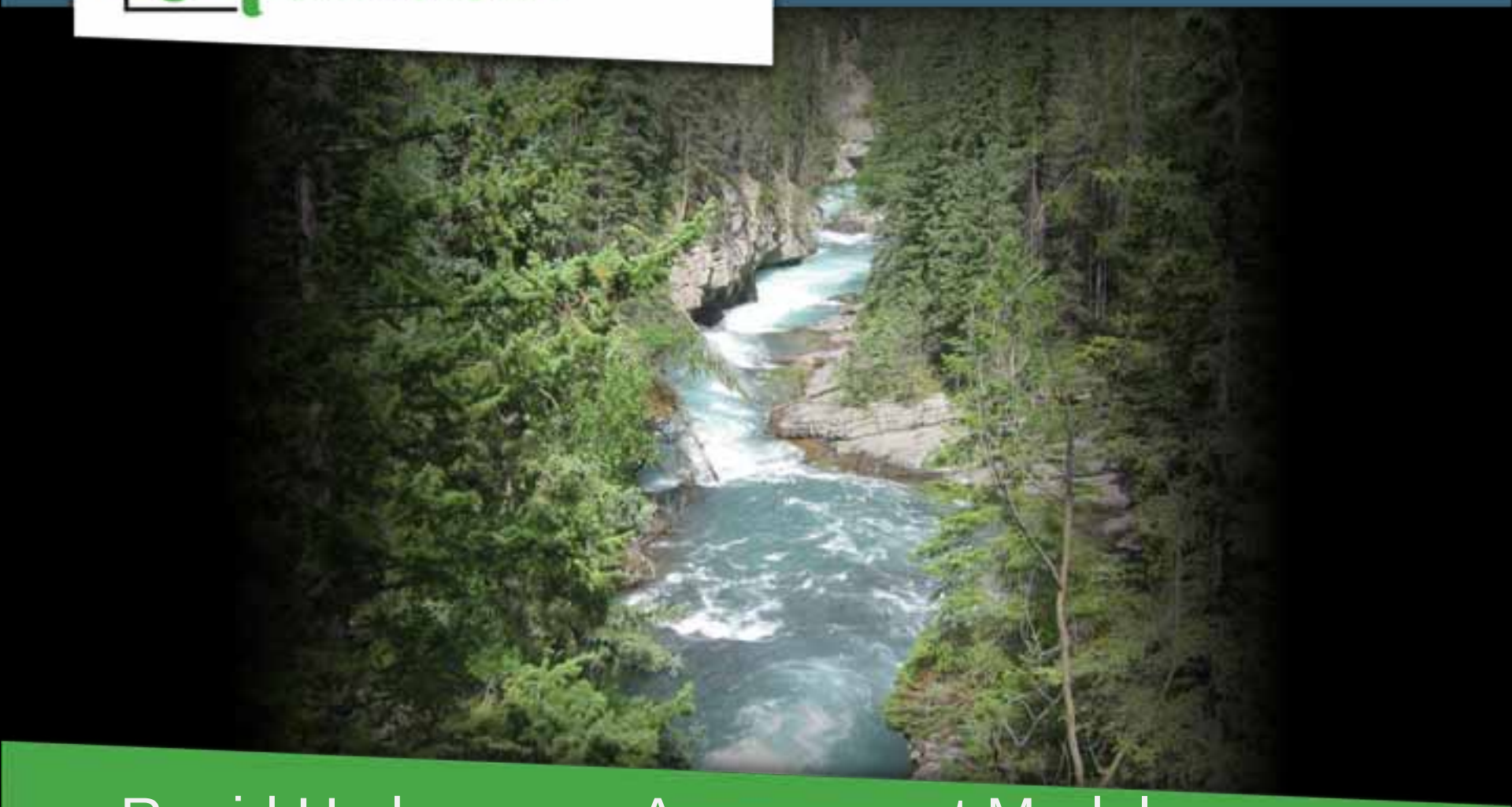
KERR WOOD LEIDAL
consulting engineers



Rapid Hydropower Assessment Model Identifying Hydroelectric Sites Using GIS

Ryan Taylor, GISP **Nan Dai, P.Eng**

Outline

- About Kerr Wood Leidal and BC Hydro
- What is RHAM
- Application of RHAM
- Model Development
- Storage Analysis
- RHAM Online

About Kerr Wood Leidal

- Engineering consulting company located in Vancouver, BC
- Employee owned (130 full-time employees)
- ESRI users since 1998 (ArcView 3.2)
- Now run ArcGIS Desktop & ArcGIS Server 10.1
- Over 35 staff use ArcMap weekly or daily

About BC Hydro

- A provincial crown corporation and Canada's third-largest electric utility headquartered in Vancouver, BC
- Reports to the BC Ministry of Energy and Mines, and is regulated by the British Columbia Utilities Commission

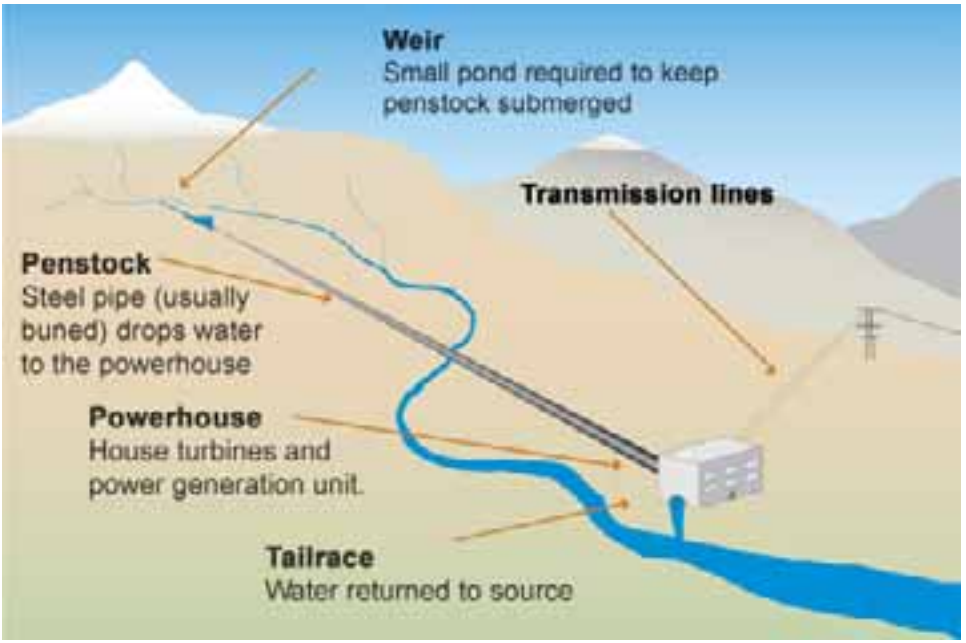
About BC Hydro

- Has approximately 1.8 million customers and serves 95 per cent of B.C.'s population by delivering electricity safely and reliably at competitive rates
- Operates 31 hydroelectric facilities and three natural gas-fired thermal generating plants totaling 12,000 megawatts (MW) of installed generating capacity

Rapid Hydropower Assessment Model

- Created to identify new clean energy sources
- Determines potential for small hydro projects
- Works anywhere in the world (where data is available)
- 2008 Consulting Engineers of BC Award of Merit
- 2009 GeoTec Conference & Exhibition Map Gallery Competition Winner

Typical Small Hydro Project



Intake Weir

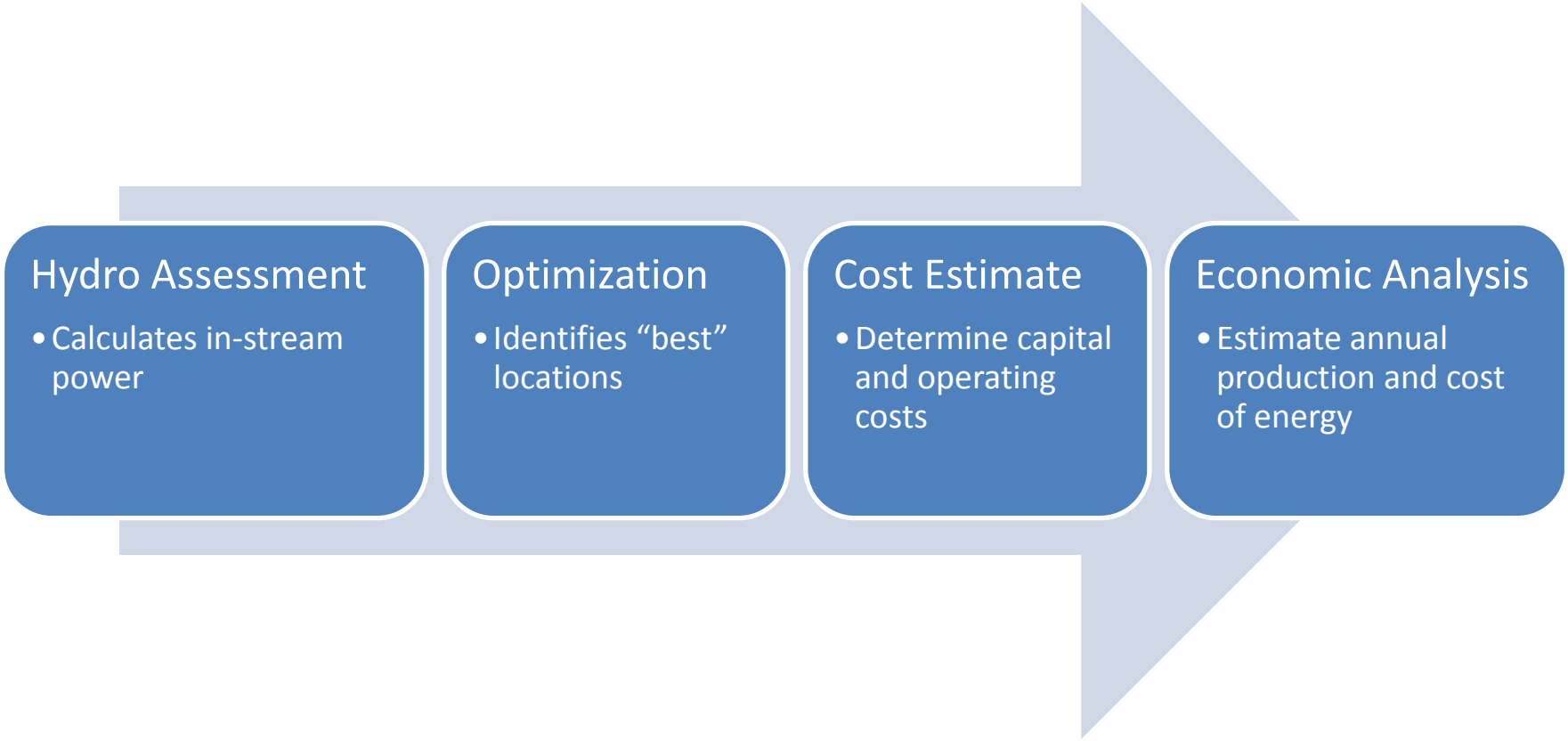
Penstock

Powerhouse

Application of RHAM

- RHAM projects to date:
  - British Columbia
  - Yukon
  - Mexico
  - Southeast Asia
- Can be used on large areas (e.g. BC) or small scale (watershed-level)

RHAM Operations

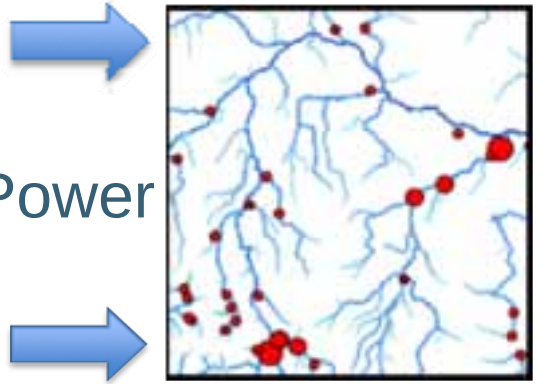


Stream Power

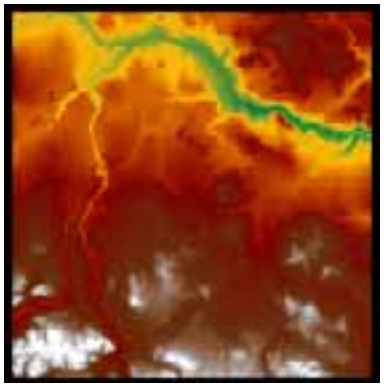
Power = γ_w Q H η

- γ_w unit weight of water
- Q (flow) from regional hydrologic model
- H (head) from digital elevation model
- η efficiency

Flow



Power

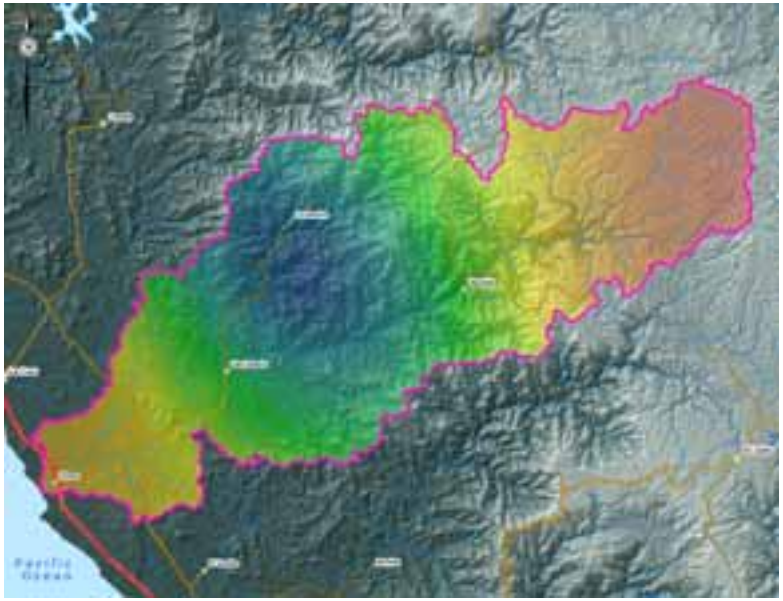


Head

Optimization

How to find this…

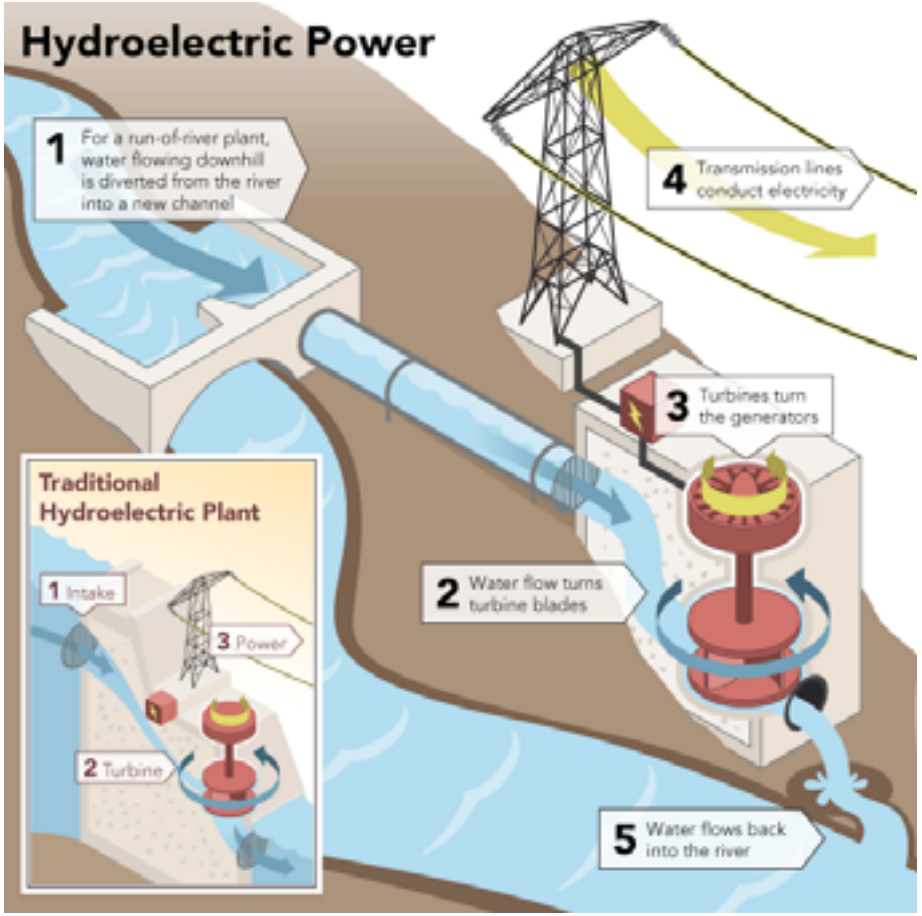
…using this



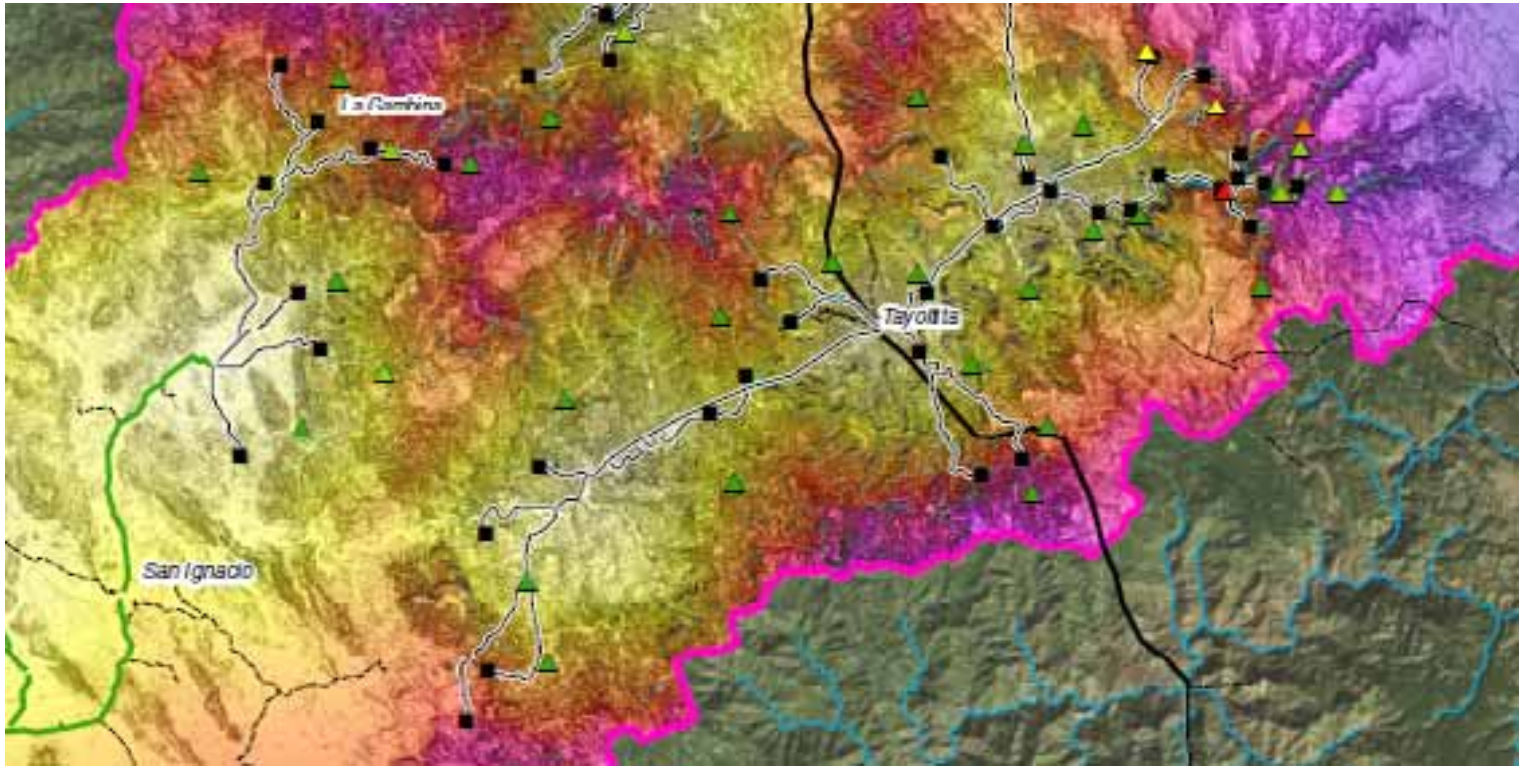
…for the least $

Cost Estimating

- Site-Based Costs
  - Intake
  - Penstock
  - Powerhouse
  - Electrical Generating Equipment
- Access Costs
  - Road
  - Powerline

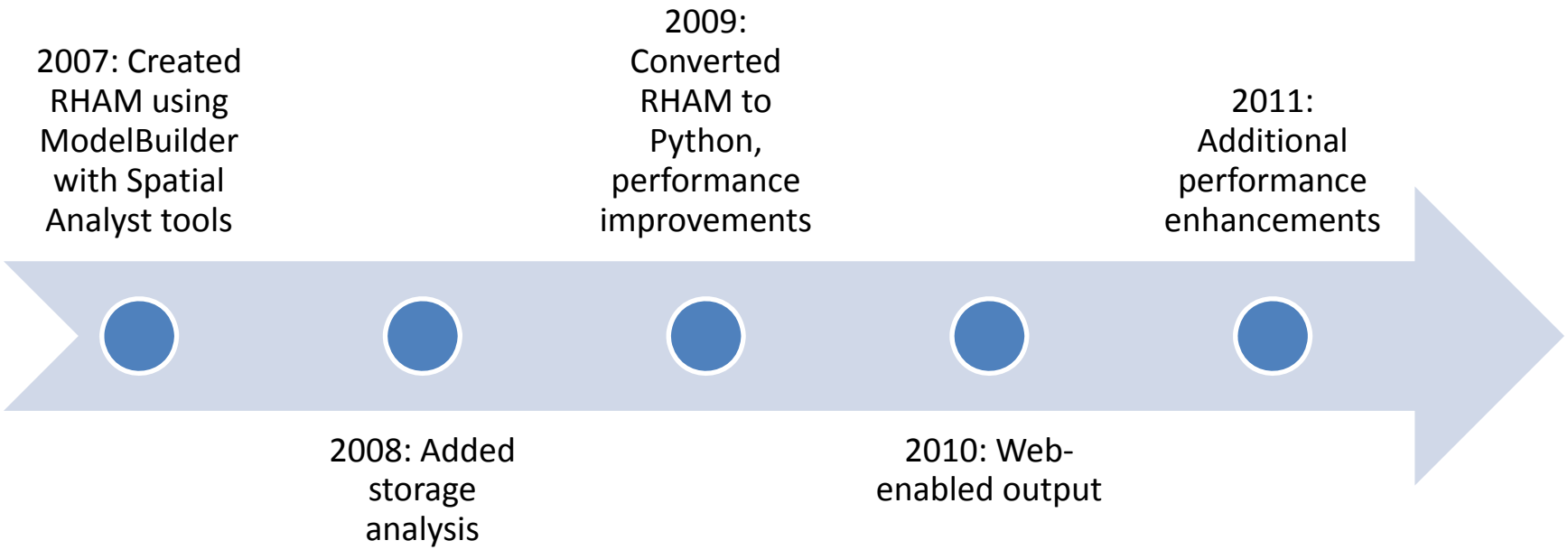


Cost-Distance Modelling

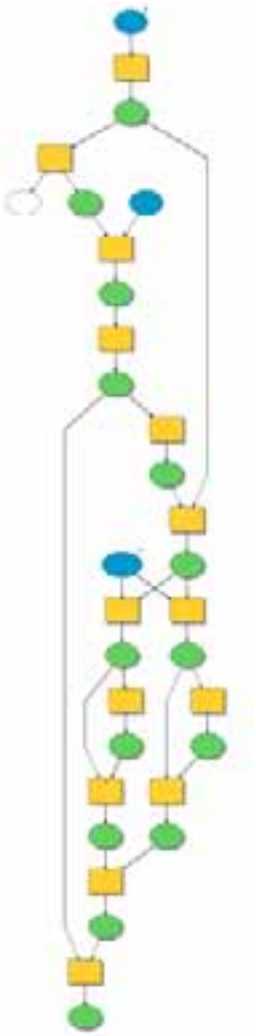


- Roads and Powerlines
- Terrain Model to Cost Surface (DEMS, etc.)
- Generate Pathways for Roads, Powerlines, etc.

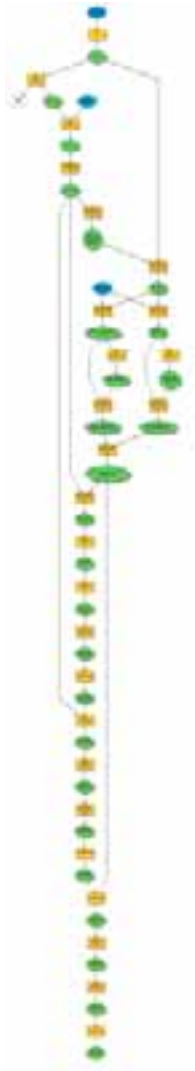
Model Development



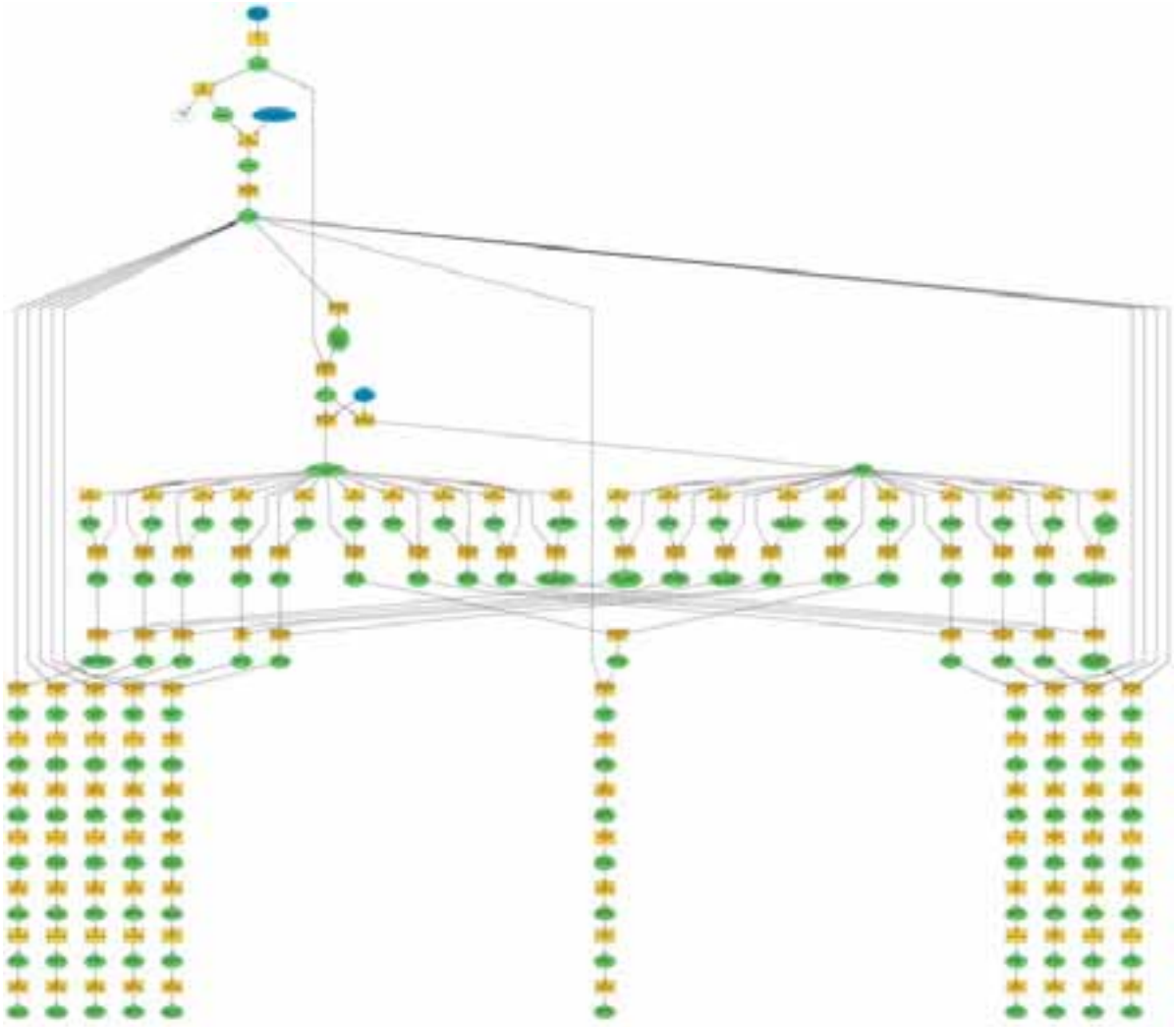
RHAM Model History (v.1)



RHAM Model History (v.2)



RHAM Model History (v.3)



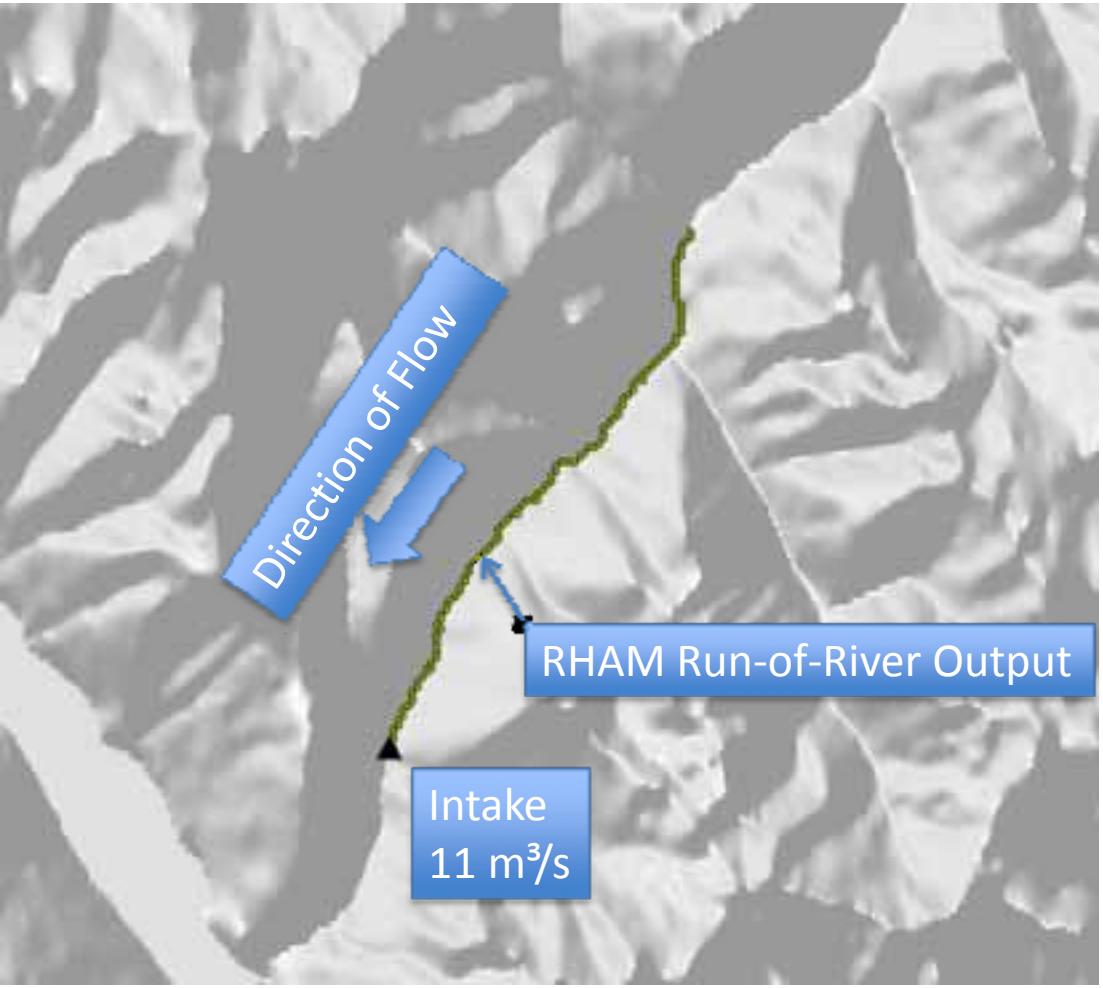
RHAM Model History (v.4) (Current)

94 lines of Python code

Storage

- Increases Dependable Capacity
- Increases Energy Delivered when Needed by Customers
- Increases Energy Production
- Increases Flow for Aquatic Habitat
- Reduces Downstream Flood Risks

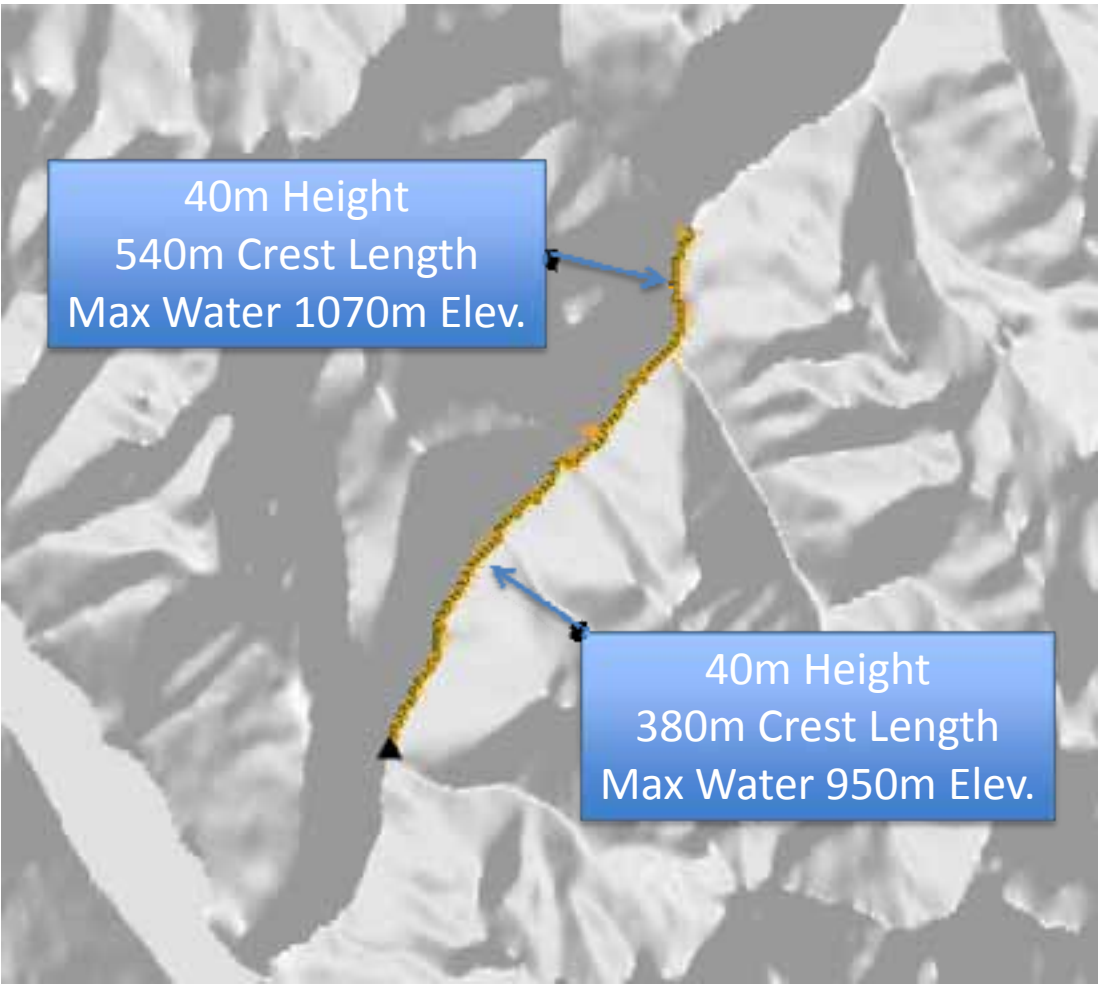
Storage Analysis in RHAM



Inputs

- Use RHAM Run-of-River Output as Input
- Select Dam Heights (user defined)

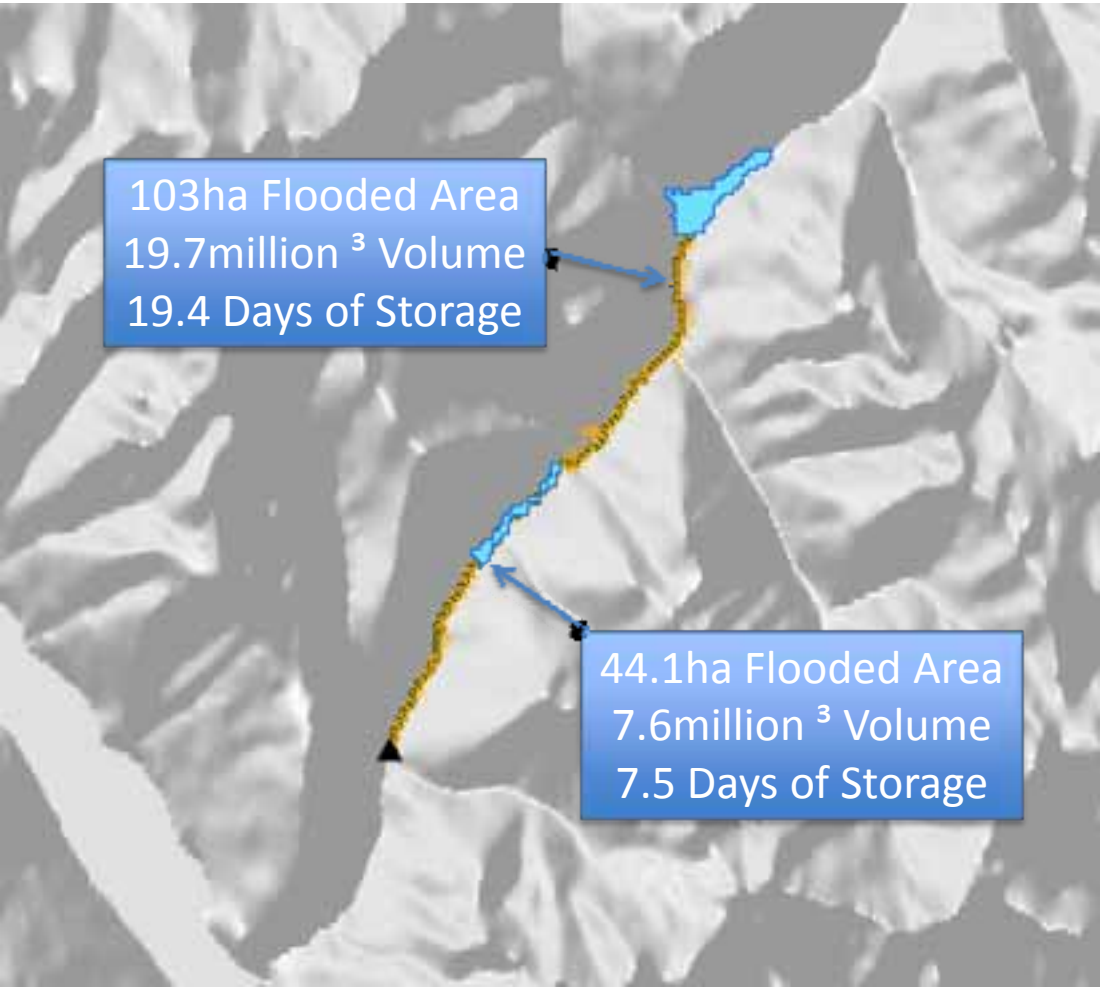
Storage Analysis in RHAM



Process

- Dam Height
- Dam Length
- Max Water Elevation

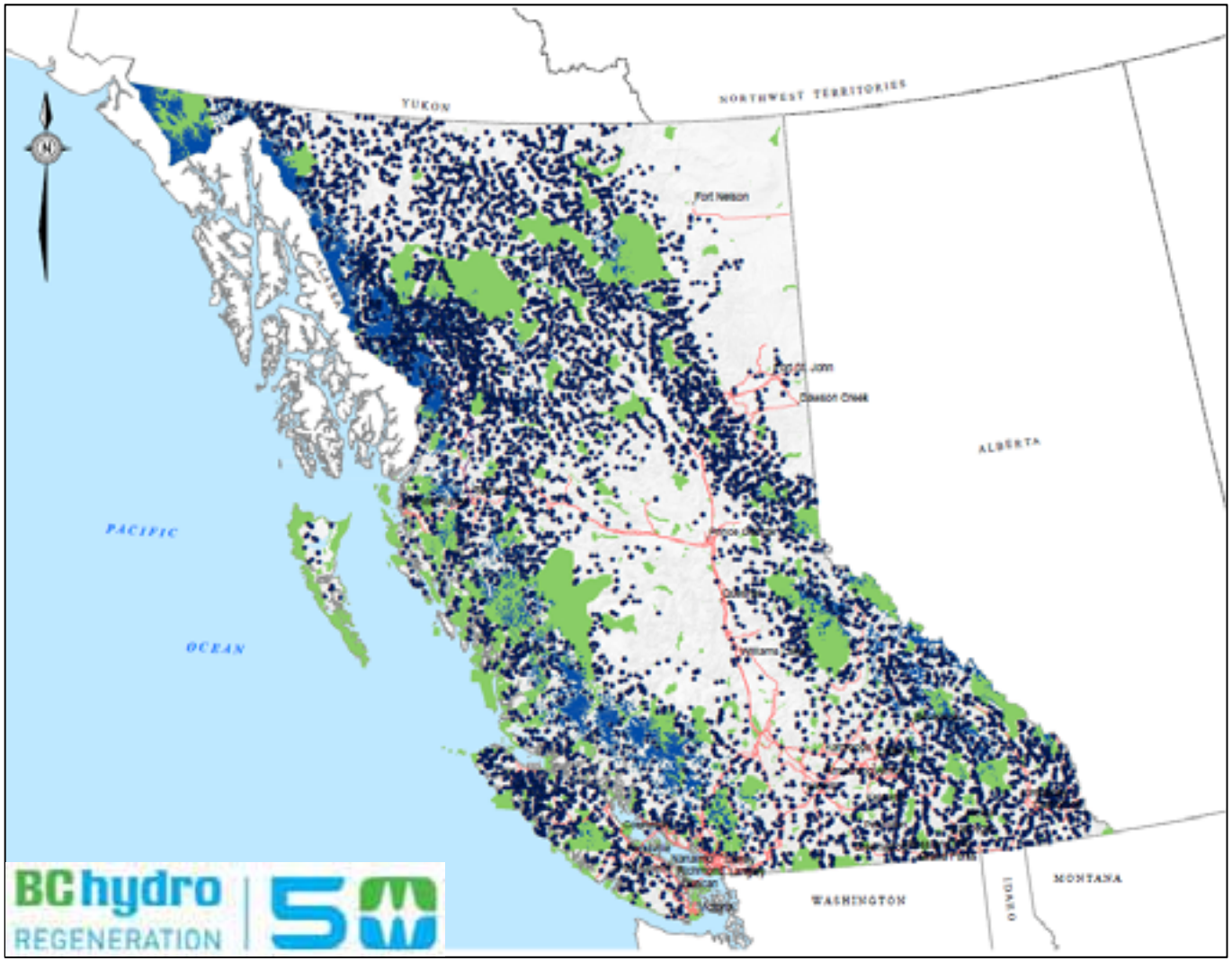
Storage Analysis in RHAM



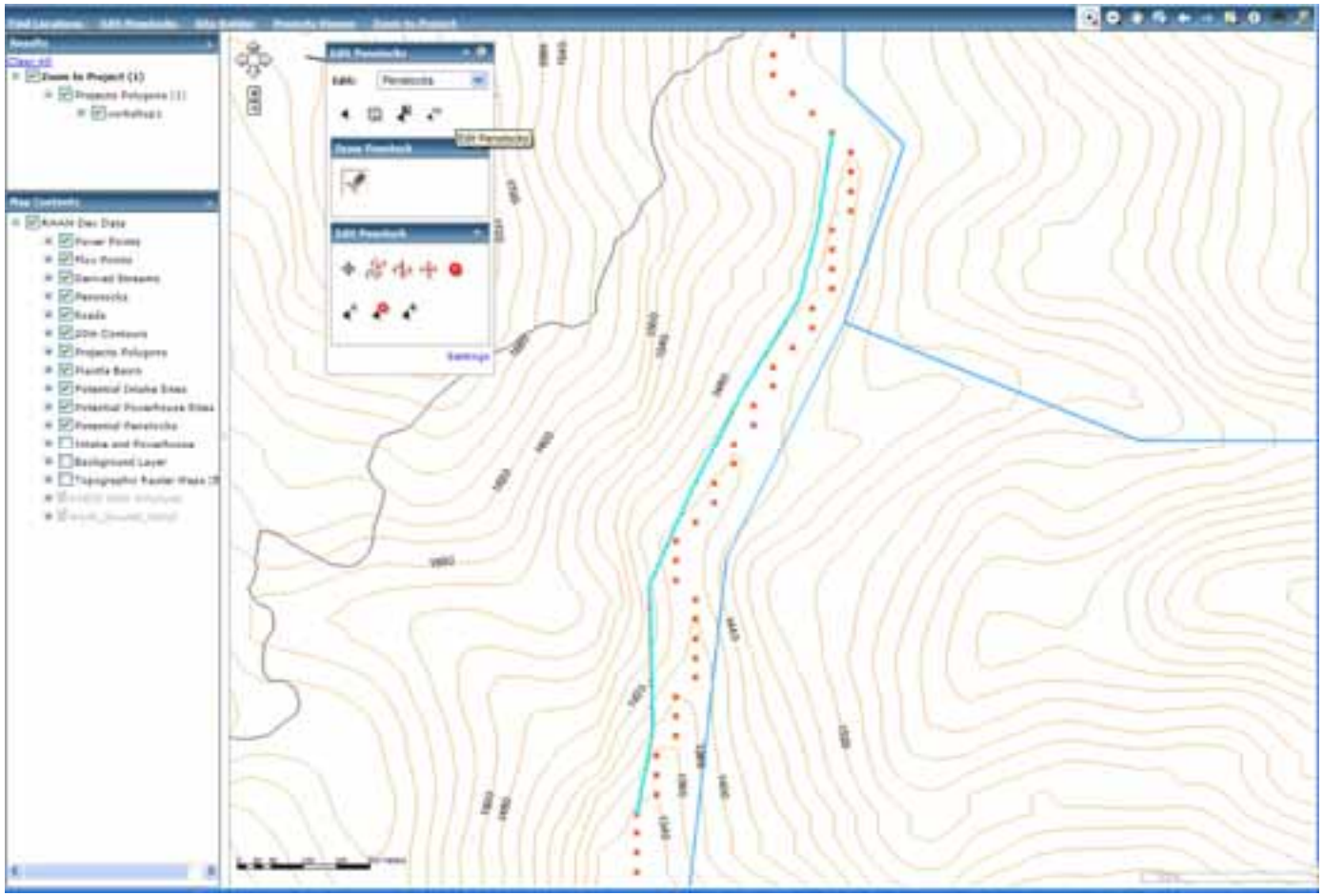
Output

- Lake Surface Area
- Lake Volume (m^3)
- Storage Time

Potential Small Hydro in British Columbia



RHAM Online



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