

Highlights of the Nanaimo Lowland Groundwater Study



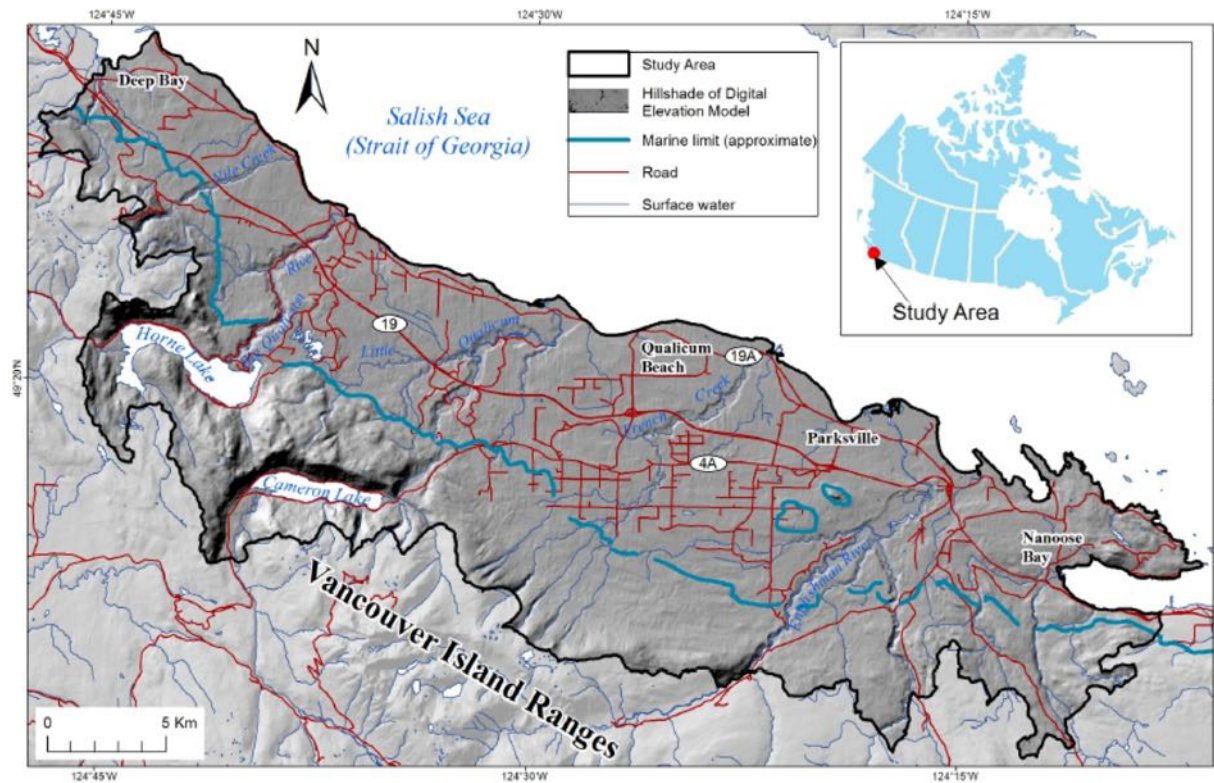
Daniel Paradis

Geological Survey of Canada

Workshop: Nanaimo, BC, 28-29 February 2018

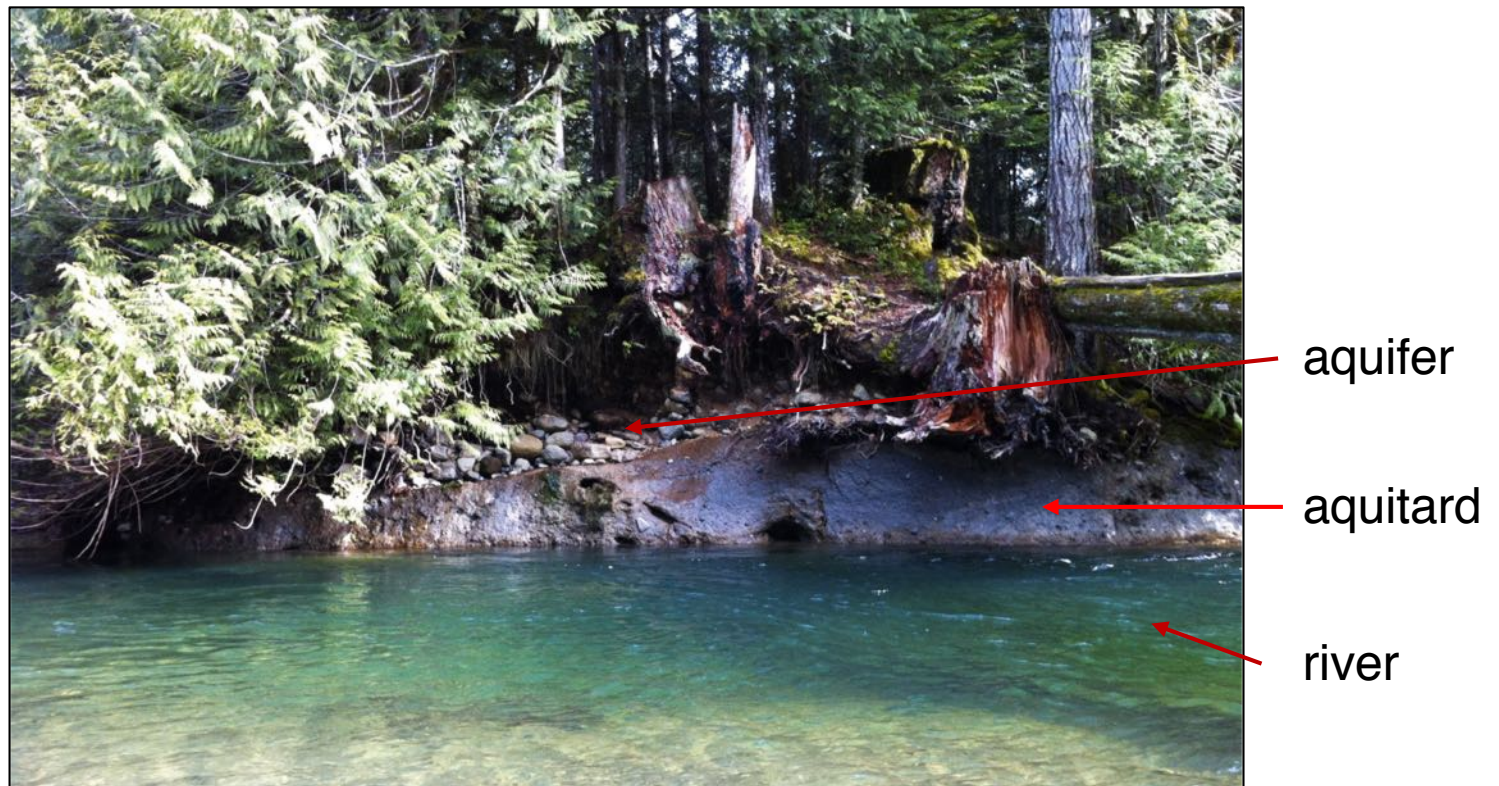
Study Area

- Study area covers the Nanaimo Lowland area from *Nanoose Bay* to *Deep Bay* (~600 km²):
 - large deposits of sediments with excellent aquifer potential (e.g. Quadra Sand)
 - increasing demand in groundwater (e.g. Qualicum Beach, Parksville)

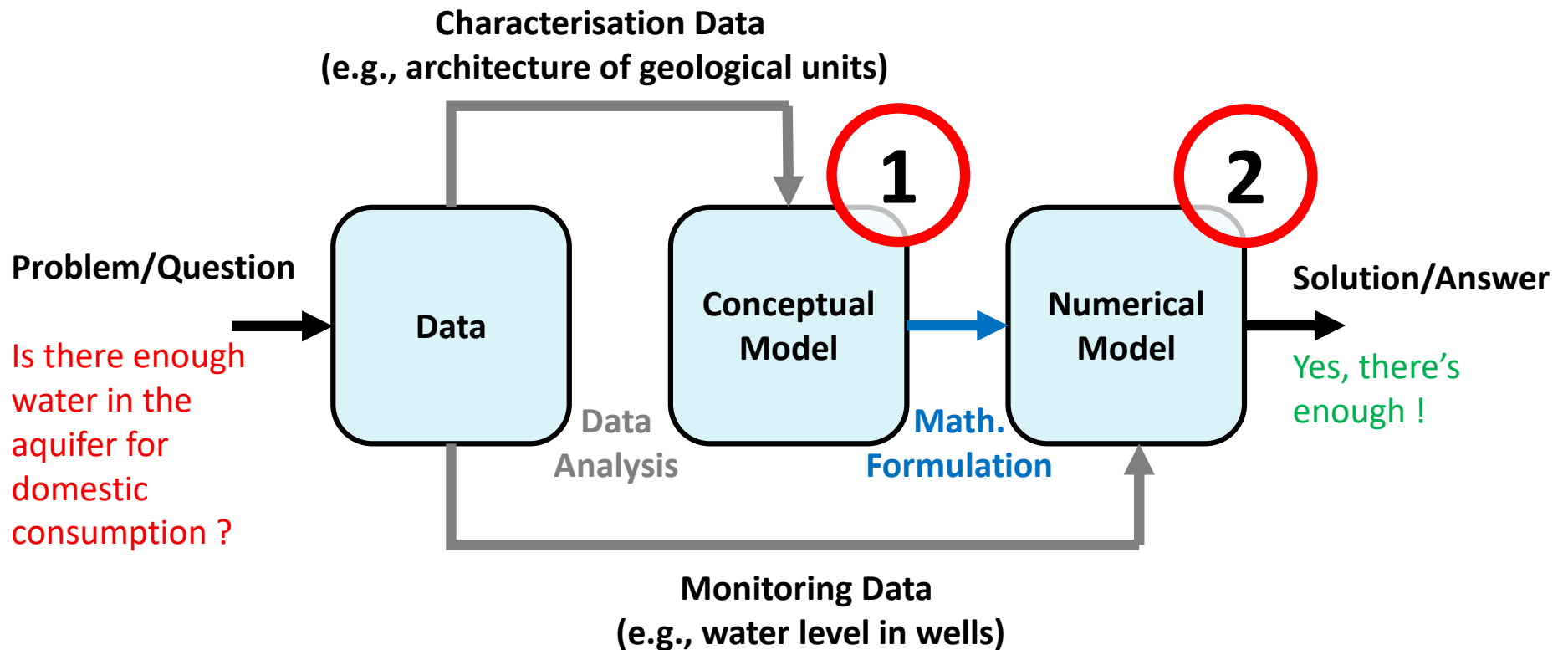


Study Objective

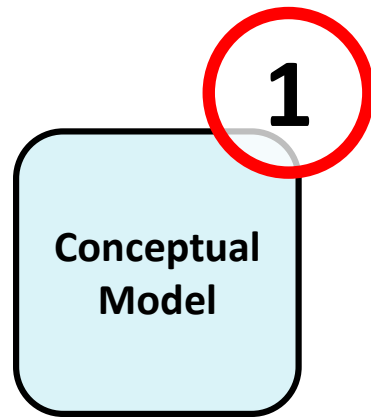
- Study objective was to better understand the extent (distribution, thickness) and dynamics of the aquifer system (aquifers, aquitards, rivers)



GSC Approach for GW Study



3D Hydrostratigraphic Model



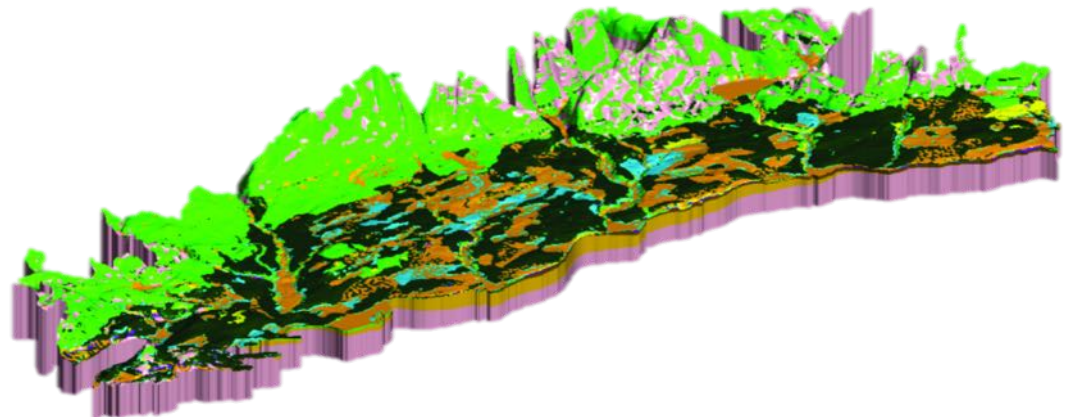
- Conceptual model is used to represent the important features (geological units), events (pumping) and processes (gw flow) that relate hydrologic inputs (gw recharge) to outputs (discharge to rivers)



3D Hydrostratigraphic Model: represents the architecture of the hydrogeological units

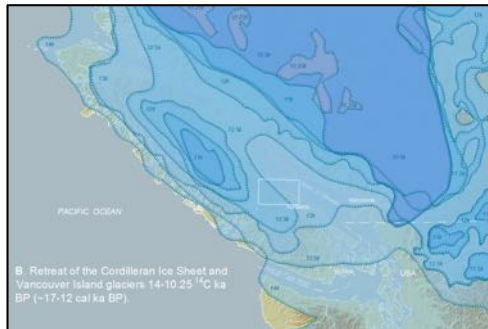
Built from:

- Geological maps
- Well logs/cores
- Geophysical surveys

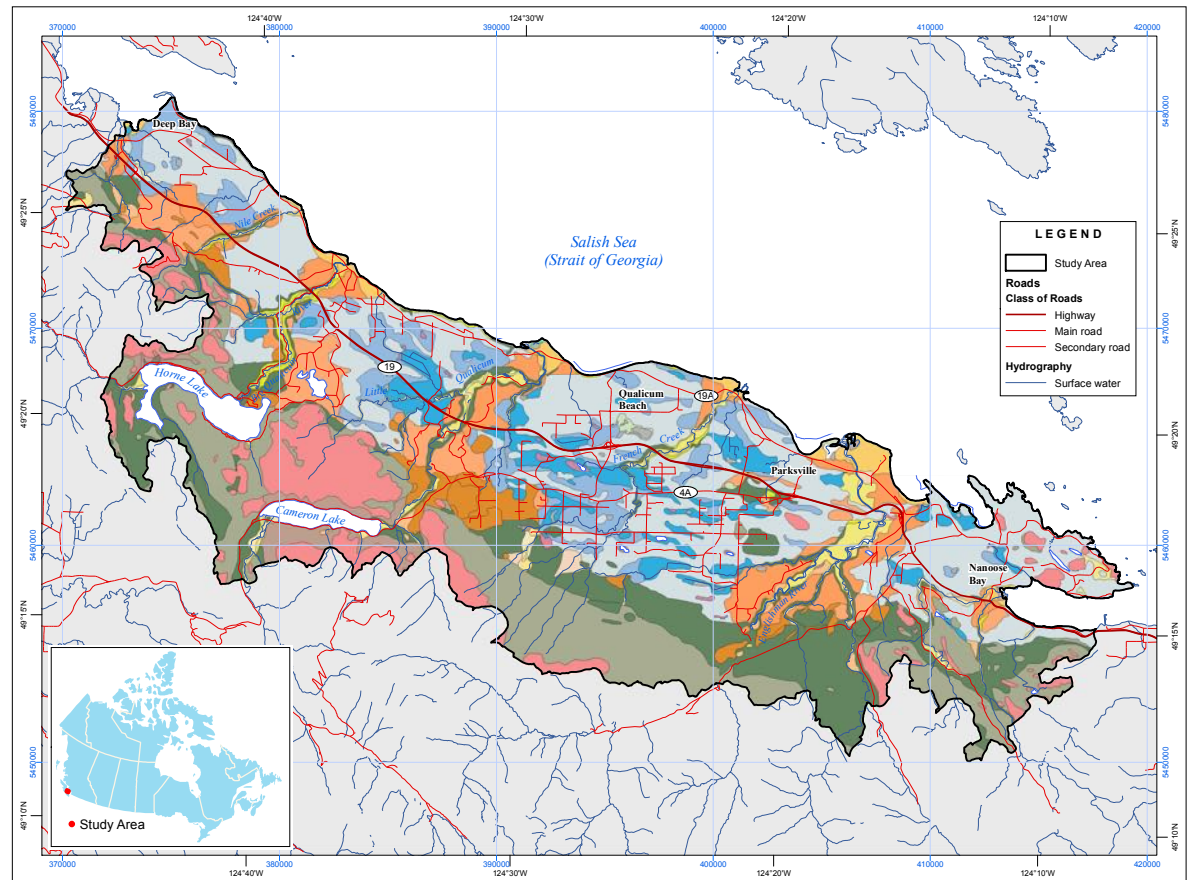


Surficial Geological Map

Geological History



Field Observations

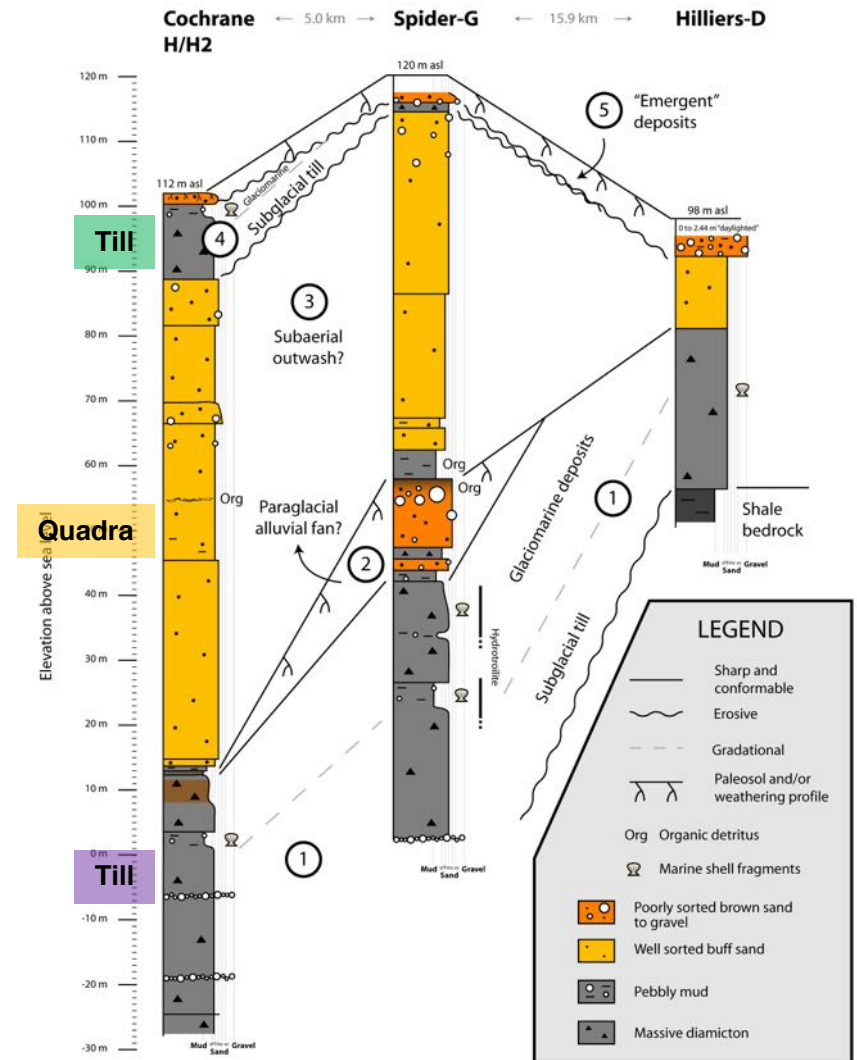


Well Logs/Cores

Roto-Sonic Drilling

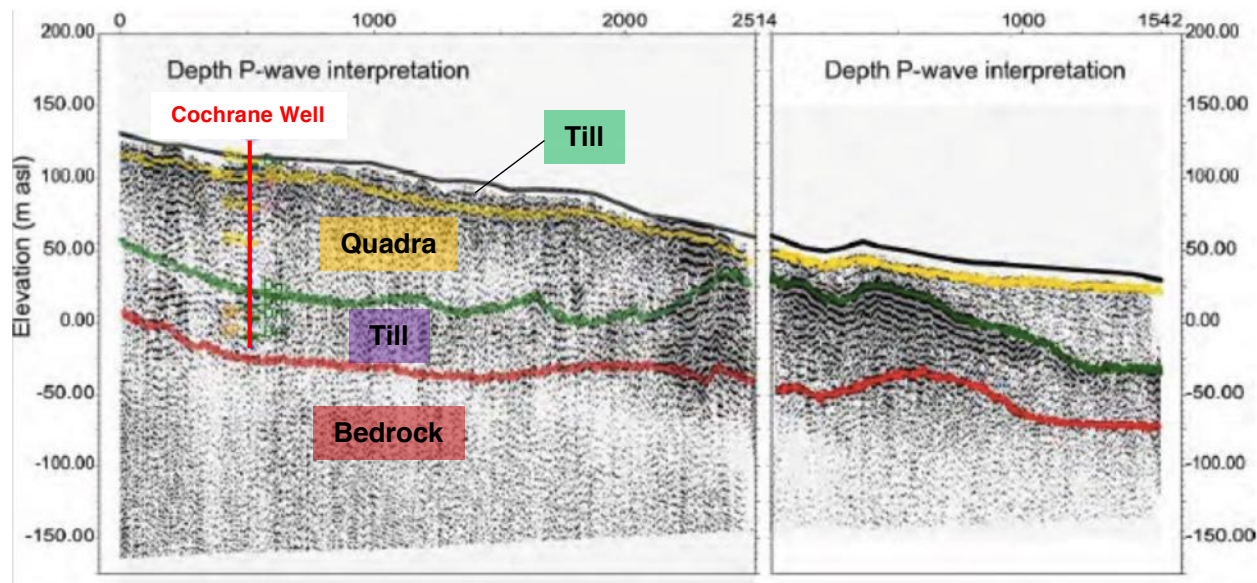


Sediments Cores



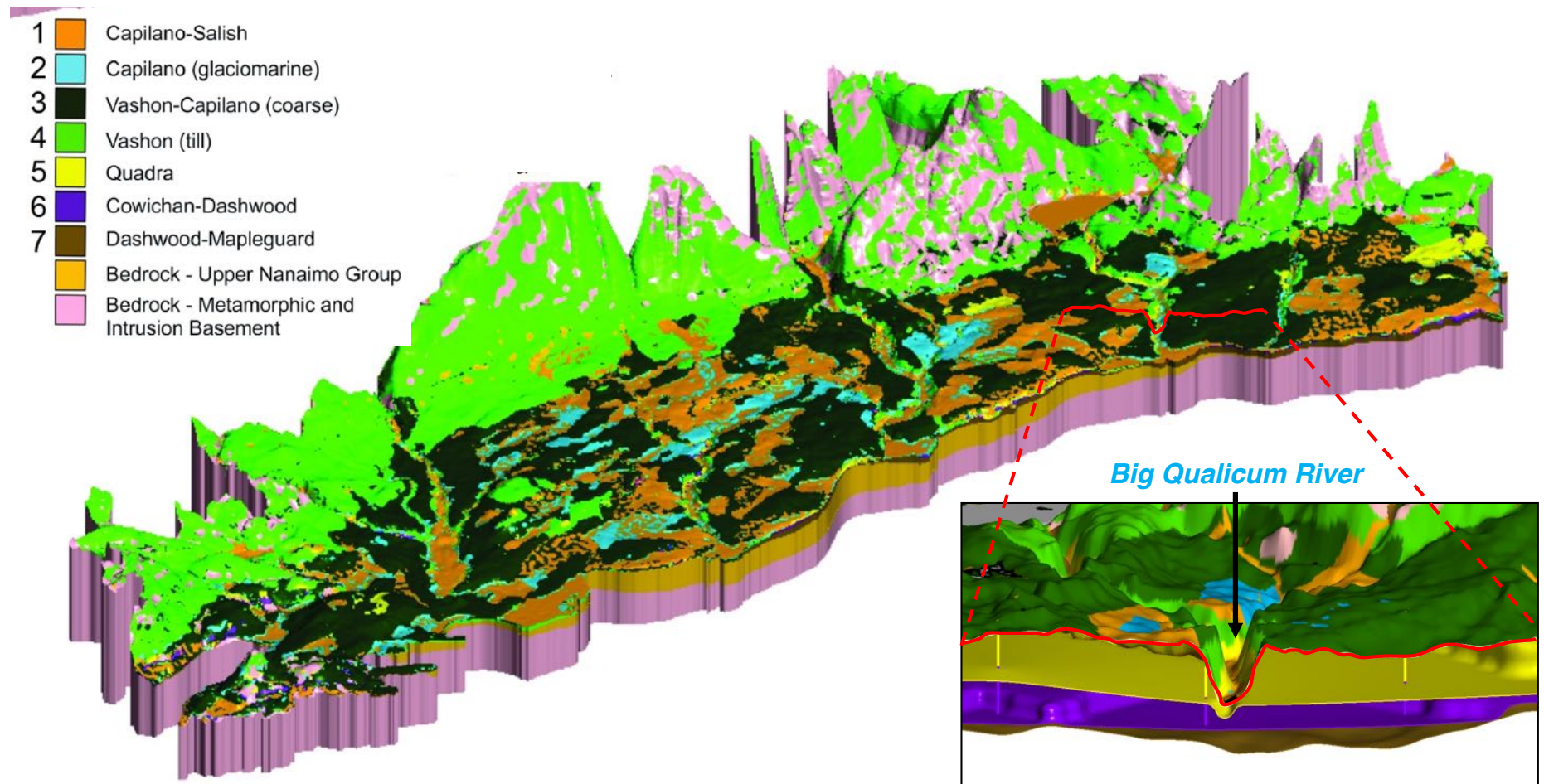
Seismic Surveys

Vibroseis (Mini-Vibe) Rig

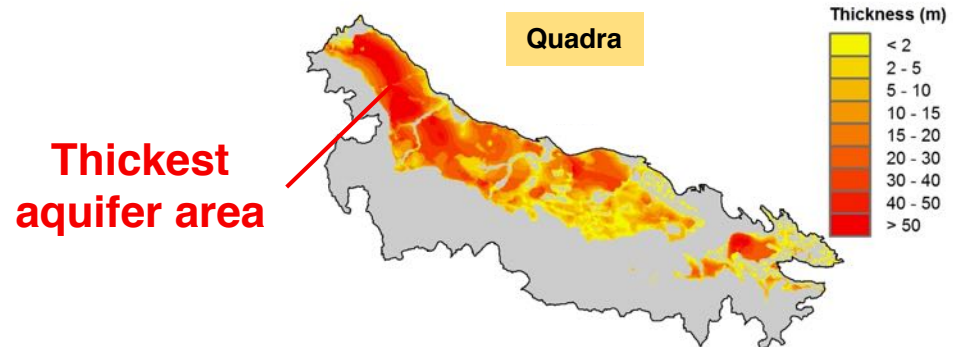
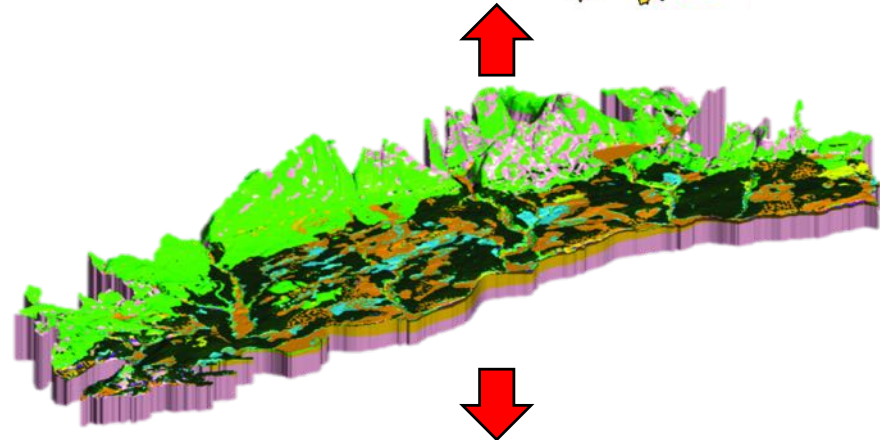
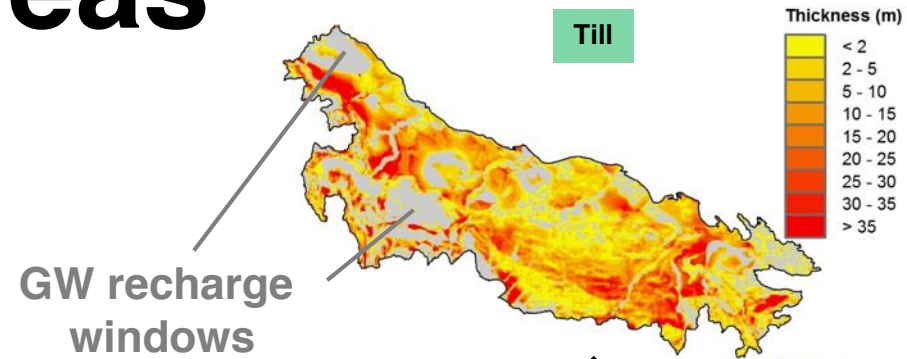
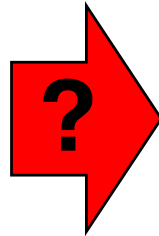
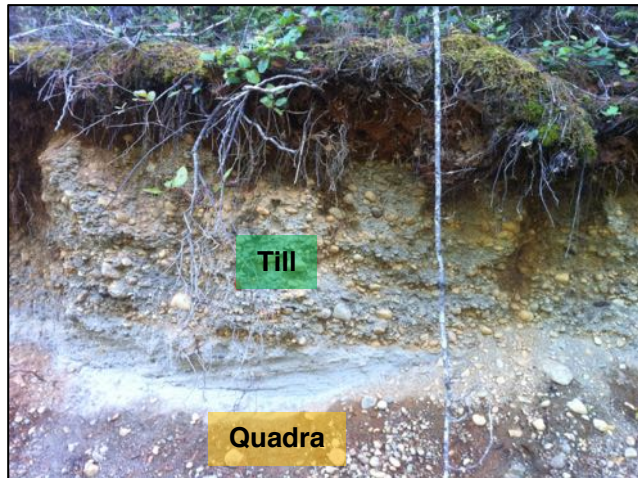


3D Hydrostratigraphic Model

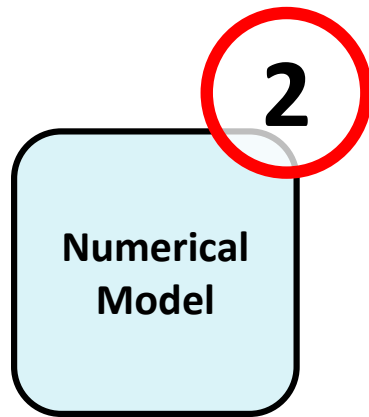
- 3DHS Model represents the architecture of the hydrogeological units (aquifers and aquitards)



Distribution of the Quadra and Recharge Areas



Numerical Model



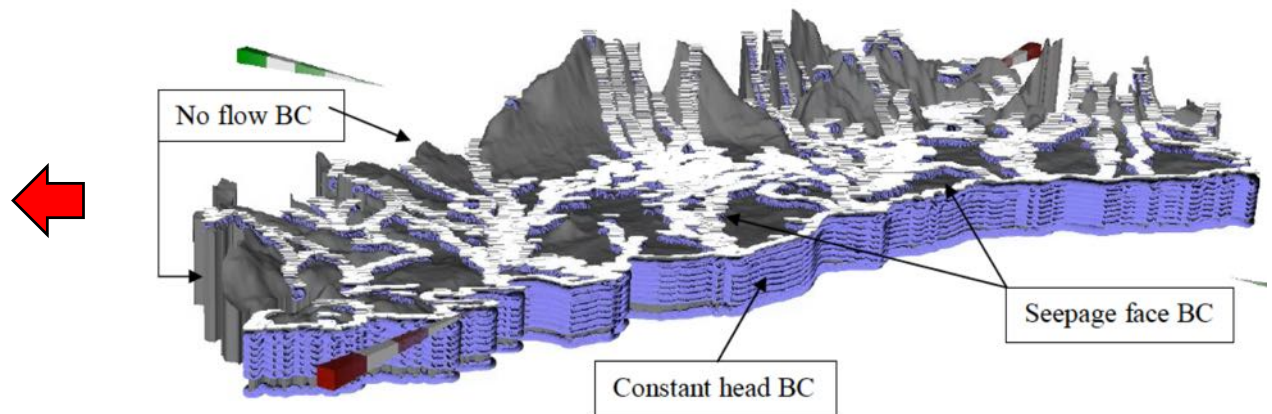
- Numerical hydrogeological model is the mathematical formulation of the conceptual model, and it is helpful to:
 - Validate/invalidate the conceptual model
 - Quantify the water budget



3D Numerical Model

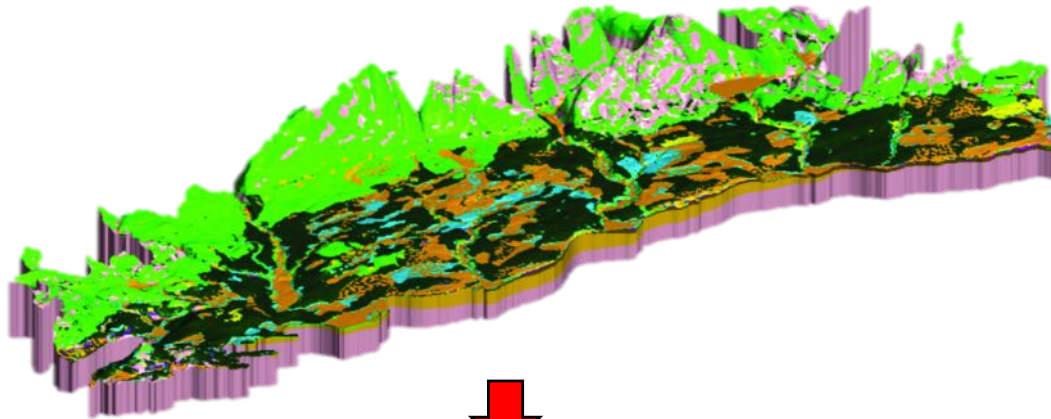
Necessary steps:

- Mathematical translation
- Calibration with monitoring data

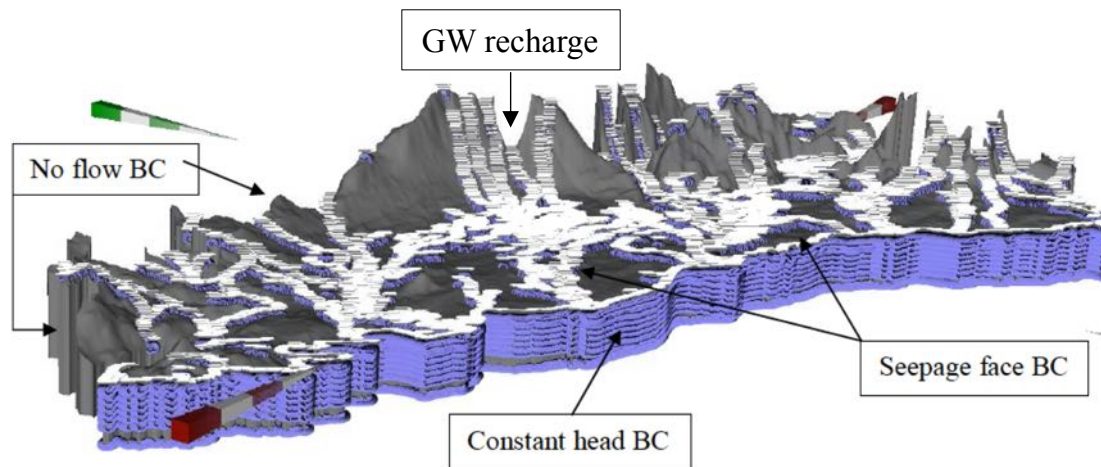


Mathematical Translation

3D Hydrostratigraphic Model

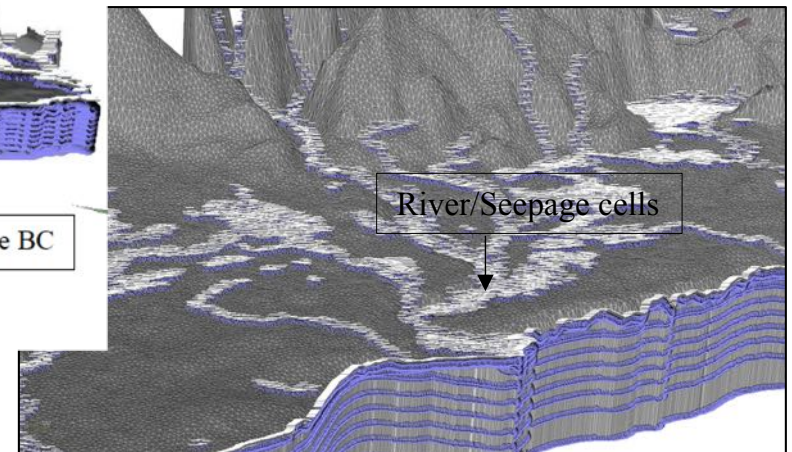


3D Numerical Model



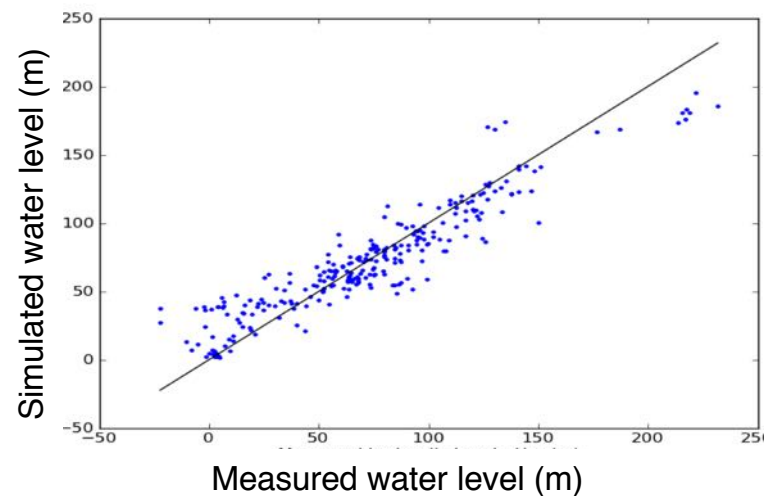
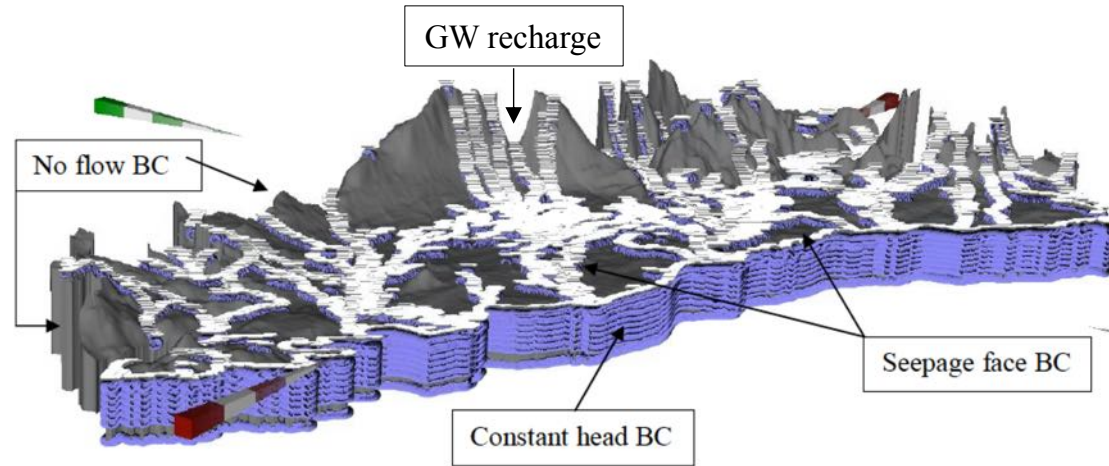
Need to specify:

- Material properties (K , n)
- Boundary conditions (recharge, rivers)
- Inputs/outputs (injection/pumping wells)



Model Calibration

Numerical Model

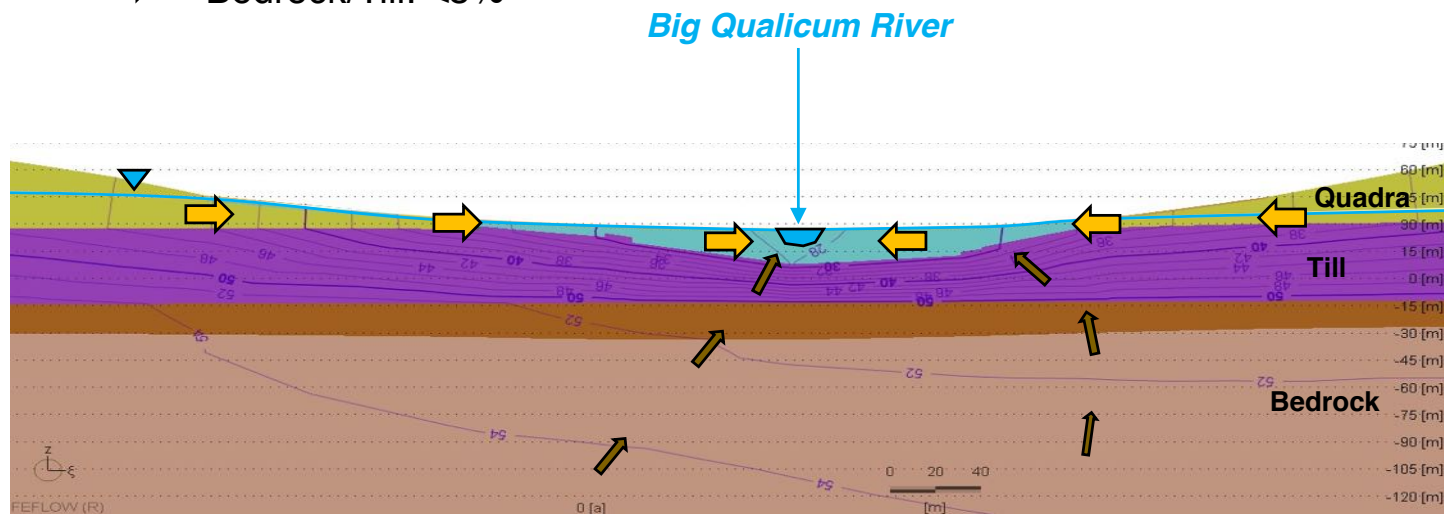


**Comparison of
measured and
simulated water
levels in wells for
the calibration**

Groundwater Contributions to Rivers

Approximate Groundwater Contribution to River Baseflow

- ➡ Quadra: >95%
- ➡ Bedrock/Till: <5%



Numerical cross-section across the Big Qualicum River.
Purple lines are hydraulic heads.