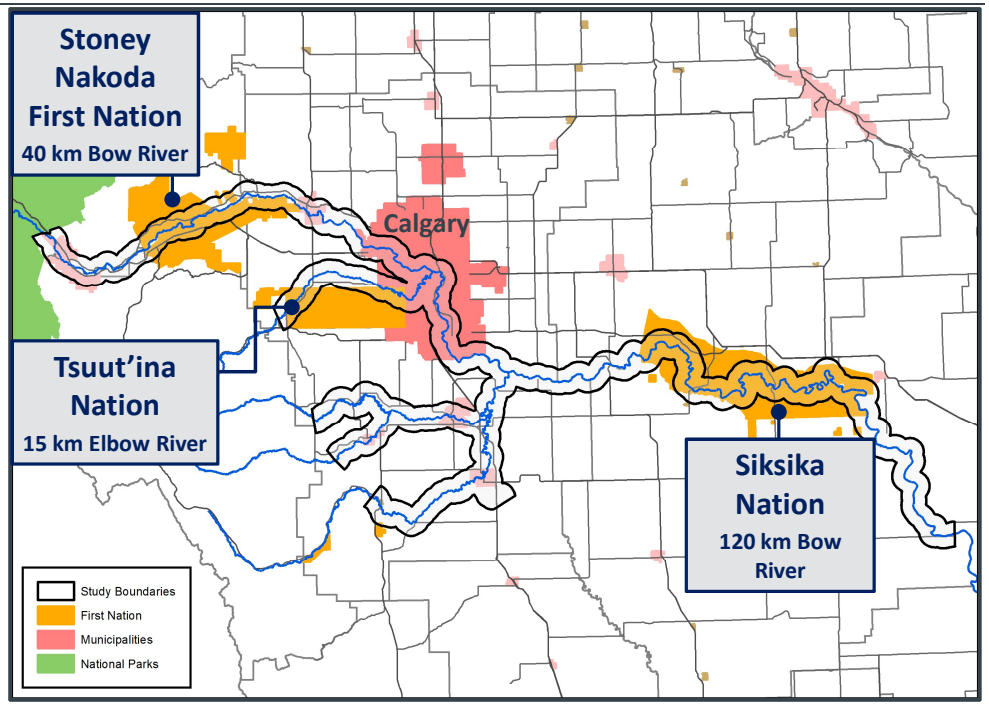
Hydrology – Climate change considerations

- Current flood mapping standards don't directly address climate change
- Can be addressed by
  - Using a higher return period flood
  - Applying a freeboard to water levels
  - Incorporating climate change science and scenario modelling into design flow calculations
- Current Research - partnered with NRCan, City of Calgary, U of S – GWF (Pomeroy)
  - Diagnosis of Historical and Future Flow Regimes of the Bow River at Calgary – Using a Dynamically Downscaled Climate Model and Physically Based Land Surface Hydrological Model

New Work

Mapping Studies since 2015

- 13 large new flood mapping studies underway or completed
- Over 1,300 km of new and replacement mapping
- 30+ communities, including indigenous communities
- 8 new small studies proposed, dependent on NDMP co-funding
- Engagement with stakeholders followed by finalization of mapping products



New Work

Applications

- Flood hazard mapping website
- Flood Awareness Mapping Application – under development
  - Interactively display all 13 inundation extent scenarios - may show depths, probabilities

Policy

- Channel migration and steep creek
  - Guideline development
- Floodway development regulation, pending
- Further integration within the GoA (water and flood management)
- Design Flood
  - Hydrology – frequency, climate change effects
  - Floodway – criteria evaluation, utilizing new technologies

Hydraulic Modelling

2D or not 2D

2D or not 2D

1D HEC-RAS Advantages

- In the past, widely accepted for flood modelling and mapping purposes in North America
- Well understood, expertise common in the engineering community
- Supported by the USCAE, free download, public domain, peer reviewed
- Built-in floodway encroachment analysis
- Simplified geometry requirements
- Inherent program assumptions simplify output

1D HEC-RAS Disadvantages

- Inherent program assumptions simplify output
- Challenges to accurately represent complex flow
- Parameter selection – limited and potentially cumbersome
- Hard to explain and visualize to a non-technical audience

2D or not 2D

2D Advantages

- Getting cheaper, getting less cumbersome, good for complex flow situations
- Expertise continuing to grow in the engineering community
- Easier to explain and visualize to a non-technical audience

2D Disadvantages

- In the past, model setup challenging
- Many models, additional familiarity required, more challenging for regulators to review
- Larger geometry requirements (DTM and bathymetry)
- Computing time for large models
- Doesn’t lend itself to “encroached to floodway” elevations in floodplain

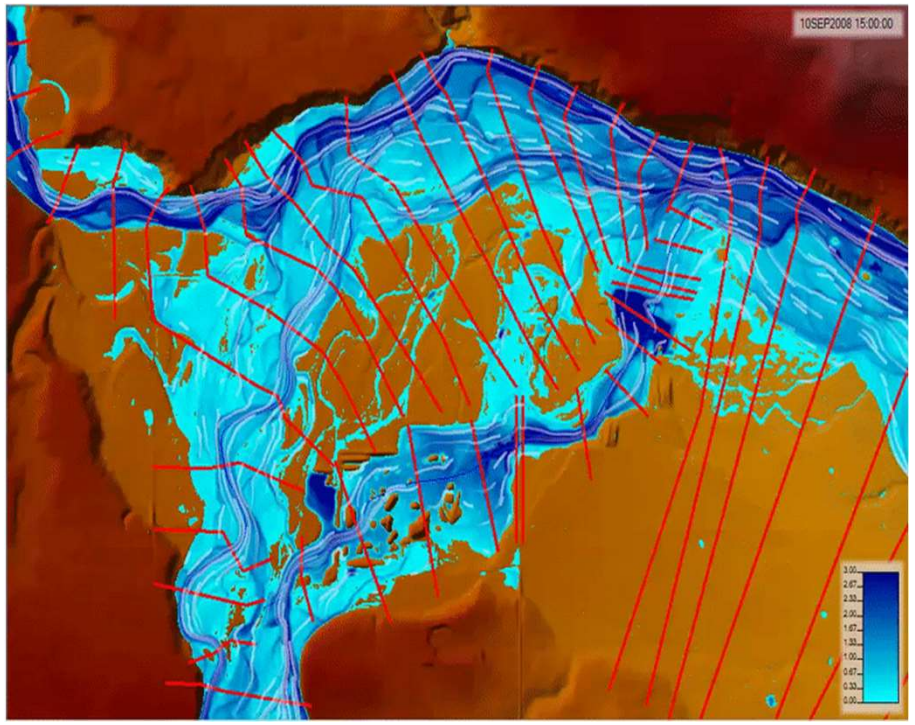
Hydraulic Modelling

Alberta Approach

Alberta Approach

2D Modelling

- In Alberta “Encroached to Floodway” design flood elevations complicates 2D application
- Simplified 2D models can inform 1D cross section layout
- Detailed 2D models can inform flow split discharges
- Detailed 2D models can inform understanding of complex overflow in floodplain



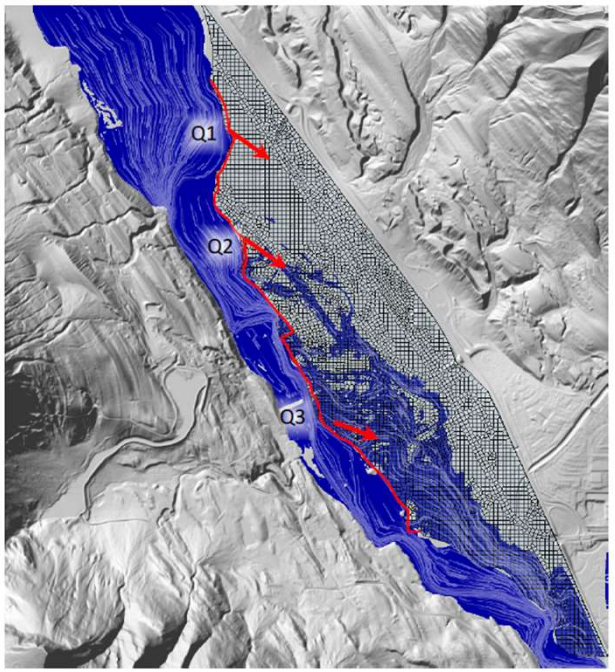
Hydraulic Modelling

Alberta Application

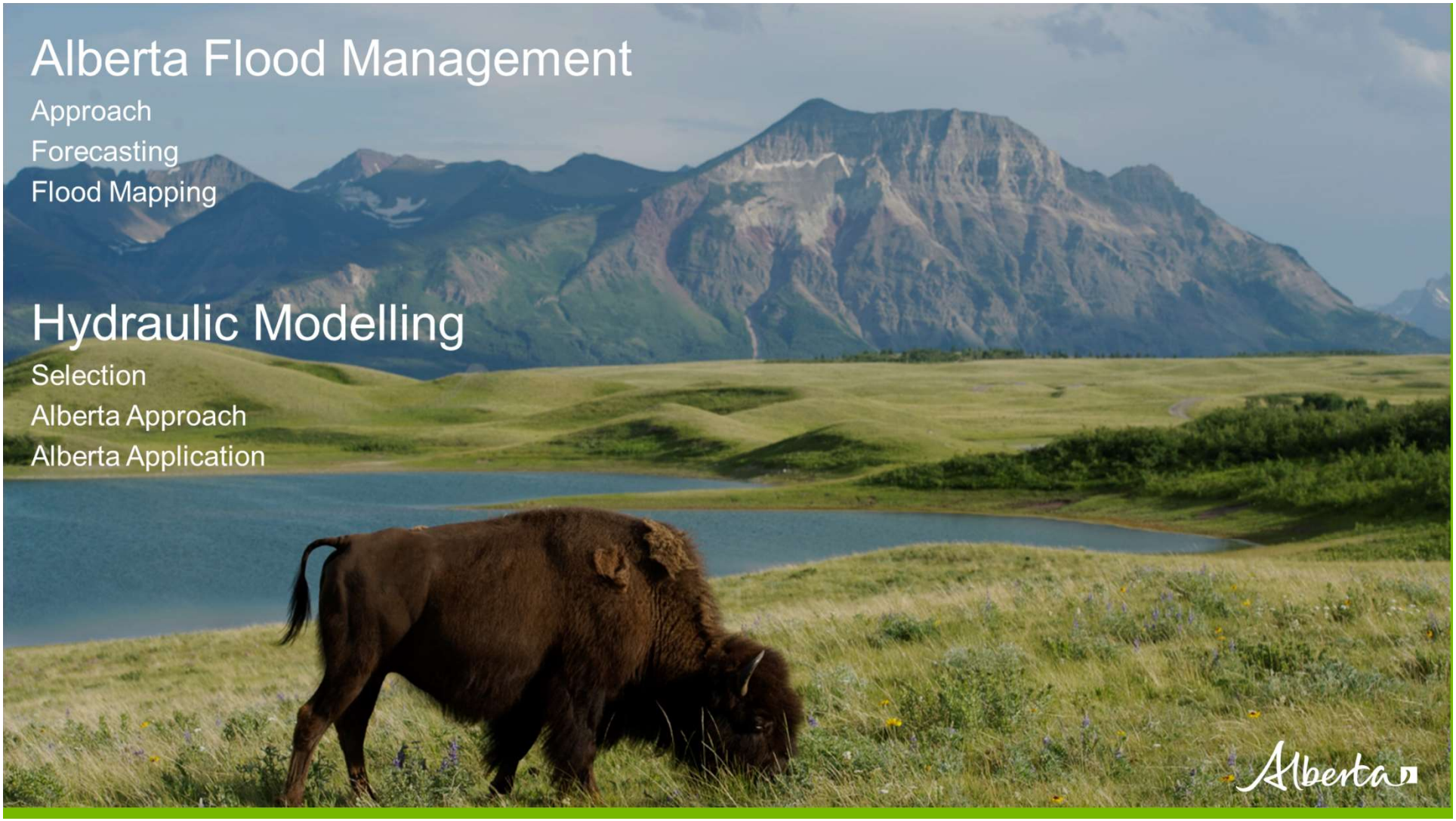
Alberta Application

2D Modelling examples

- 2D models used by most of our current consultants to layout 1D river cross sections
- Mike Flood used prominently to determine flow split upstream of High River in Highwood River Study
- HEC-RAS 2D used to understand complex overflow in Canmore area



100-year


Alberta Flood Management
Approach
Forecasting
Flood Mapping
Hydraulic Modelling
Selection
Alberta Approach
Alberta Application
Alberta

Questions?