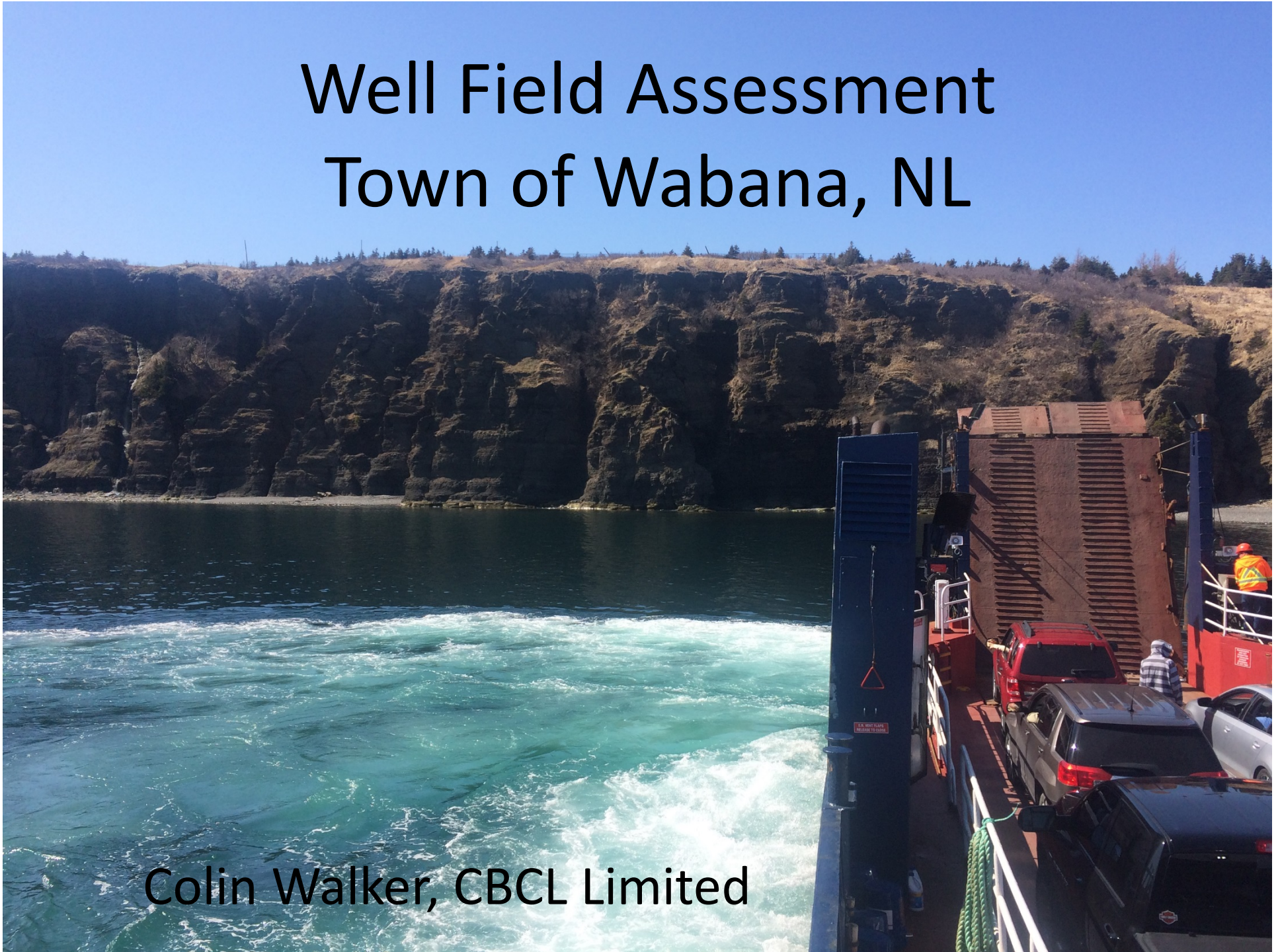
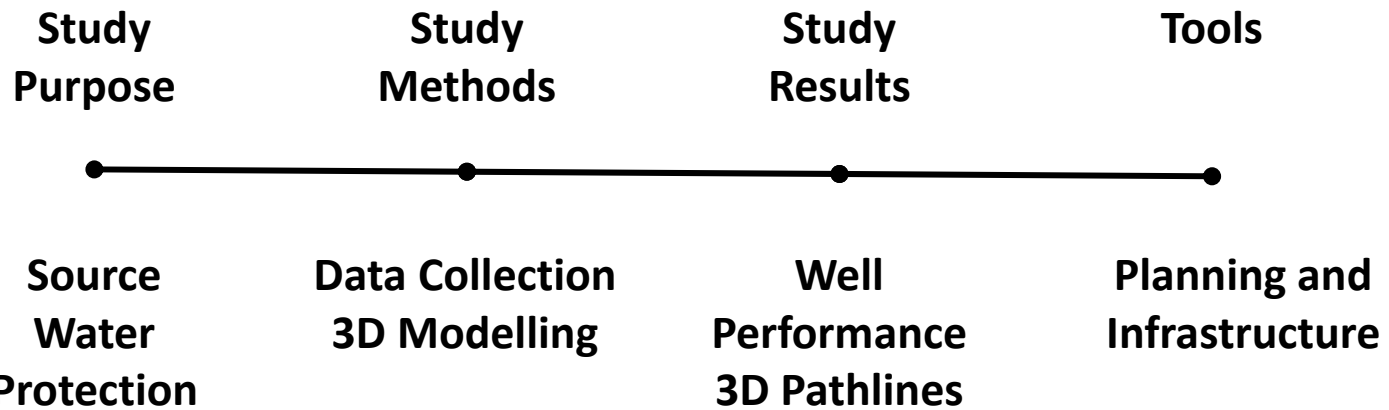


# Well Field Assessment Town of Wabana, NL

Colin Walker, CBCL Limited









# Bell Island





Purpose Methods Results Tools

# Town of Wabana



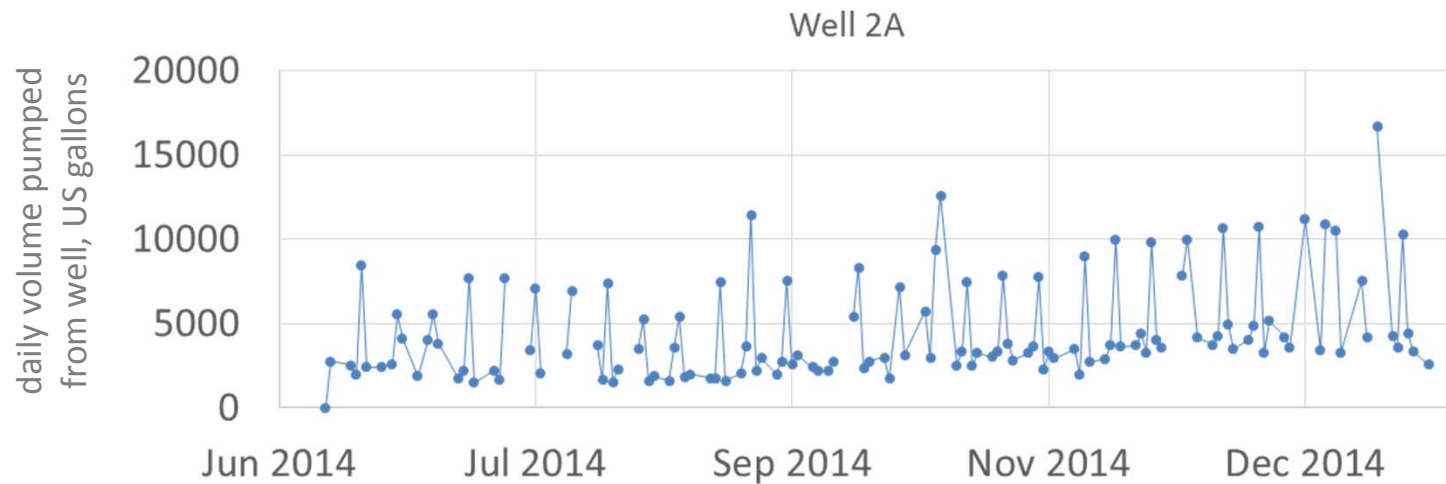


- 13 Production Wells
- Well ages vary, date to mid-1960s
- Varying construction
- Tied directly into distribution system
- No central control
- Boil water advisory



well field



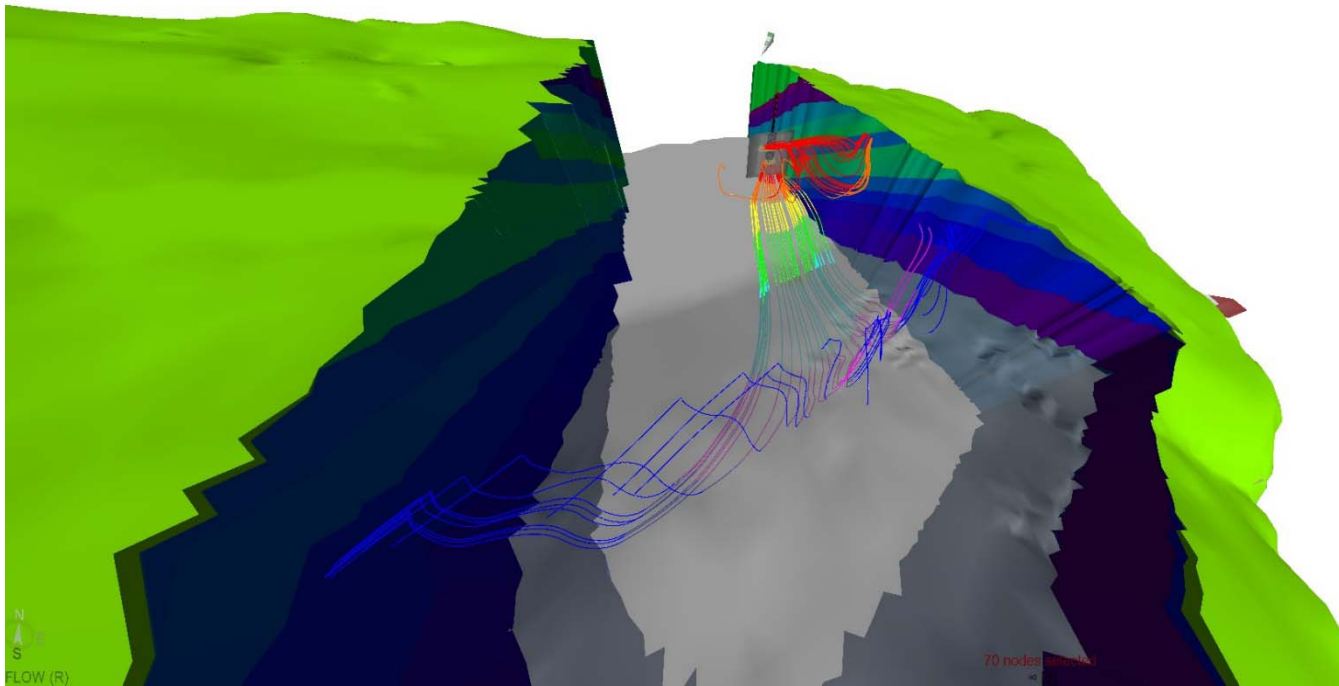


- Depths: 90 to 215 metres
- Installed across varying types of rock
- Yields: 10 to 200 m<sup>3</sup>/d
- Average daily use 1125 m<sup>3</sup> (480 L/person/day)



assess well performance





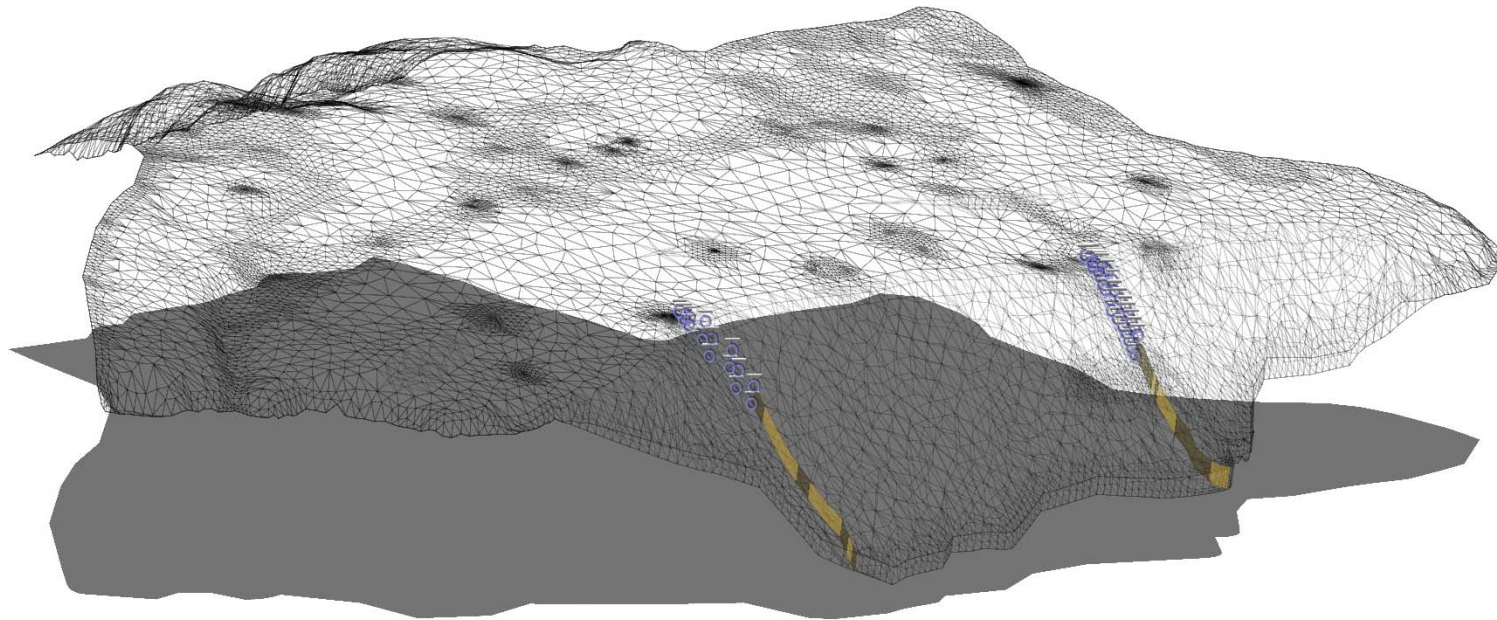
- Groundwater flow paths
  - Source water
  - Time of travel
- Simulations (drought, pump on or off, new well)



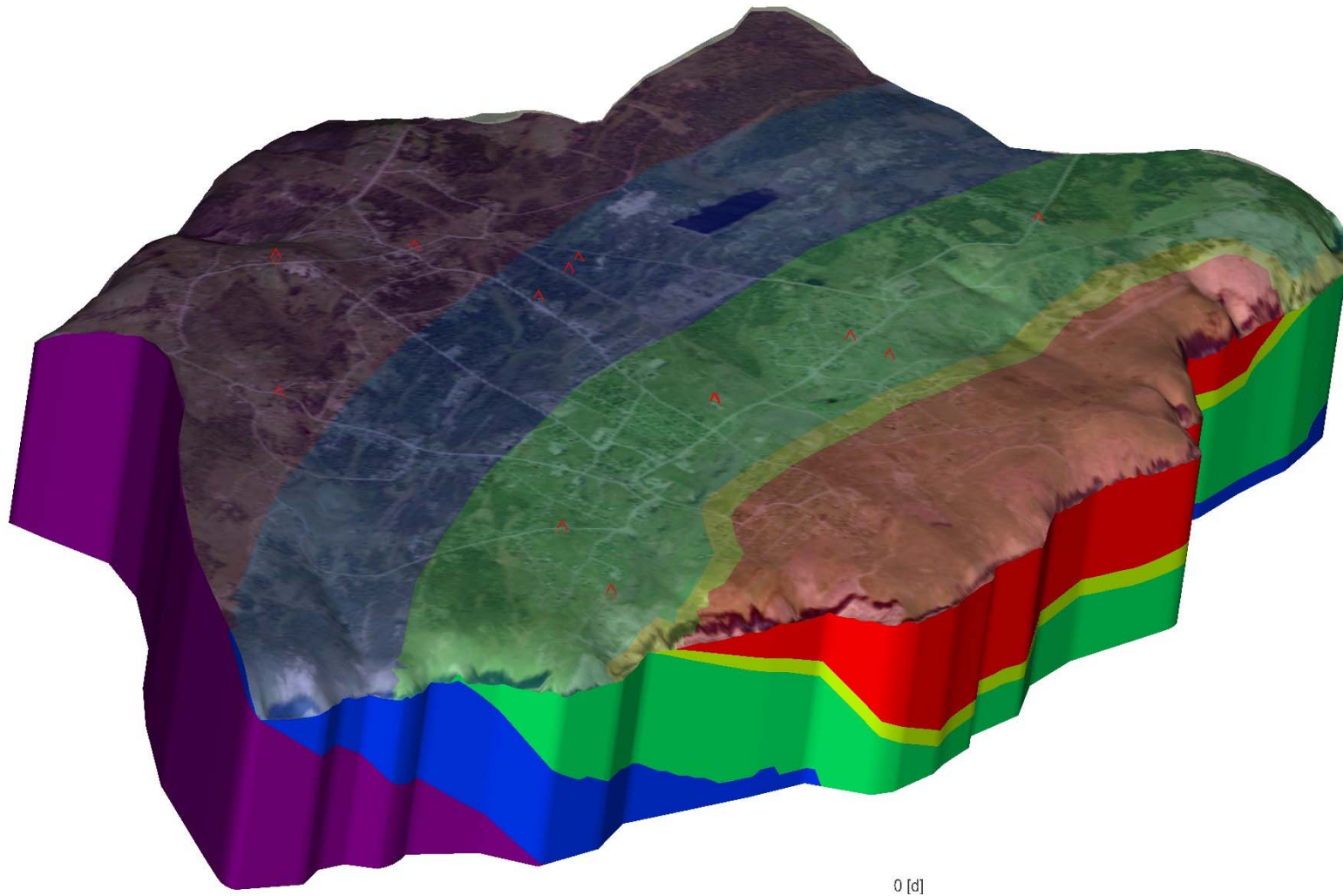
# 3D groundwater flow model



- Map source water areas
- Manage pumping schedules
- Siting of future wells
- Ways to improve reliability
  - quantity
  - quality



tools for decision making

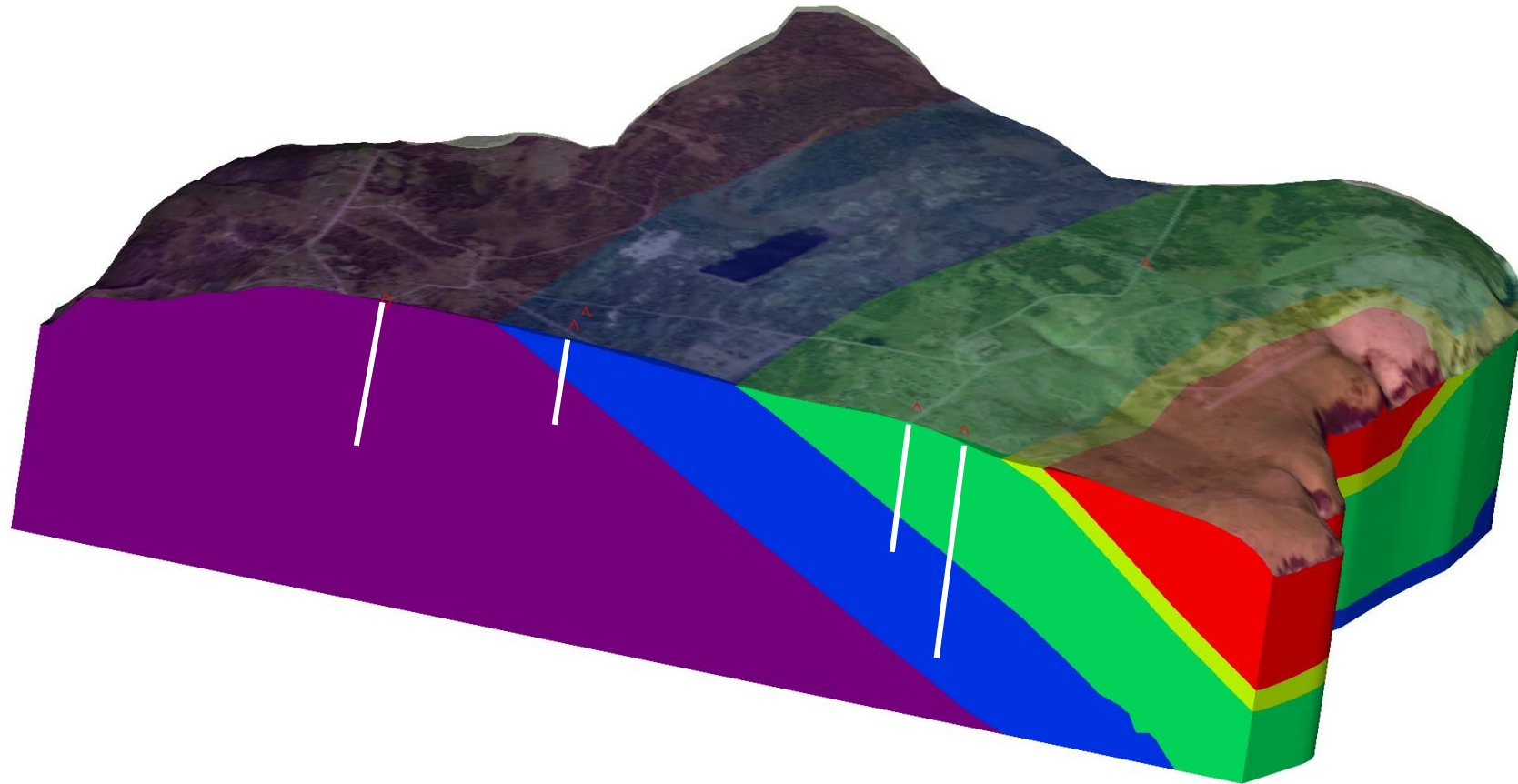


0 [d]



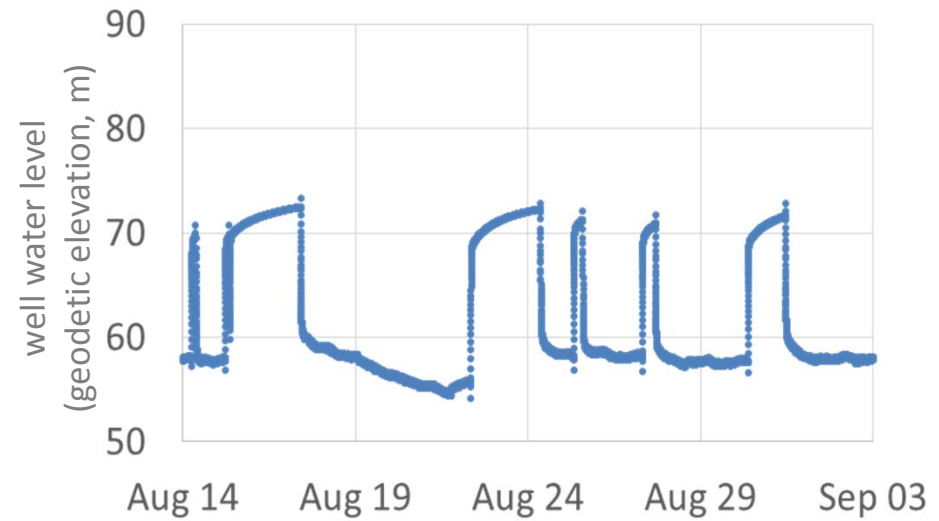
# wells and geology





Purpose                      Methods                      Results                      Tools

# wells and geology



- Construction: age, depth, bedrock units, pump depth
- Pumping record: daily water use, pump cycles
- Performance: water levels, response of aquifer to pumping, available head



well data

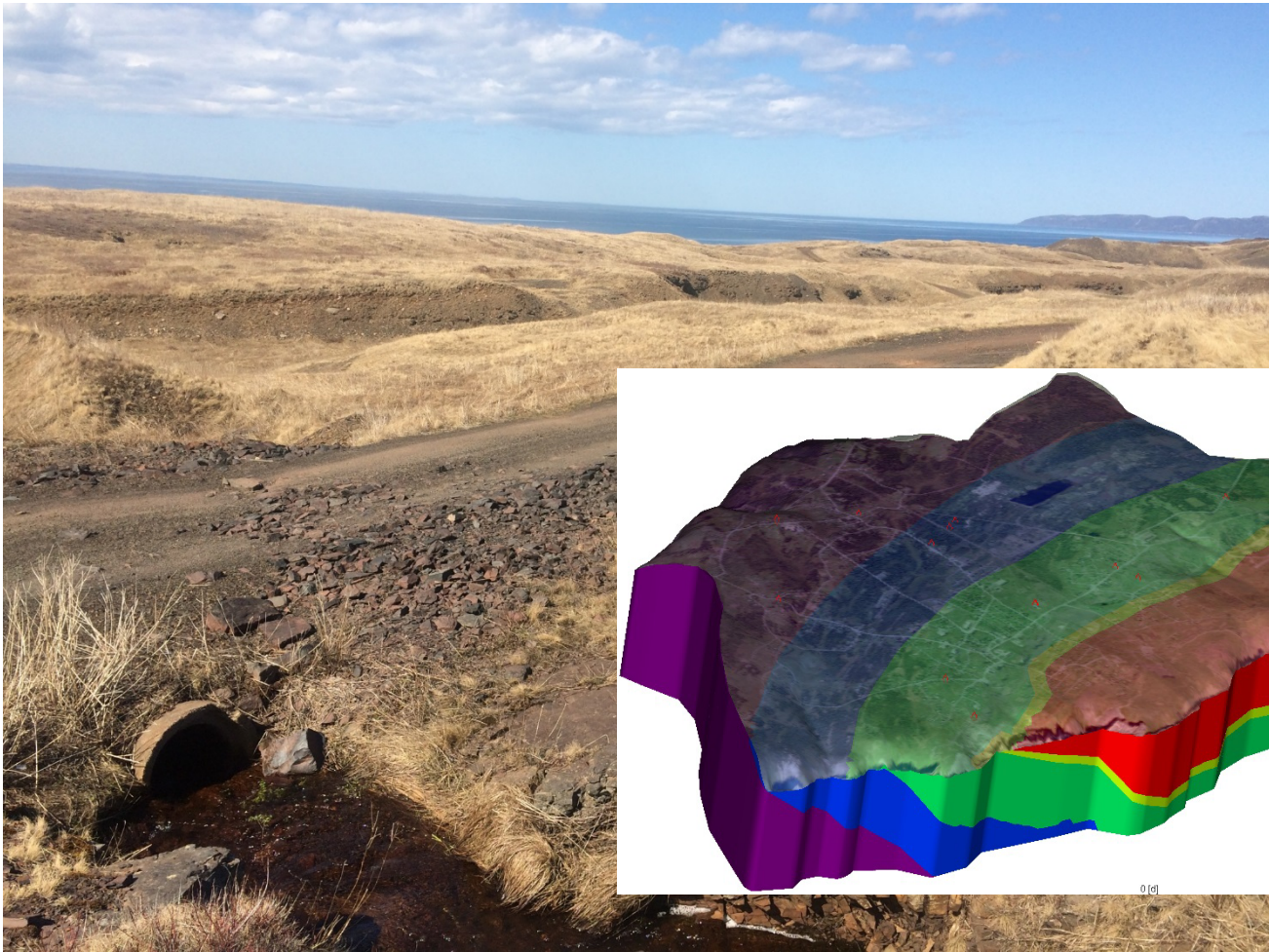




- Water level data
  - Manual measurements
  - Data logger installations
  - SCADA data processing
  - Elevation Survey
  - Water table features
- Climate and budget data
  - Stream gauging
  - Rainfall data
  - Wetland features
  - Springs

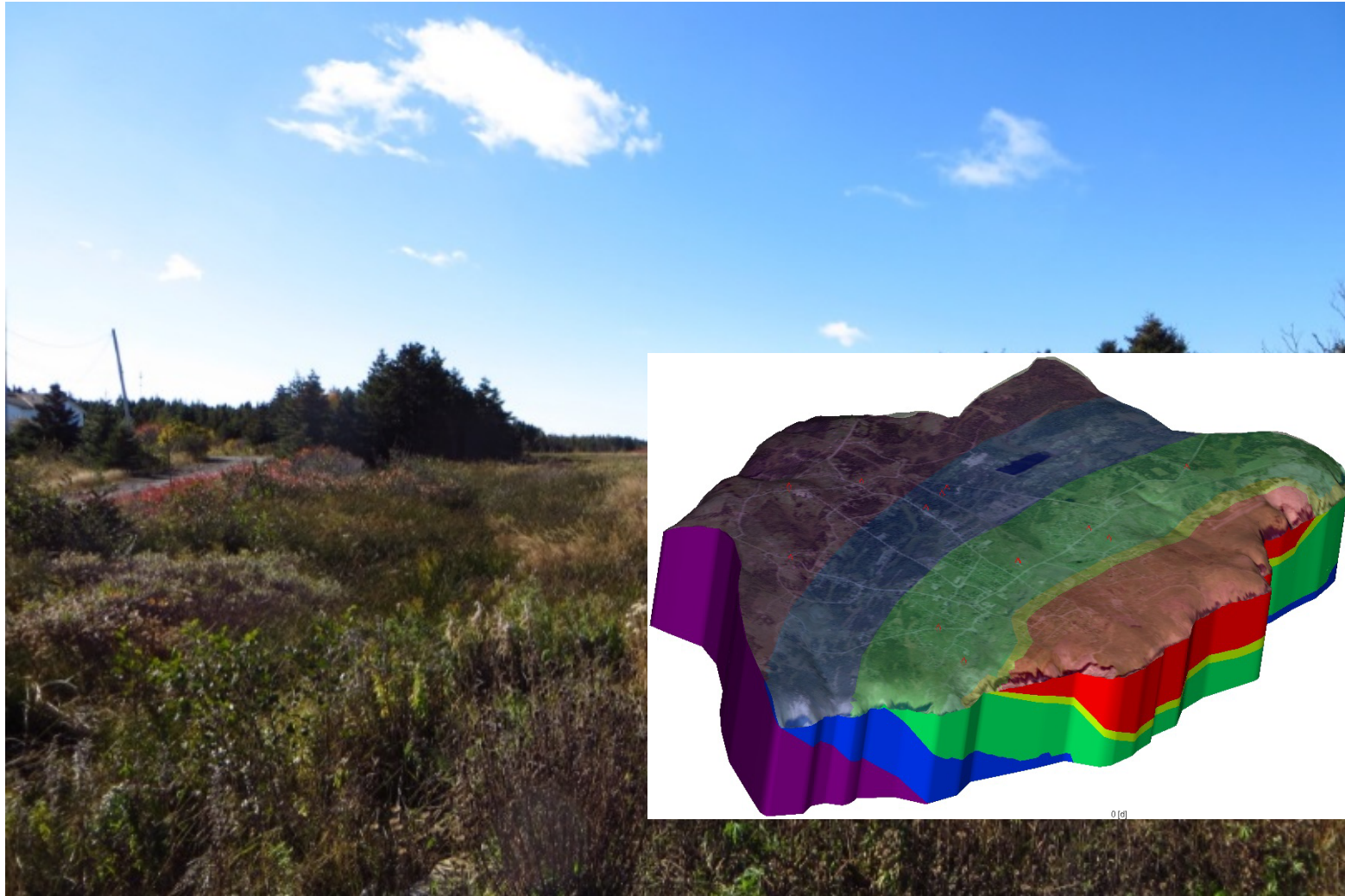


field program



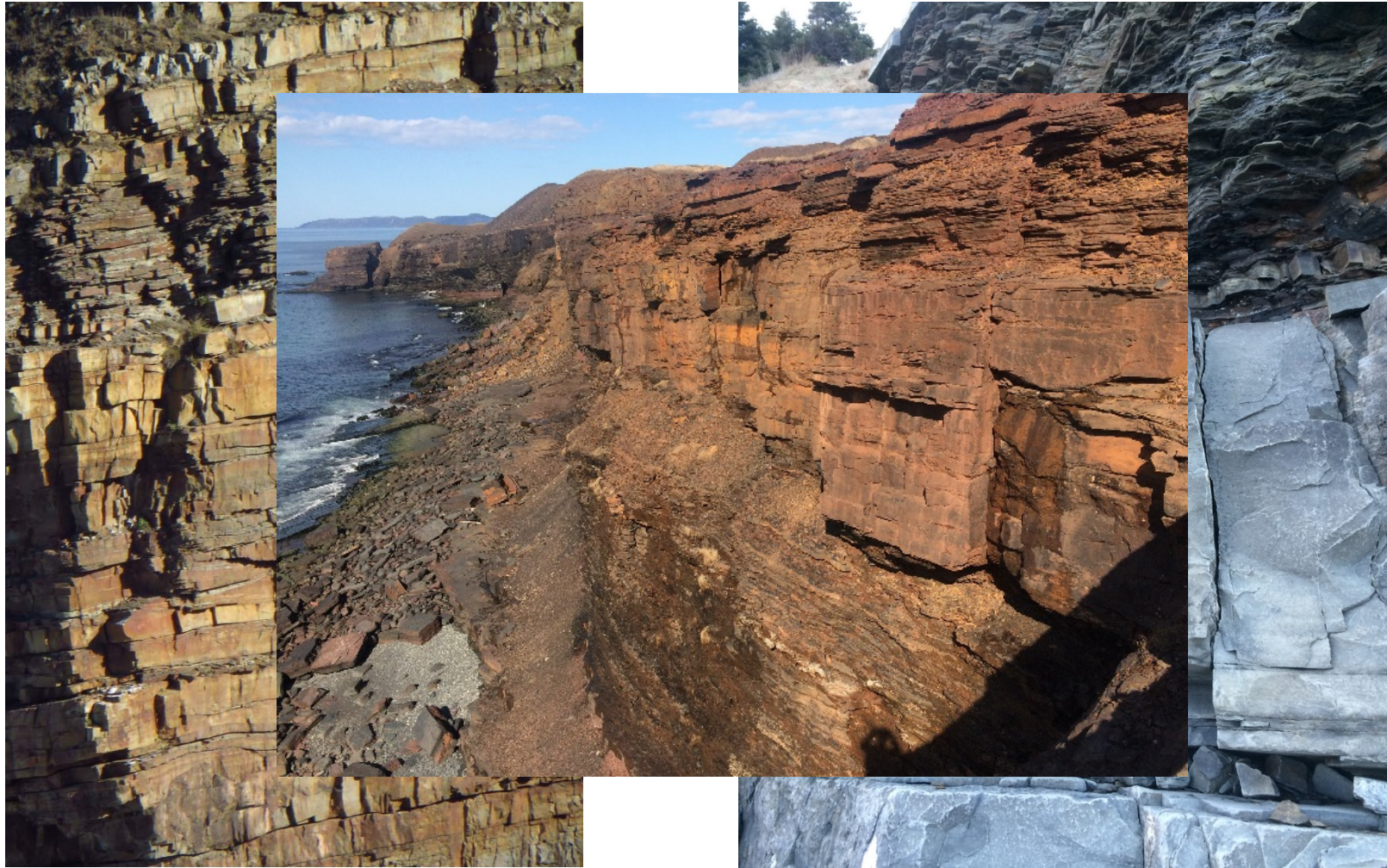
# terrain





# terrain

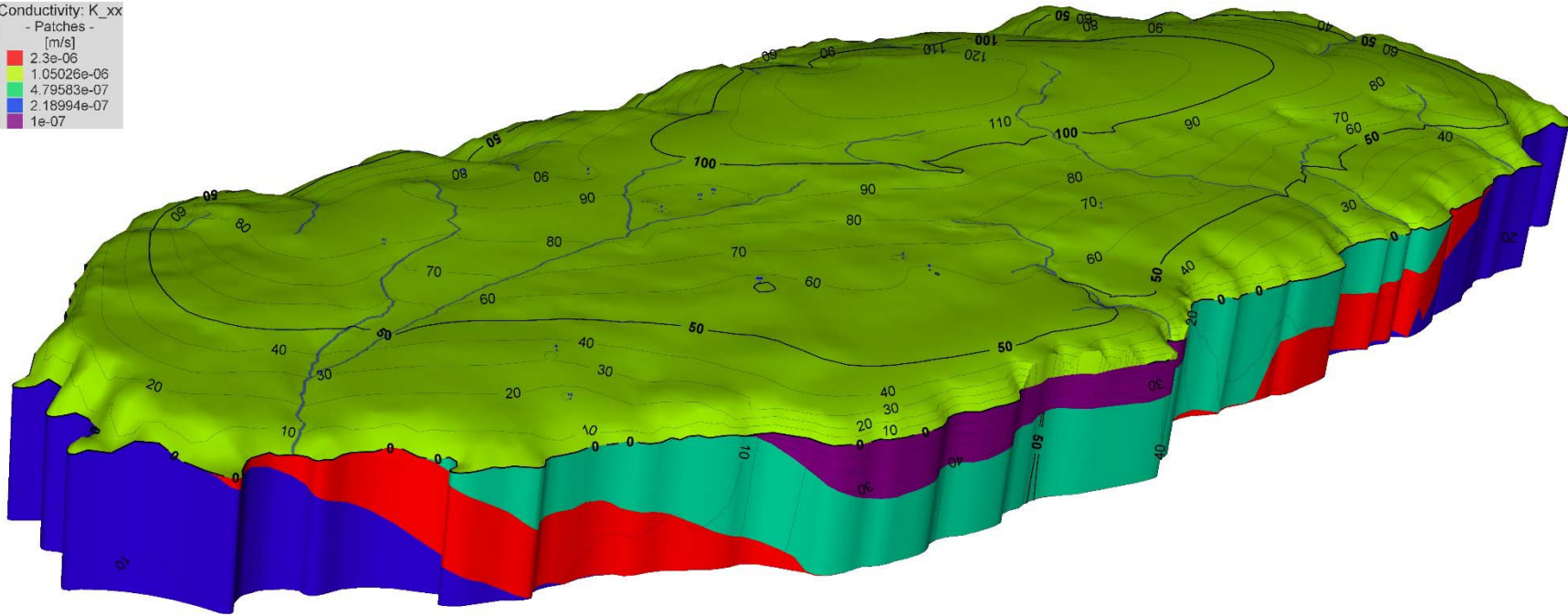




# bedrock geology



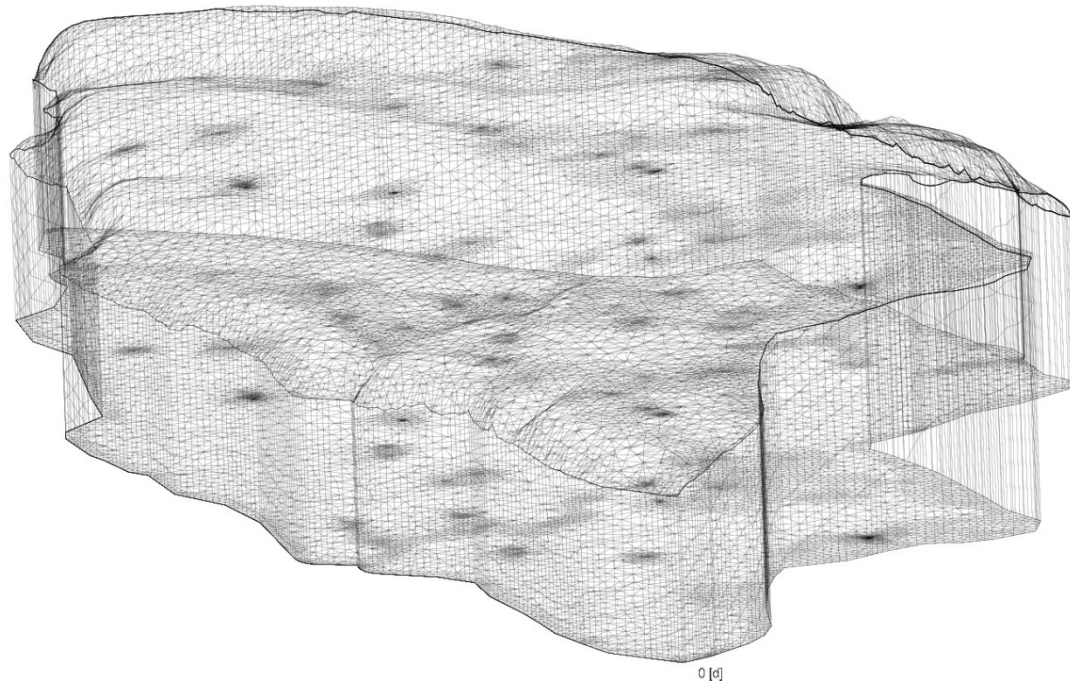
Conductivity: K\_xx  
- Patches -  
[m/s]  
2.3e-06  
1.05026e-06  
4.79583e-07  
2.18994e-07  
1e-07



- Regional test bed for scoping
- Sensitivity of layer properties
- Locate groundwater flow divides

Purpose                      Methods                      Results                      Tools

model development



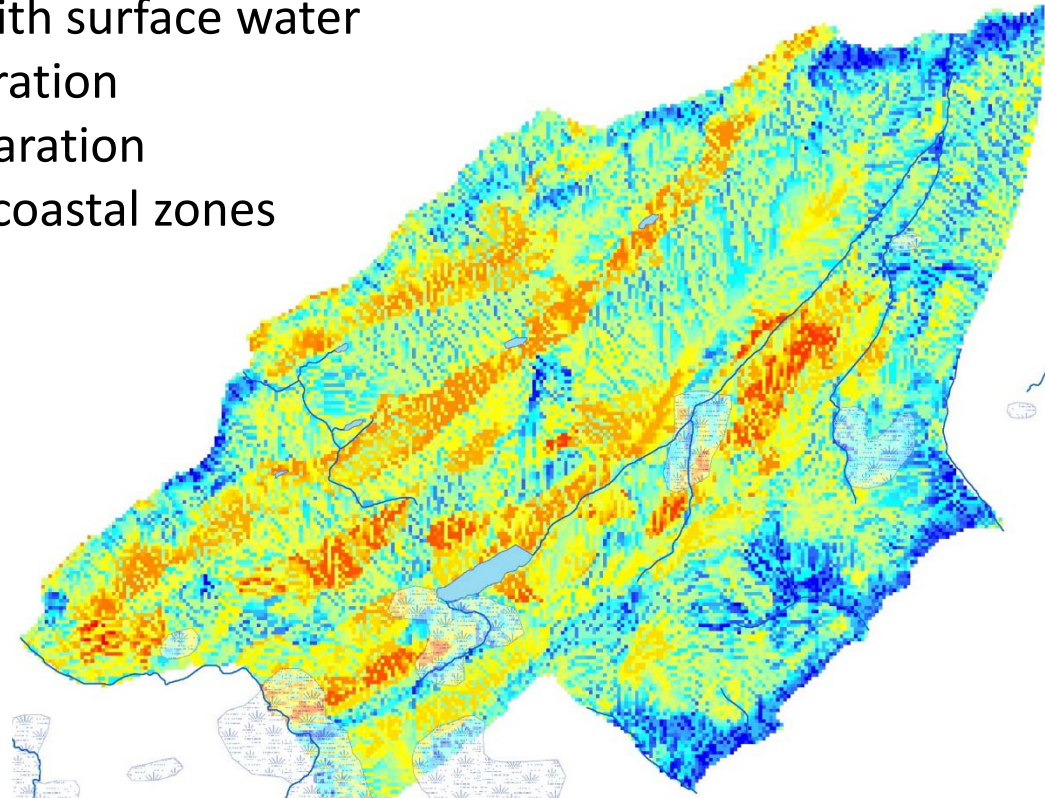
- Refined spacing around wells
- Careful consideration of shape
- Monitoring and data
- Pumping rates



model development

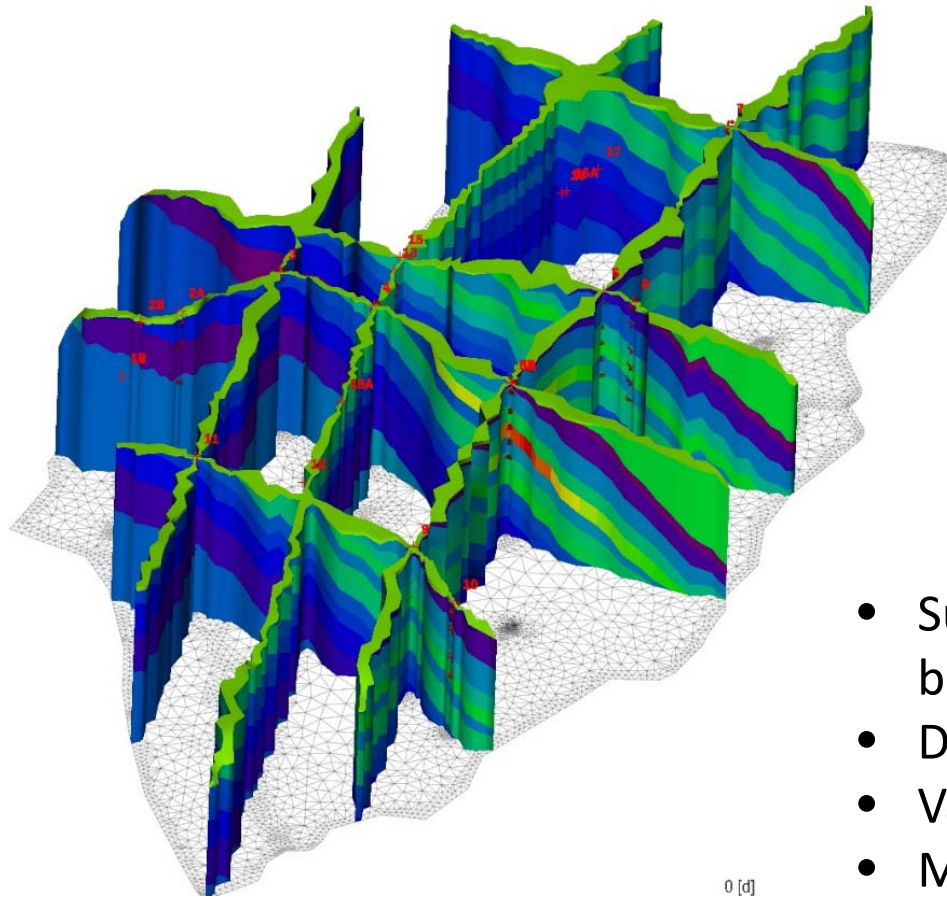


- Water budget
  - Interaction with surface water
  - Indexed infiltration
  - Baseflow separation
  - Discharge to coastal zones
  - Flow divides



Purpose                      Methods                      Results                      Tools

model development



- Sub-layers within each bedrock unit
- Dipped bedding within layers
- Varied with position
- Mine Tunnels

Purpose                      Methods                      Results                      Tools

model development



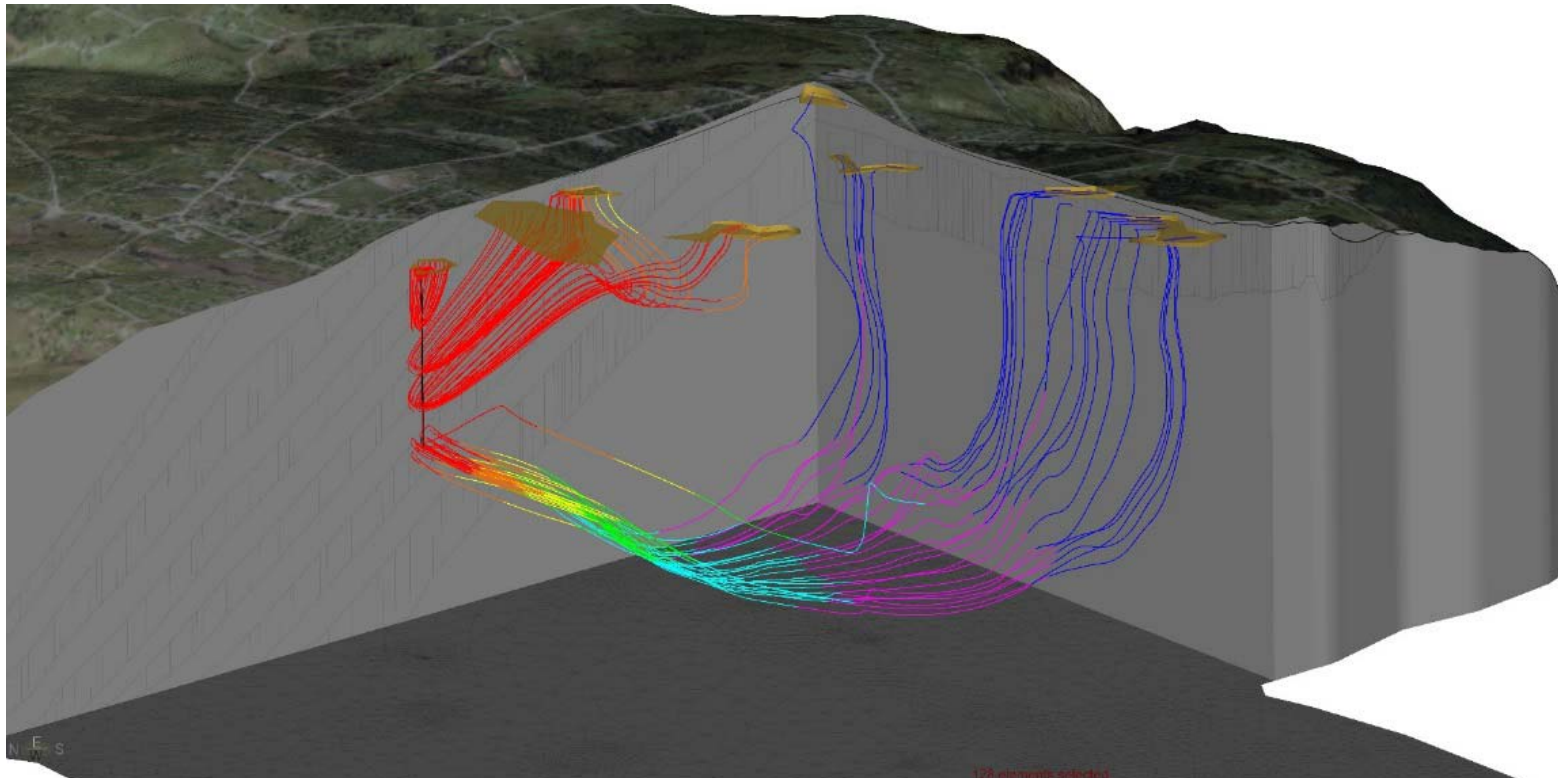


Transfers	m <sup>3</sup> /d	mm/yr
Boundary in	8409	204
Rainfall in	7684	186
Pumped out	1135	27
Boundary out	14 398	363

- Water table position, patterns of hydraulic head
- Budget data
- 1000s of model runs
- Calibration of rock parameters
- Statistical package FePEST



model calibration

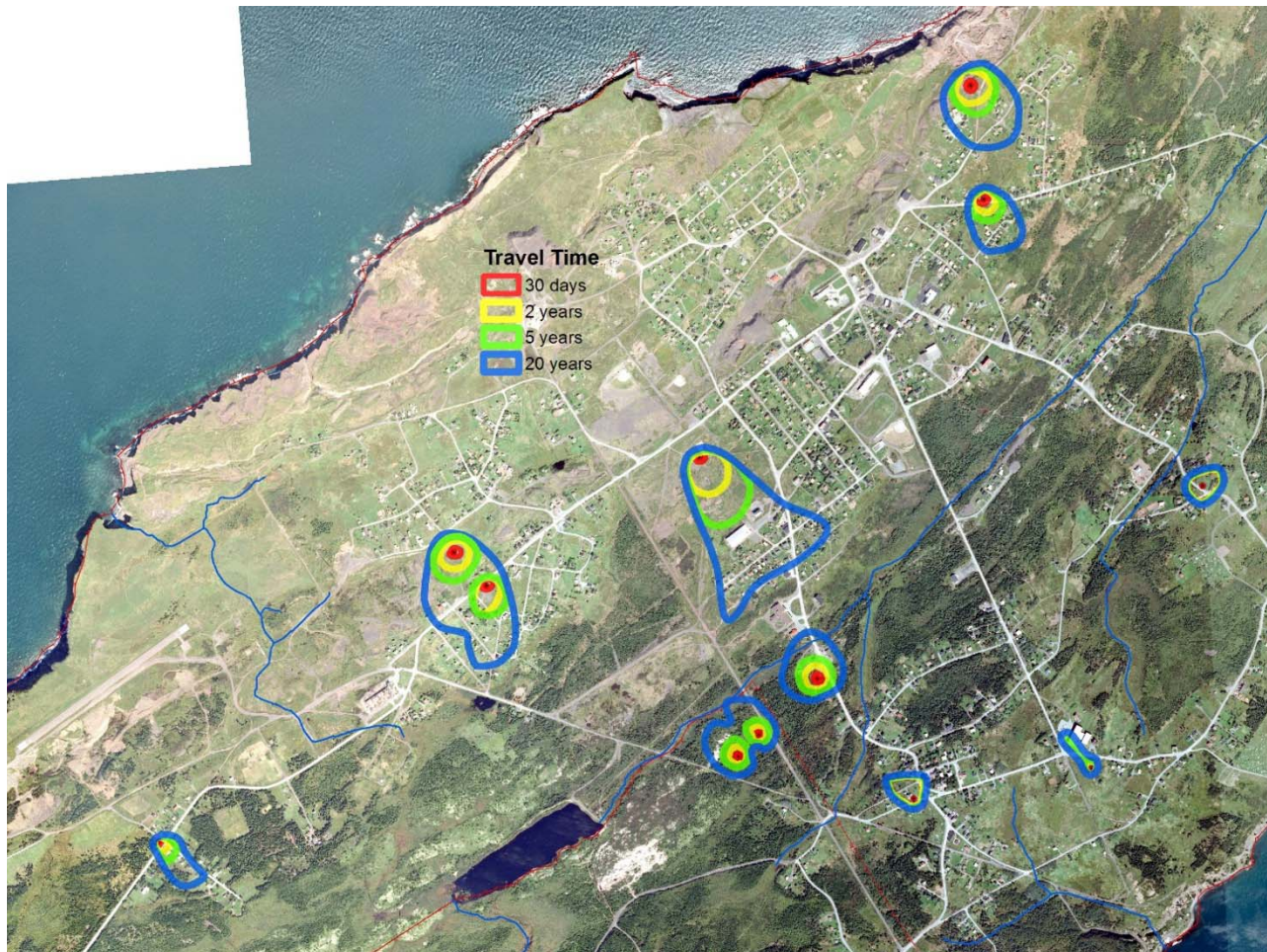


- Flow to well intake from source area (rainfall or wetland)



## 3D flow paths and source water





Time of Travel:  
amount of time it  
takes for  
groundwater to  
travel from the  
edge of the zone  
to the well.

Purpose

Methods

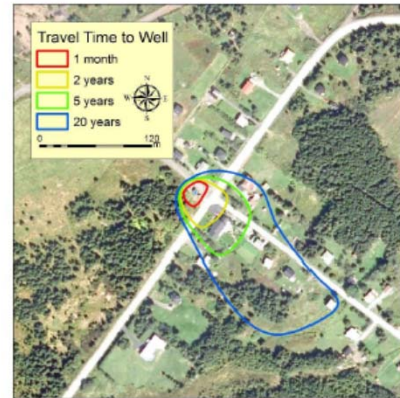
Results

Tools

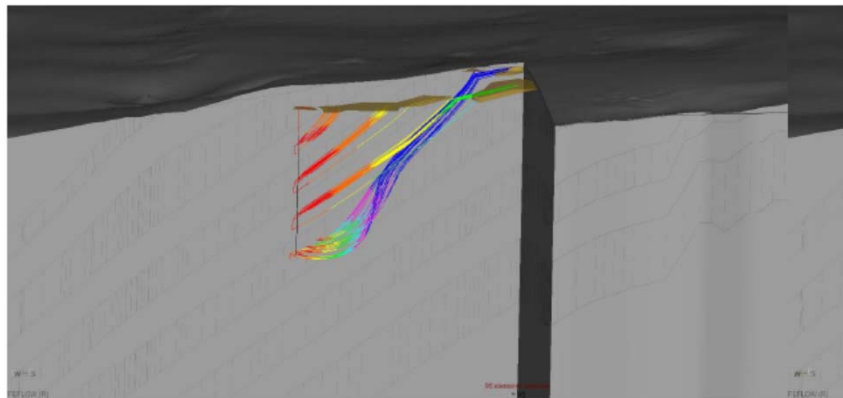
time of travel zones

Production Well 7  
Middleton Avenue

YEAR CONSTRUCTED		1979
DIAMETER	mm	203
STICK UP	m	0.28
CASING LENGTH	m	6
DEPTH	m	121.9
PUMP DEPTH	m	68.58
STATIC WATER LEVEL	m	16.97
PUMPING WATER LEVEL	m	25.87
DRAWDOWN	m	8.90
SATURATED THICKNESS	m	115.92
AVAILABLE HEAD	m	51.89
INSTANTANEOUS PUMPING RATE	USGPM	10
AVERAGE DAILY PUMPING RATE	USG	8 865
	m <sup>3</sup> /d	34
THEORETICAL 20-YEAR SAFE YIELD	m <sup>3</sup> /d	39
TRANSMISSIVITY	m <sup>2</sup> /d	1.58



- Form a well head protection committee
- Field reconnaissance of zones
- Inventory of land uses and ownership
- Reporting on well performance
  - water use
  - water levels
  - raw and treated water quality

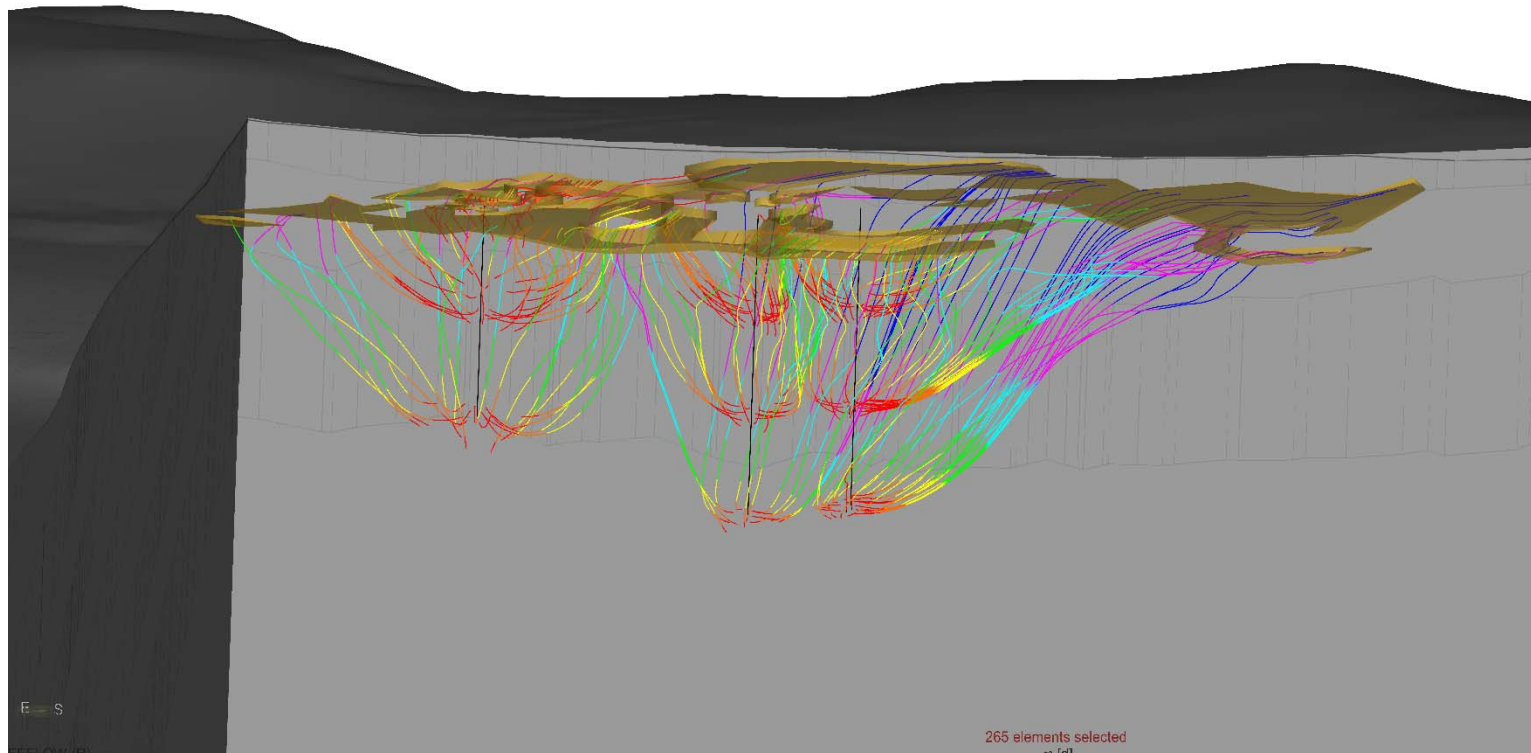


3D Pathlines to Well Showing Source Zones (Infinite Travel Time)



# well head protection planning

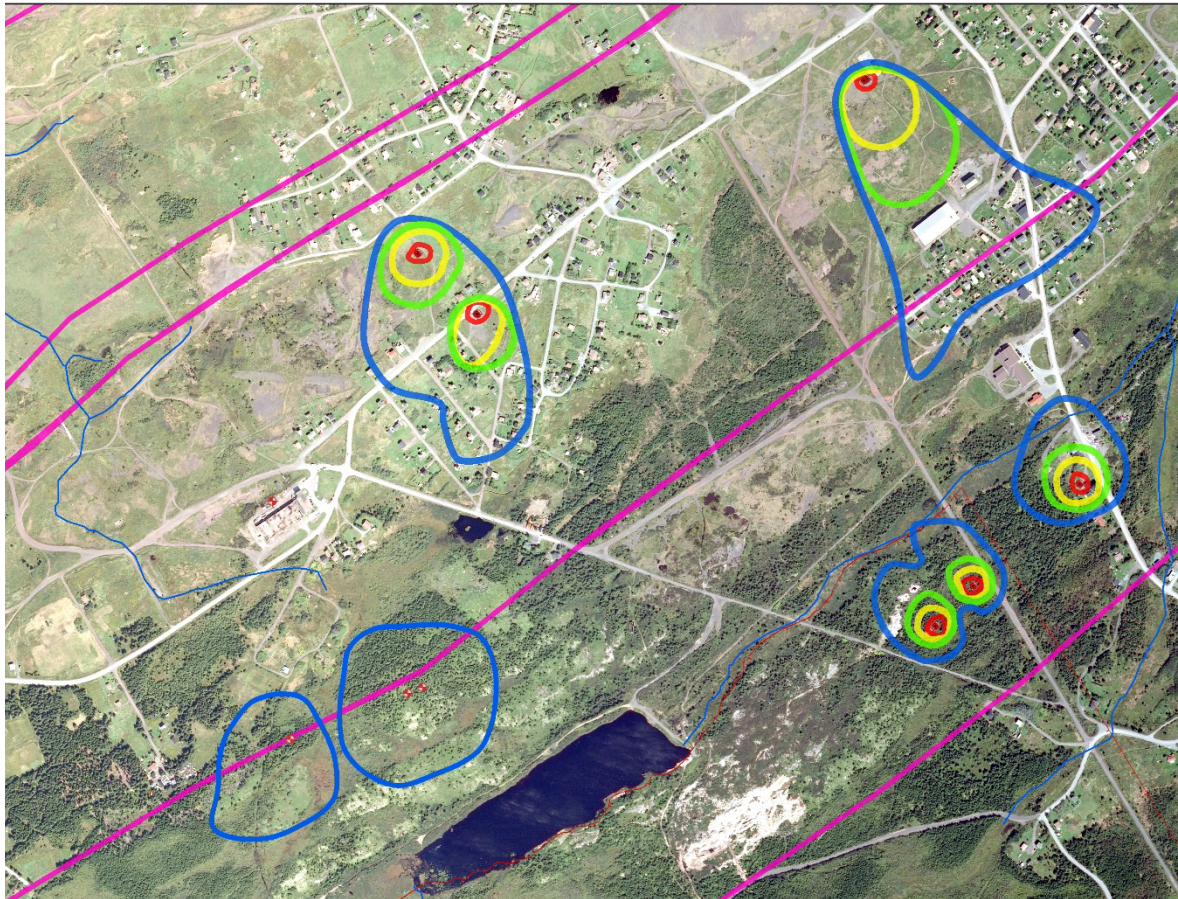




- Intersecting source water zones = competition for water by wells
  - Limit of local yield



**water availability / yield information**

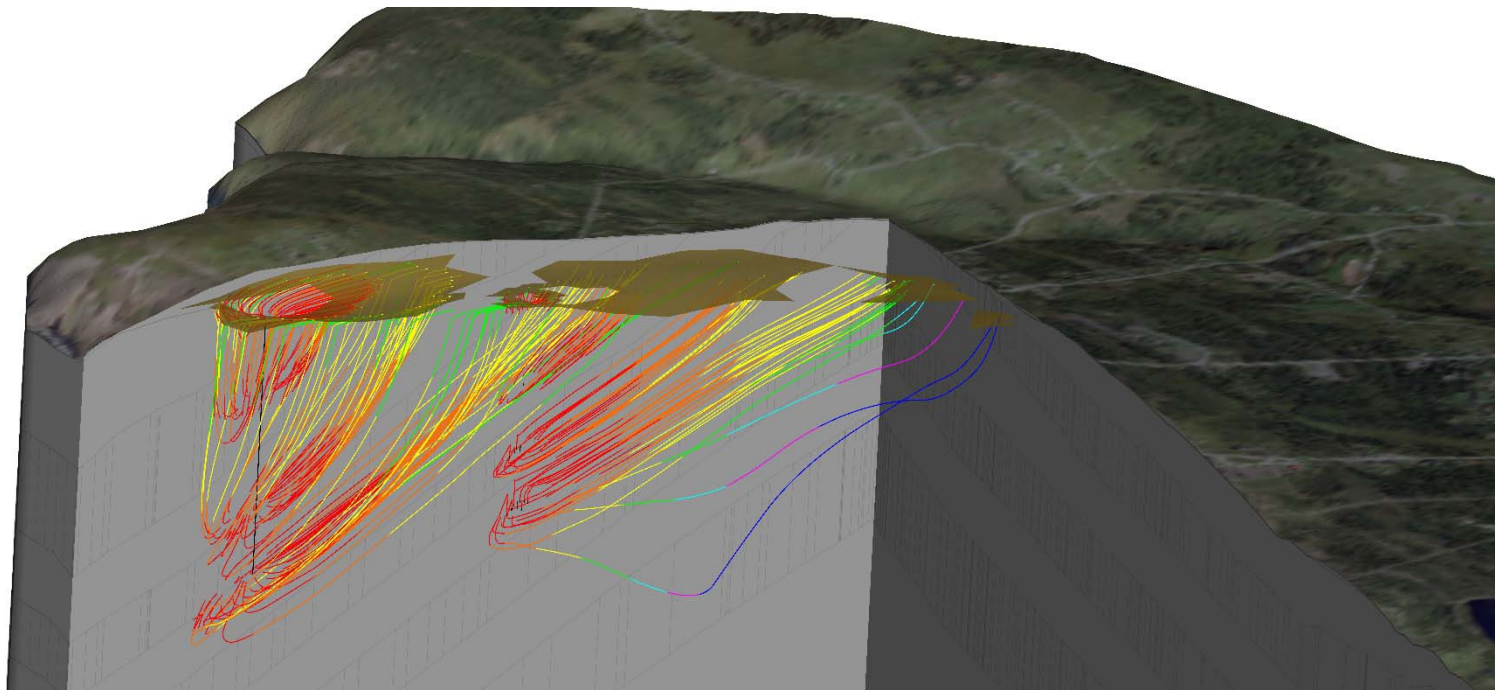


- Avoid intersecting source water zones
- Major bedrock contacts
- Redmond source water area
- Ochre Cove sites
- Considerations for distribution



# test well siting



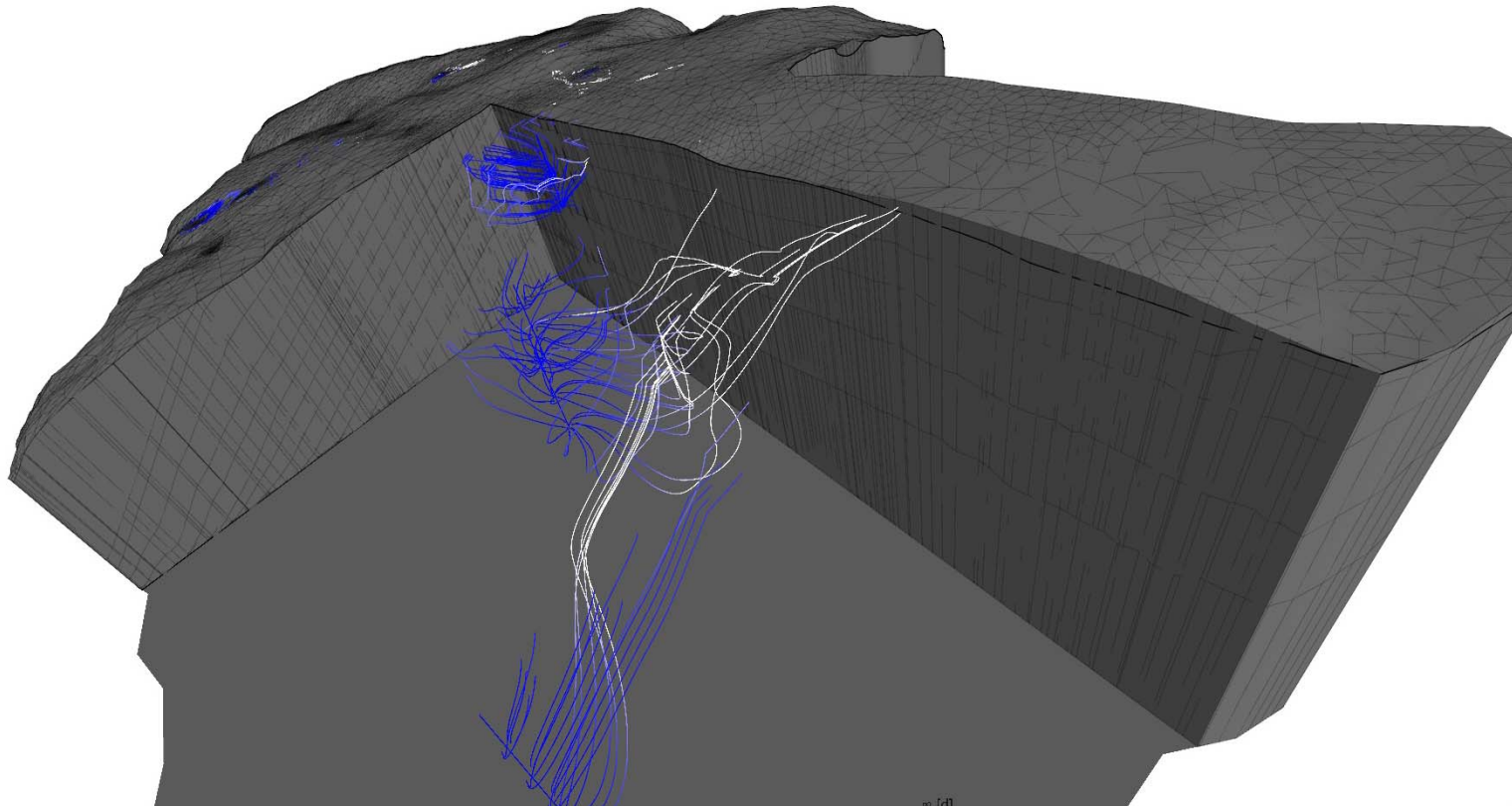


- Pathways to surface water
- Pathways to former industry / commercial / landfill
- Salt water
- Deep groundwater



**water quality**





- Test effects of new well locations and pumping rates



simulations



## Documentation of Well Head Protection Plan

- Land use guidelines, By-laws
- Voluntary agreements
- Signage and community involvement

**Planning and  
Infrastructure**



**well head protection plan (WHPP)**



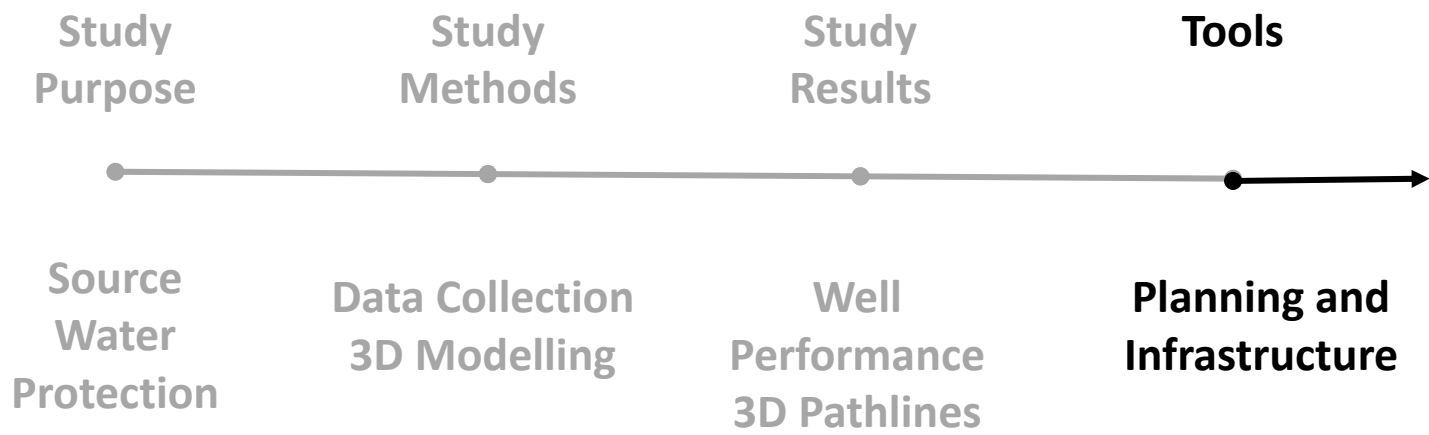
- Chlorine contact times (e.g. piping loops)
- Upgrades to well heads
- Selective pumping
- Distribution system
- Decommissioning / Conversion to Monitoring Well

**Planning and  
Infrastructure**



**well field infrastructure**





questions