Natural Resources Canada | Ressources naturelles Canada

NDGW / DNES

JANUARY 19, 2021 (1-3PM (ET))

Canada

OVERVIEW

- Happy New Year 2021 and welcome intro by Éric Boisvert
- Overview of 2020 and new process for 2021
- Presentations
  - Alfonso Rivera – His perspectives on groundwater in Canada
  - Guy Bayegnak – Alberta
  - Dan Palombi - Alberta
  - Gavin Kennedy and Gordon Check – Nova Scotia
- Next meeting: April 7, 2021 (1-2pm)

Alberta Regulatory Transformation and Groundwater Management

National Dialogue on Groundwater

Guy Bayegnak, Sr. Hydrogeologist

January 2021

Outline

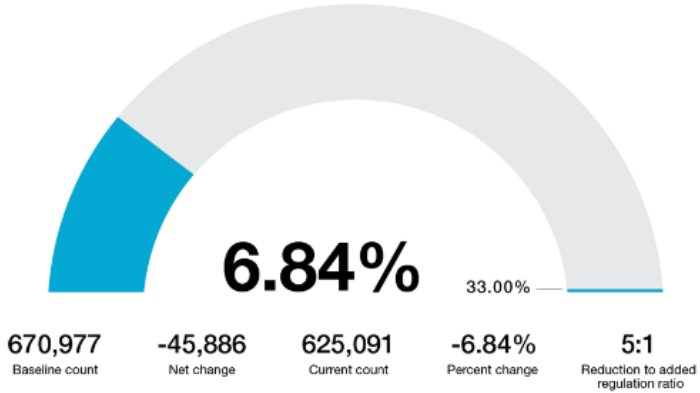
- Red Tape Reduction
- Cumulative Effects Management
  - Management framework
  - Groundwater – Surface water interaction
  - Monitoring
- Digital Regulatory Assurance System

Red Tape Reduction (RTR)

- RTR Act received royal assent on December 9, 2020 and will come into force on June 2, 2021.
  - Modernize the current regulatory environment
  - Reduce or eliminate regulatory burden
  - speed up regulatory approvals

Red Tape Reduction (RTR)

- To achieve red tape reduction:
  - All existing regulatory tools were reviewed, including the Water Act (quantity) and the Environmental Protection and Enhancement Act (Water Quality) and related policies
  - Revoked all caducous policies (old policies/regulations/etc.)
  - Consolidated some policies
  - In the process of updating other policies



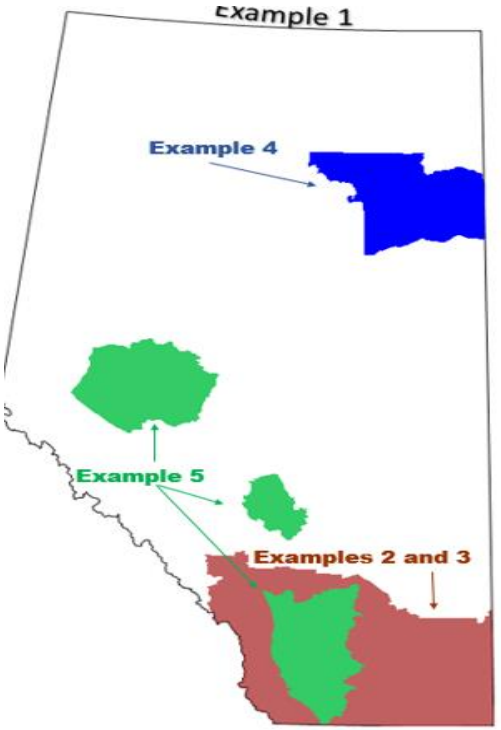
Transitioning to a New Regulatory Paradigm: Cumulative Effects Management

From….

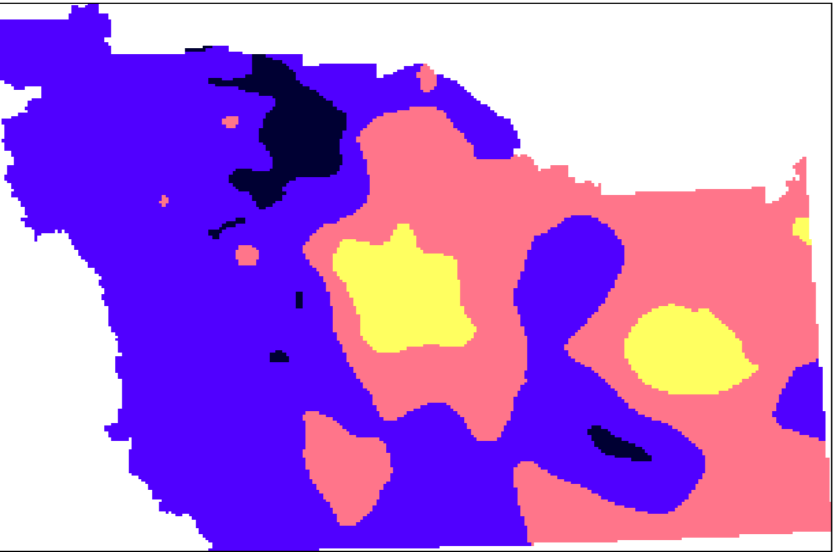
- Project-by-project regulation / allocation according to incremental effect
- Focus on preventing adverse effects
- Cumulative effects of smaller projects and non-regulated activity not directly addressed

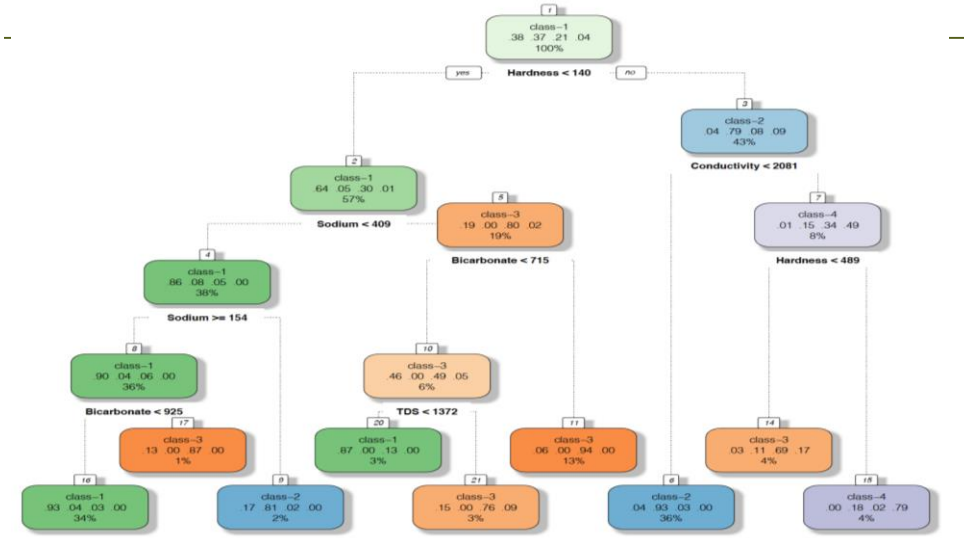
To….

- Regulation / allocation in context of environmental capacity
- Focus on achieving desired outcomes
- All decisions based on understanding of CE

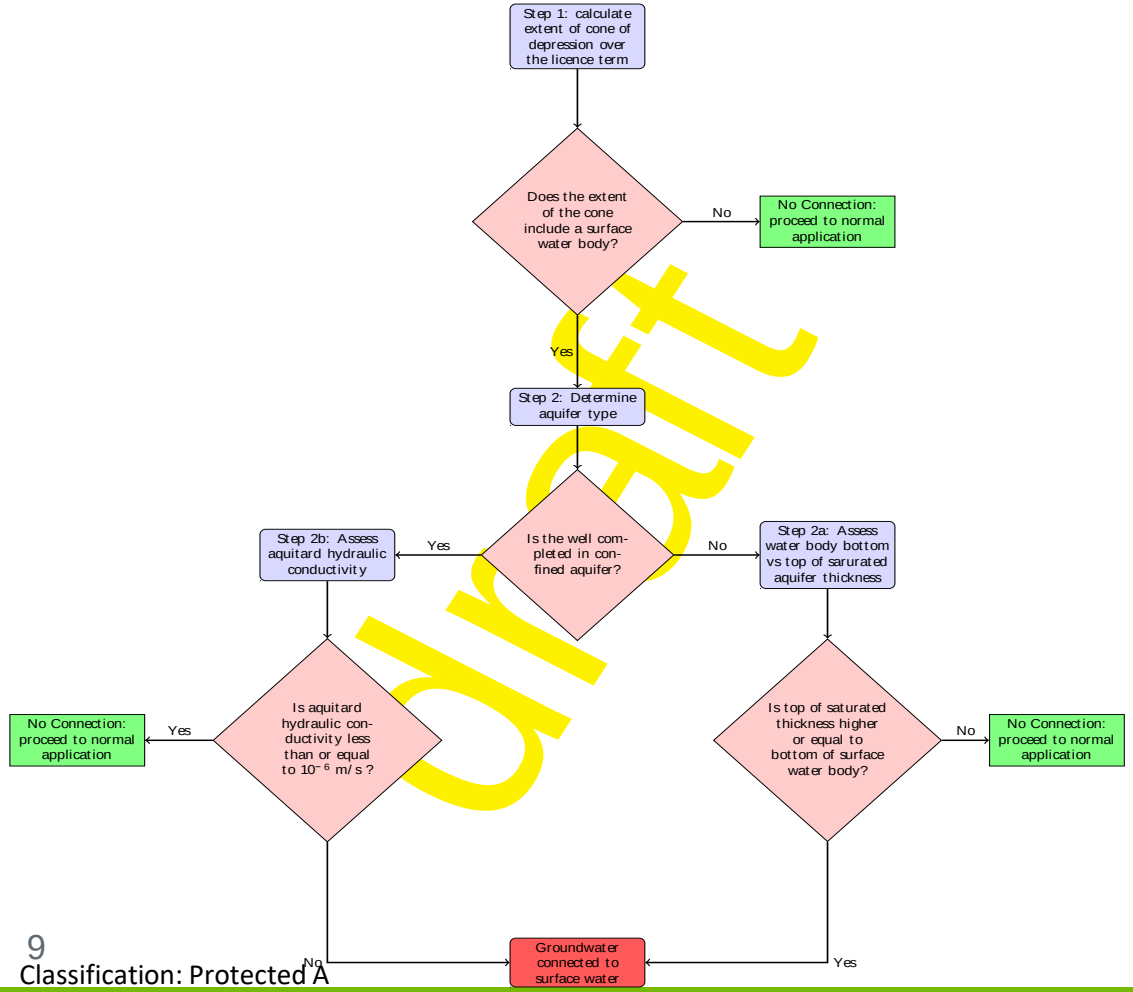


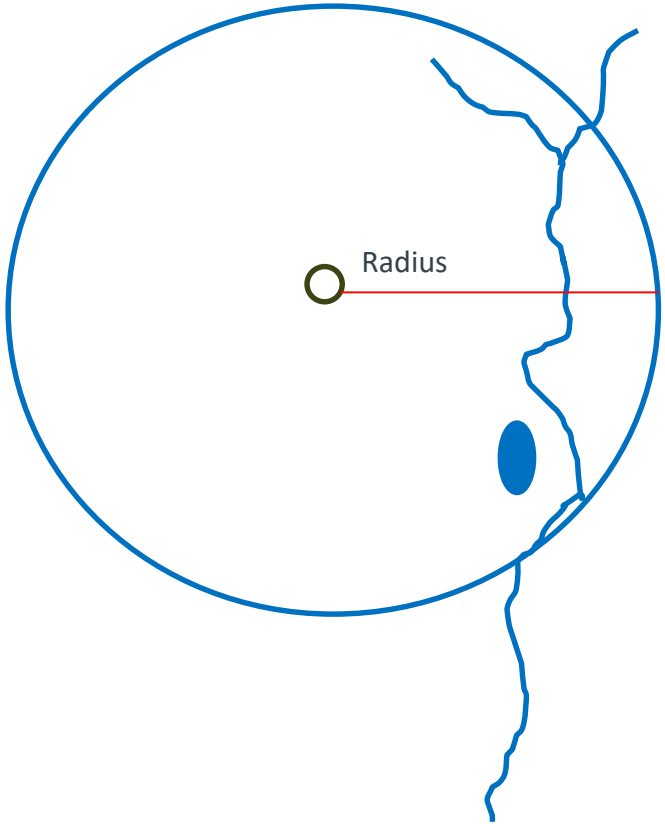
Groundwater in the CEM Context





- Single well ➔ Land use Regions ➔ sub regions ➔ Groundwater management areas
- Single variable ➔ interaction between multiple variables
  - Multivariate analysis
  - Machine learning models



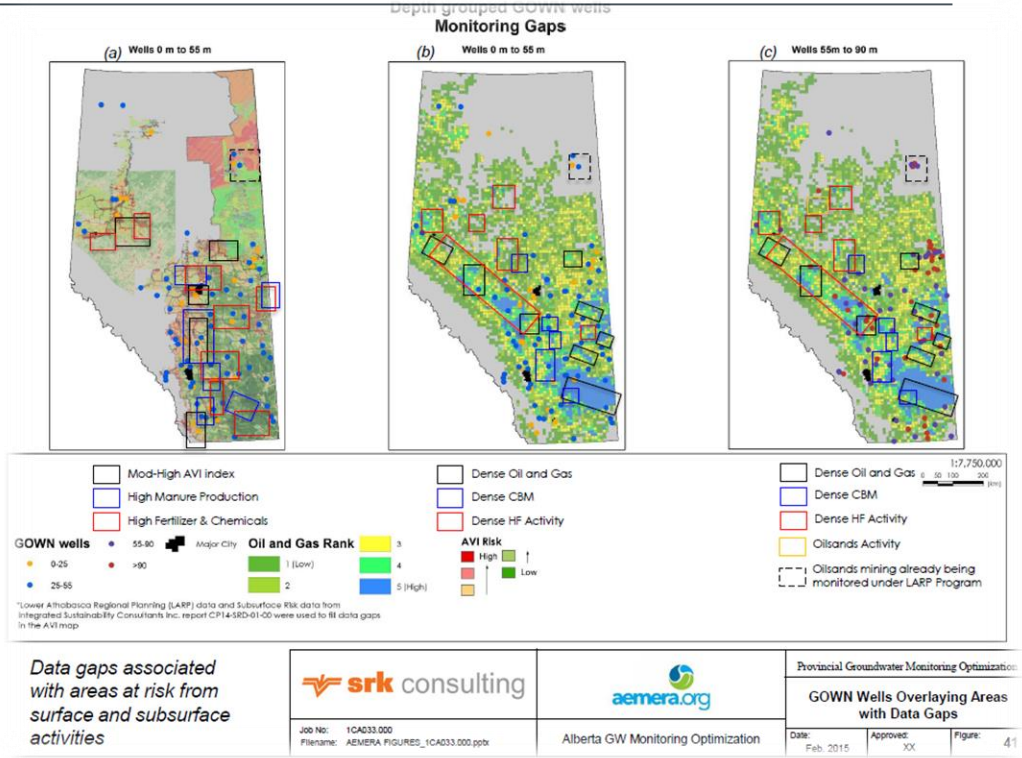


Groundwater Monitoring in the CEM Context

Optimizing the provincial Groundwater Observation Well Network (GOWN)

- Specialized oil sands monitoring network
- Stratified regional monitoring network
  - Core network
  - Secondary
  - Enhanced (High frequency sampling)

Documenting SOPs



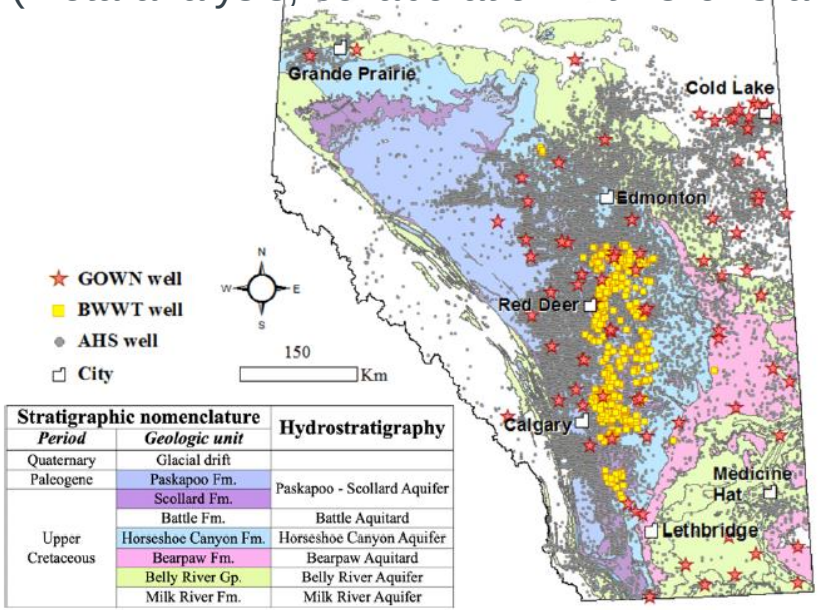
SRK, 2015

Alberta

Evaluation & Reporting on Provincial Groundwater Monitoring Data

New AI-WIP Project: Mapping groundwater contaminants in 3D aquifer framework

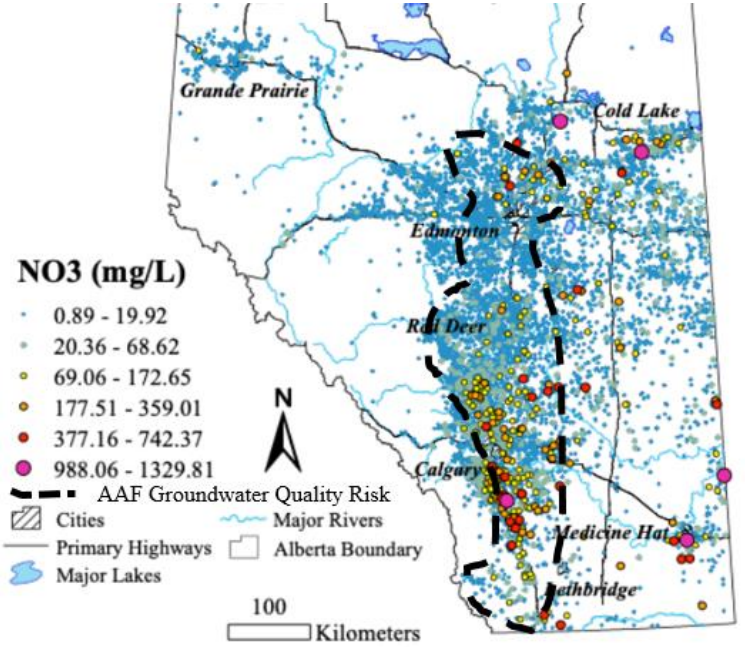
(meta-analysis; collaboration with U of C and AGS)



Stratigraphic nomenclature		Hydrostratigraphy
Period	*Geologic unit*	
Quaternary	Glacial drift	
Paleogene	Paskapoo Fm.	Paskapoo - Scollard Aquifer
	Scollard Fm.	
Upper Cretaceous	Battle Fm.	Battle Aquitard
	Horseshoe Canyon Fm.	Horseshoe Canyon Aquifer
	Bearpaw Fm.	Bearpaw Aquitard
	Belly River Gp.	Belly River Aquifer
	Milk River Fm.	Milk River Aquifer

Humez et al., ES&T, 2019

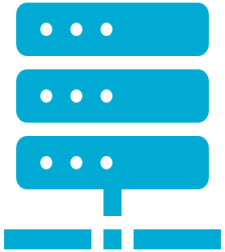
Elevated nitrate coincides with high groundwater quality risk



Wilson, 2019; McClain et al., GeoConvention, 2020

2. Digital Regulatory Assurance System

The Digital Assurance Regulatory System, or DRAS, will be the technological backbone of the transformed regulatory system, enabling clear, expedient decision making and straightforward environmental monitoring.
It is a multi-million dollar investment in automating Alberta's regulatory system by 2023.



DRAS is an integrated technology solution that will compliment and codify Regulatory Transformation

Right now AEP uses several dated information systems to process, track, and monitor approvals across the province. They don't talk to each other.

DRAS will replace the multiple independent systems with one single, consolidated system for proponent applications, approvals, and long-term monitoring.

DRAS will streamline the proponent experience from application through to file management and closure.

Benefits of DRAS for Proponents

Why Does DRAS Matter?

DRAS will:

Be a "one-window" portal for applicants: one development, one application.

Ensure application requirements are clear: applications are complete and correct the first time; removing the "back and forth" between proponents and AEP.

Streamline the approvals process: the system will identify standard or routine applications, expediting time to decision.

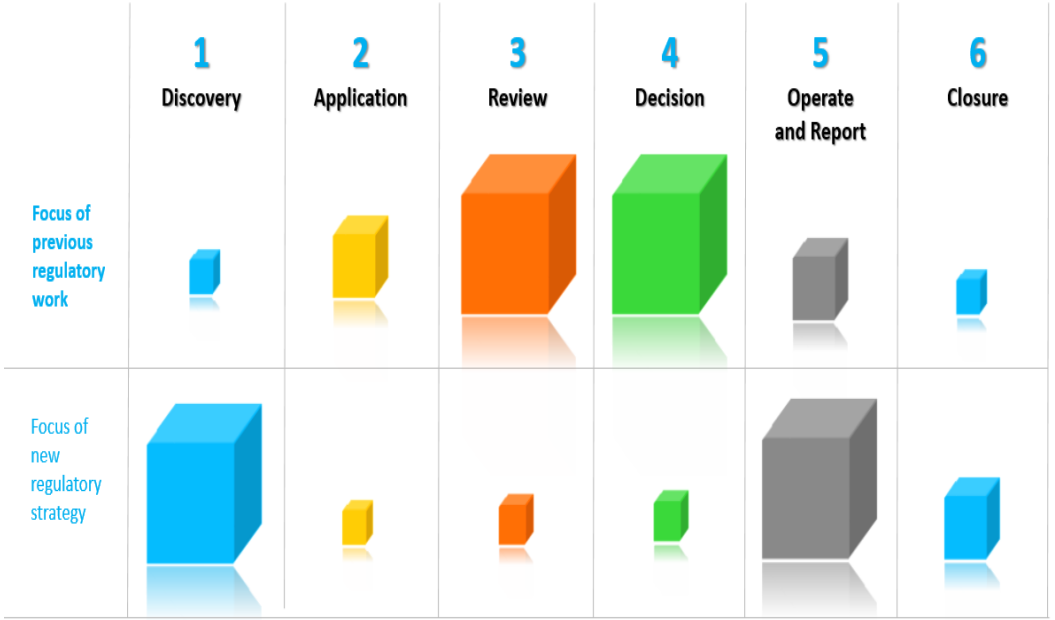
Provide visibility on application progress: proponents will be able to see where their application is in the approvals process, increasing transparency and visibility for proponents.

Standardize long-term monitoring: Compliance and reporting requirements will be clearly communicated and submitted electronically in standardized data sets, drilling down on the regulatory monitoring that matters.

Digital Regulatory Assurance System

To meet the objectives of RTR and CEM:

- Shift focus on applications and referrals to post approval regulatory assessments to validate environmental standards are being met
- Requires high quality data and knowledge
  - Digitize and automate the regulatory process where feasible
  - Strengthening partnership with research organization (e.g. Universities, AGS)



Alberta Energy Regulator

AGS ALBERTA GEOLOGICAL SURVEY 100 YEARS

Overview of the Groundwater Geoscience Program at AGS

Dan Palombi, Senior Advisor – Resource Geoscience

Presented to: National Dialogue on Groundwater Working Group, 19 January 2021

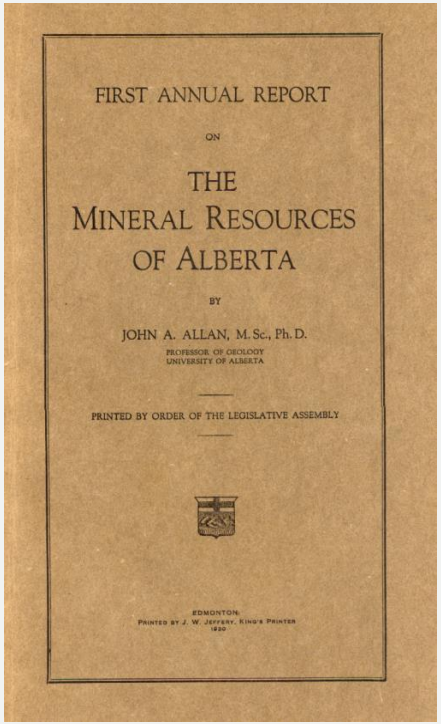
Photo: R.Elgr

Outline

- Brief history of the AGS and mandate
- Roles and purpose of the AGS Groundwater Geoscience Program
- Examples of groundwater and near-surface geological products and studies
- Program summary and future focus areas

Brief History of the AGS

- Alberta Geological Survey (AGS) was established in 1920 at the University of Alberta / Alberta Research Council.
- Since 1996 the AGS has been with the energy regulator.
- This unique positioning ensures that strong geoscience is developed and implemented to support regulation of Alberta's energy resources.
- AGS also provides geological data, information, and knowledge required for Alberta government departments (e.g., Alberta Environment & Parks and Alberta Energy).
- AGS supports the need for unbiased geoscience information and outreach for industry and the public.



The Alberta Geological Survey is responsible for describing Alberta's geology and resources.

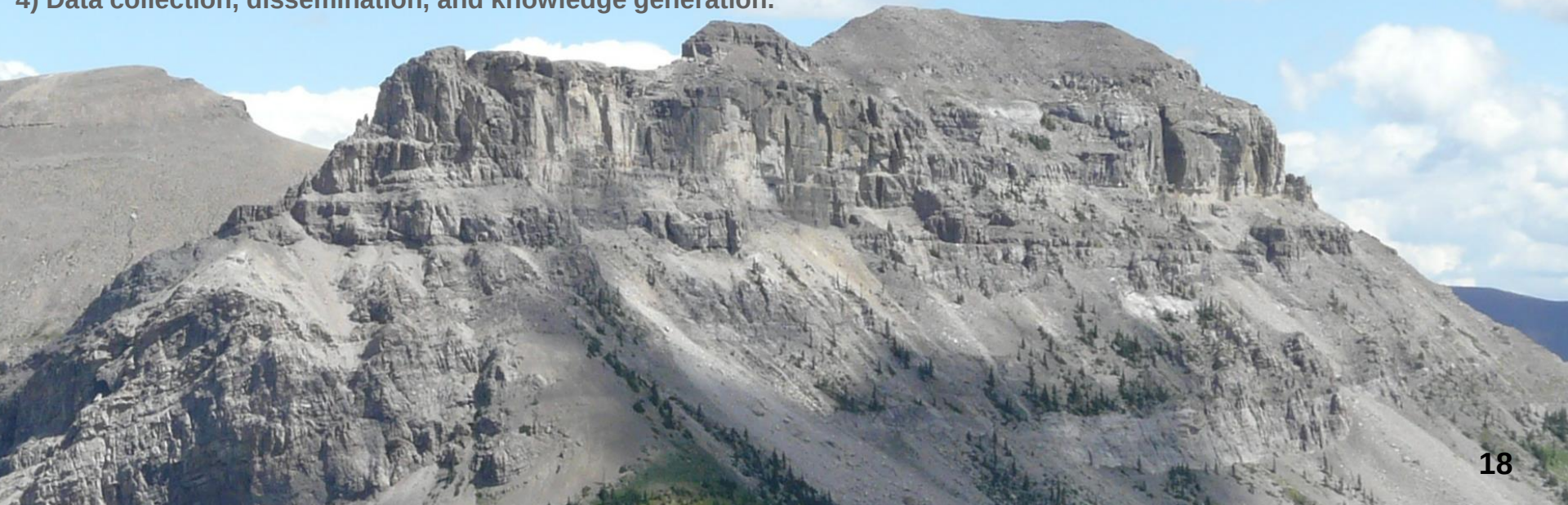
AGS generates, manages and communicates integrated geoscience knowledge to inform regulatory processes, public safety, economic opportunity, environmental stewardship, and sustainable resource development. Our primary roles include:

1) Conduct surface and subsurface geological mapping.

2) Conduct energy, water and mineral resource assessments.

3) Evaluate and monitor landscape change and geological hazards.

4) Data collection, dissemination, and knowledge generation.

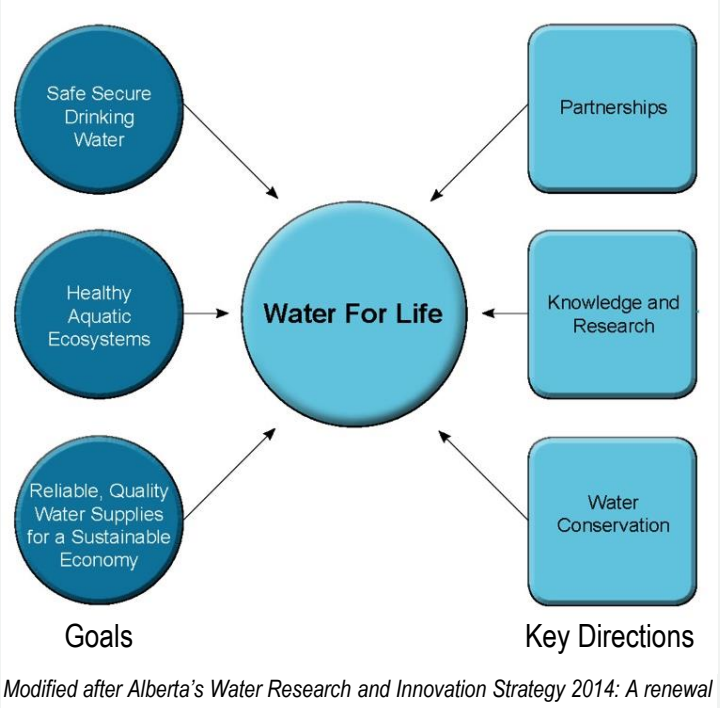


Groundwater Geoscience Program – Alignment with Regulatory & Policy Expectations

AER Strategic Plan: Outcomes & Measures

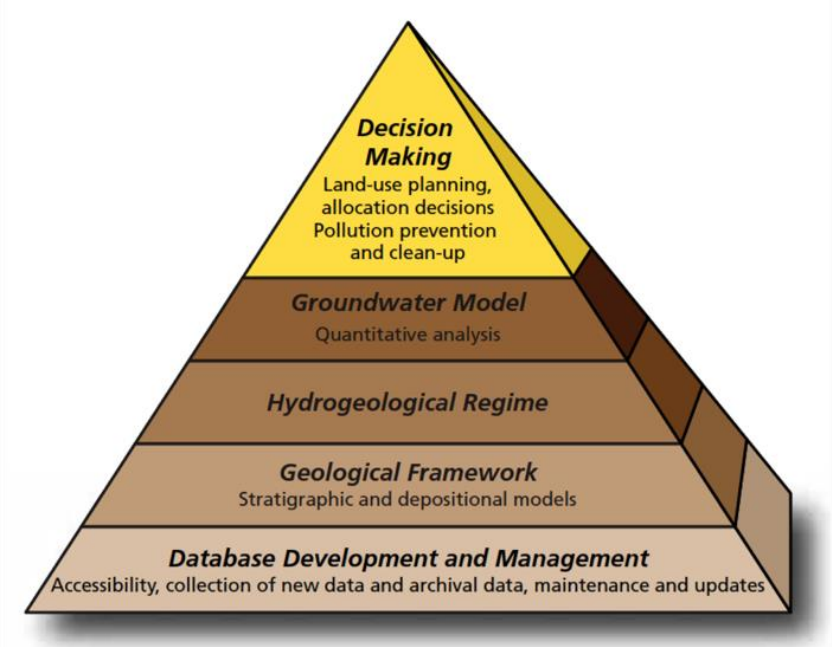
Available at aer.ca

Government of Alberta's Water Research & Innovation Strategy



Modified after Alberta's Water Research and Innovation Strategy 2014: A renewal

Technical Building Blocks for Groundwater Sustainability



Canadian Council of Academies, 2009

**Groundwater Sustainability Assessment Approach incorporates CCA model in guidance for application; Canadian Council of Ministers of the Environment, 2017*

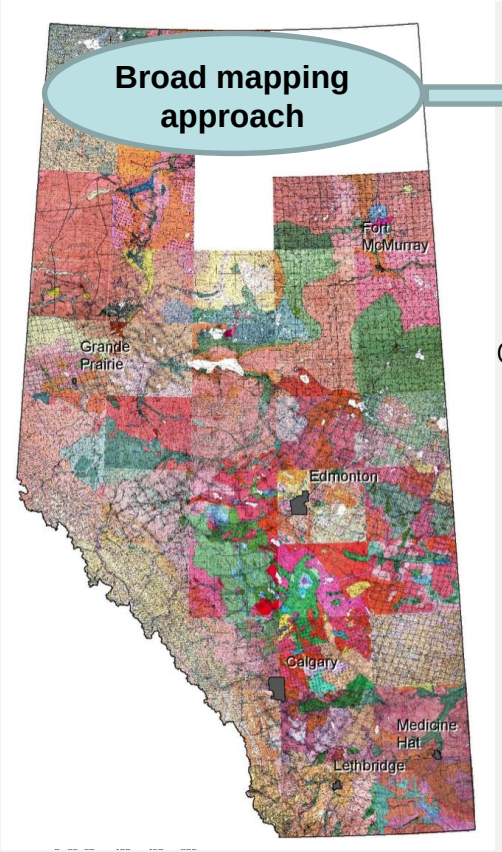
Purpose of the AGS Groundwater Geoscience Program

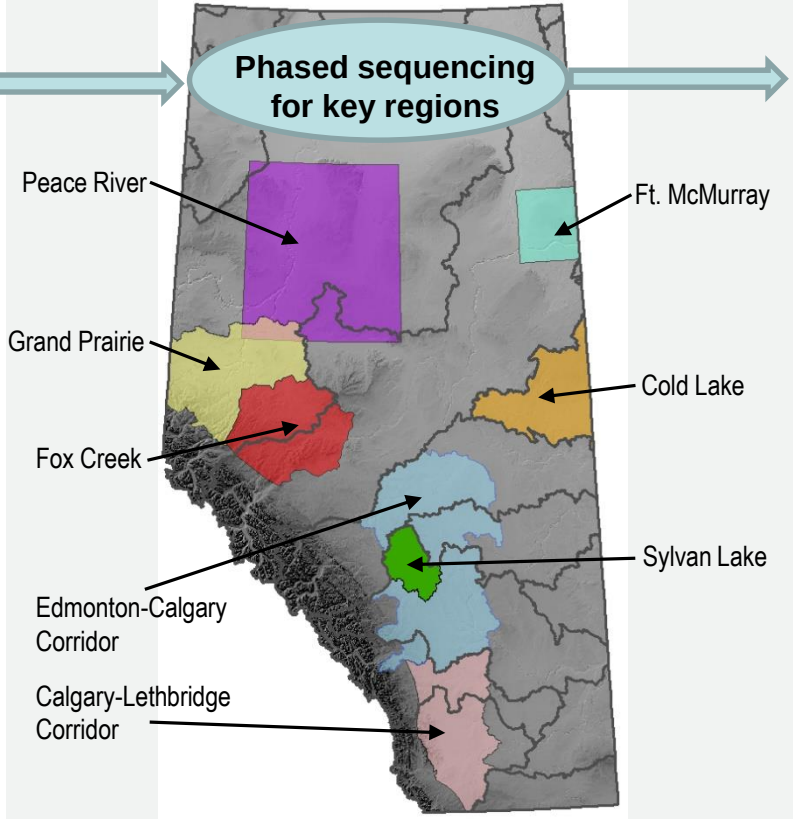
- Inform and support regulatory, policy and planning decisions related to groundwater.
- Deliver a balanced, common-sense and results-based approach to the stewardship and protection of Alberta's environment while enabling sustainable resource development that supports social and economic well-being.
- Further develop geoscience-based groundwater policy and environmental monitoring strategies, regional plans, environmental management frameworks and decision support tools, including meeting transboundary water commitments.

Alberta Research Council Groundwater Reconnaissance Program (1968-1982)

Alberta Geological Survey Groundwater Geoscience Program (2007-present)

Groundwater Geoscience Program Timeline with Alberta Environment & Parks

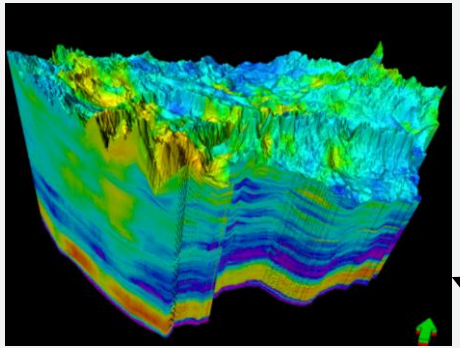




Memorandum of Understanding with Alberta Environment & Parks

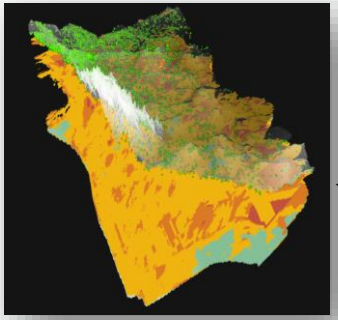
- 2007: Established to support *Water for Life* strategy
- 2011: MoU established scientific phases and roles
- 2017: MoU updated to align with AEP initiatives
- *December 2020: Expanded MOU to strengthen collaboration, partnerships, and objectives*

Example Geological Products



Property Modelling

- Illustrates zones that likely contain permeable sandstone bodies.



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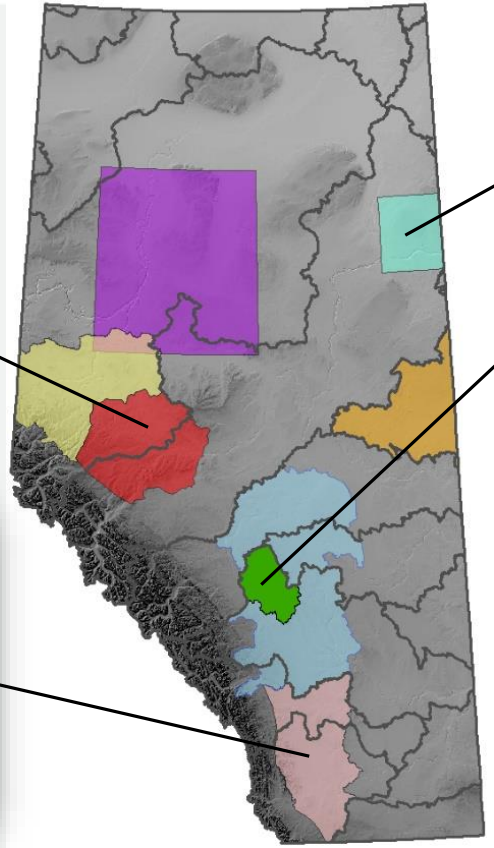
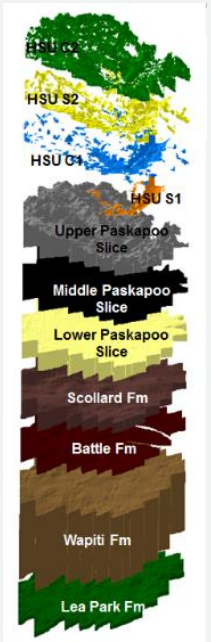
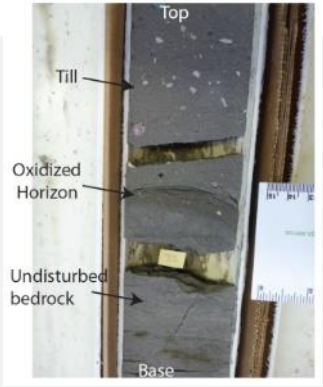


Modelling Top of Bedrock in Oil Sands

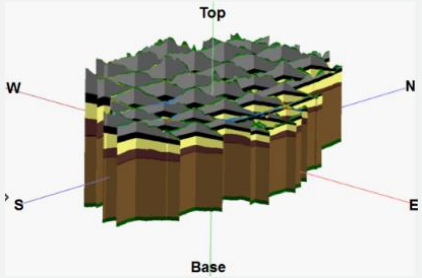
- Important for understanding caprock integrity and migration of fluids.



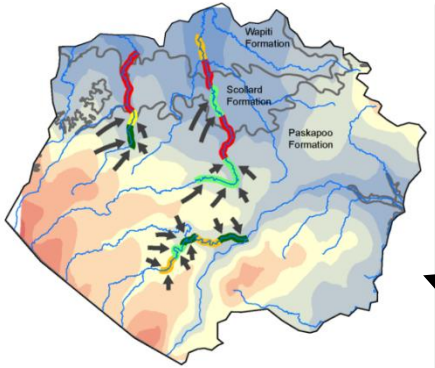


Geological Model

- 3D modelling of hydrostratigraphic units to inform groundwater flow modelling.

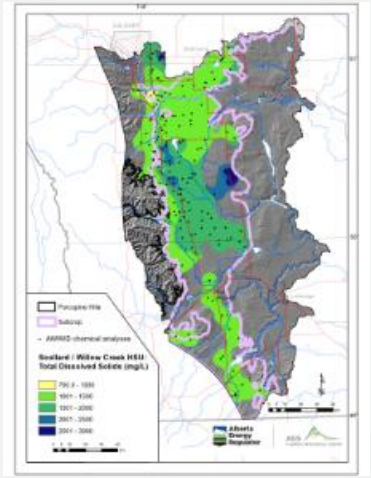


Example Hydrogeological Products



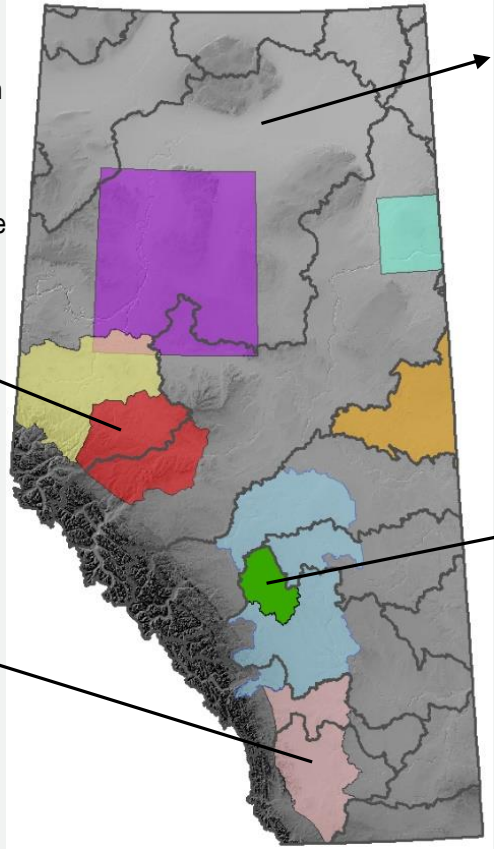
Surface water-groundwater interaction

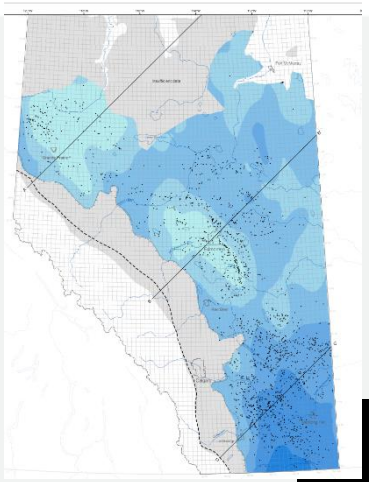
- Regional groundwater circulation
- Potential hydraulic pathways and recharge areas



Groundwater chemistry

- Water quality



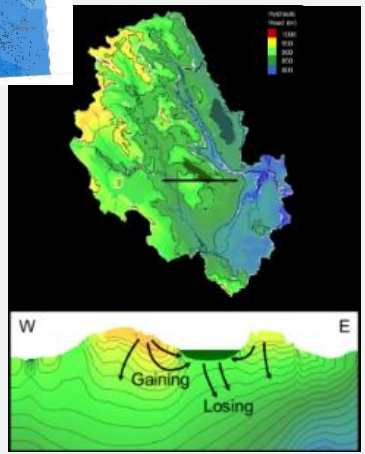


Provincial Hydrogeological Mapping

- Flow directions
- Salinity distributions
- Density-dependent flow corrections
- PDF MAP and ArcGIS Online Interactive Map

Groundwater models

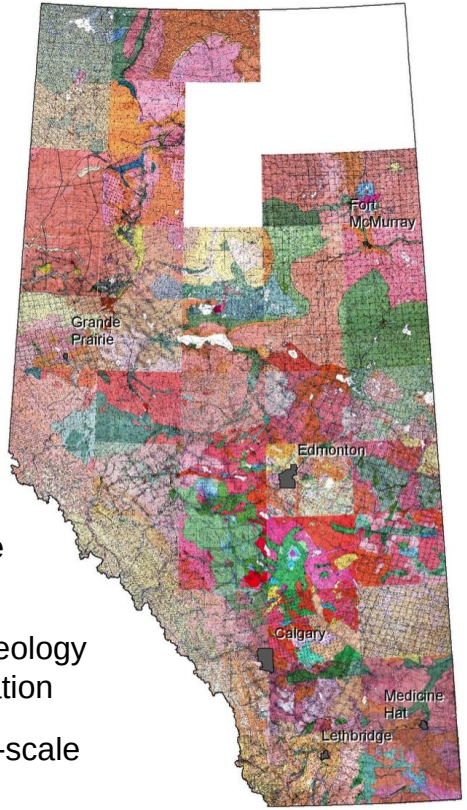
- Estimating water balance
- Quantifying groundwater availability
- Assessing water withdrawals



Groundwater Availability Assessments

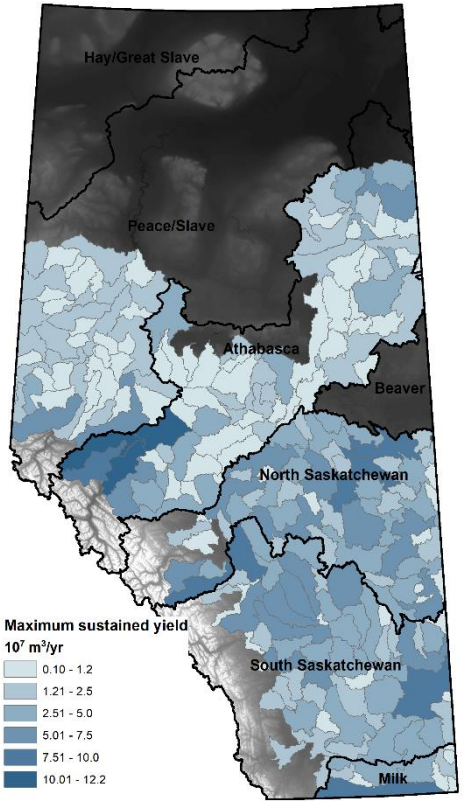
Objective:

Provide screening tool for decision-making regarding water use in areas with limited water, competing water use sectors, or lack of detailed analysis



ARC Reconnaissance Program (1968-1983)

- Estimate based on geology and pumping information
- Intended for regional-scale perspective

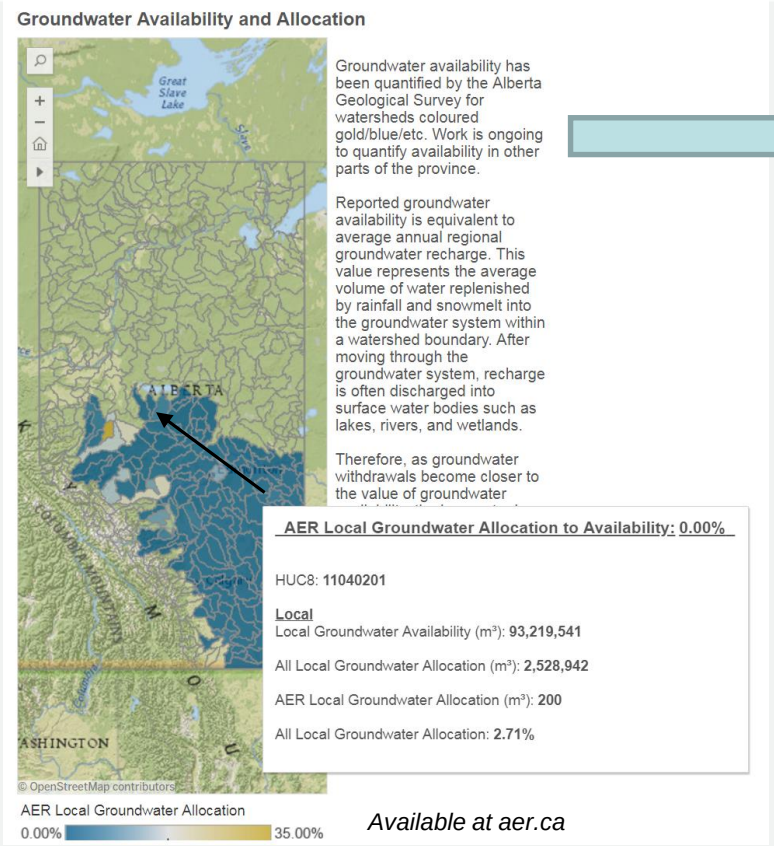


AGS Groundwater Availability Assessments

- Calculated from hydrologic data
- Watershed-scale
- A measure of how much groundwater can be withdrawn
- Ultimately a balance between the physical hydrogeological system and aquifer governance
- Methodology adopted after Kalf and Woolley, 2005; Pierce et al., 2013; HJ
- *Klassen and Liggett 2019; AGS Open File Report 2019-10*

Lemay and Guha 2009; AGS Open File Report 2009-02

Integration of Groundwater Availability Assessments into AER Water Use Reporting



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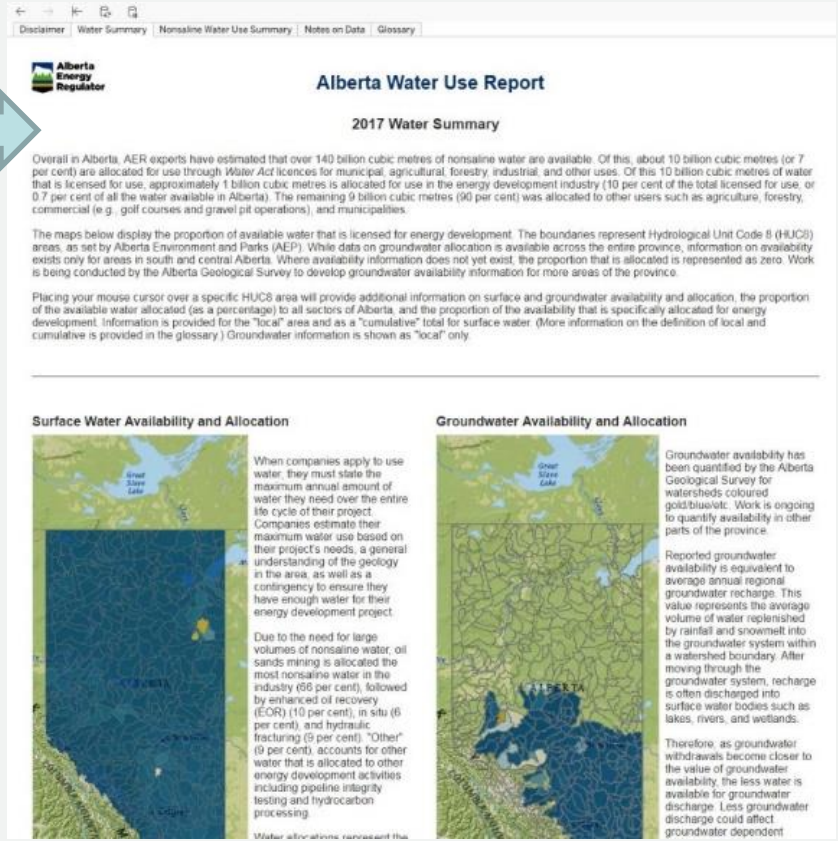
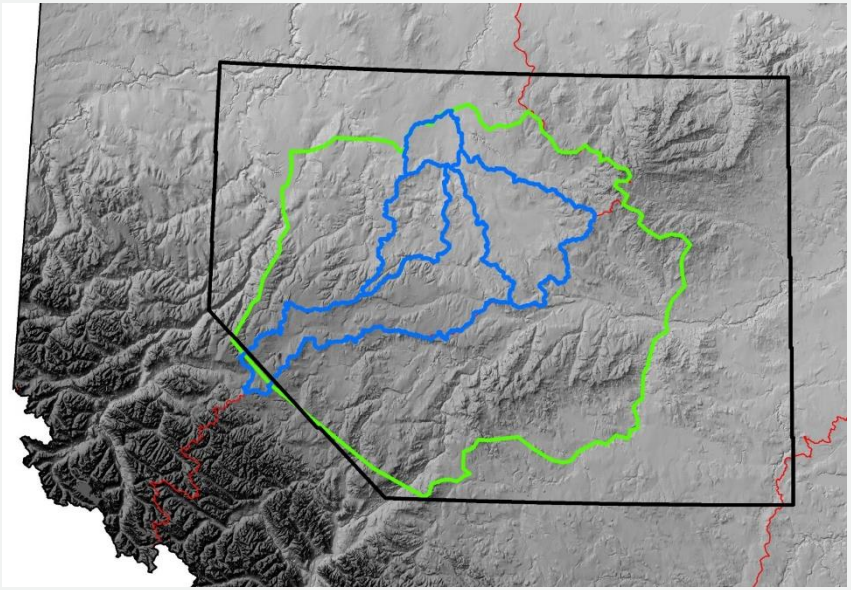


Regional-scale Geological and Hydrogeological Study: Energy development and water demand in West-Central Alberta



Study area boundaries:

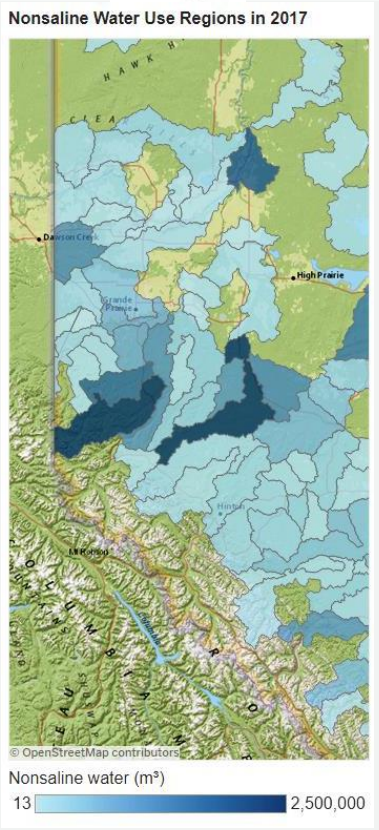
Bedrock geological model & saline aquifer mapping

Upper Cretaceous – Quaternary hydrogeology

SW/GW model

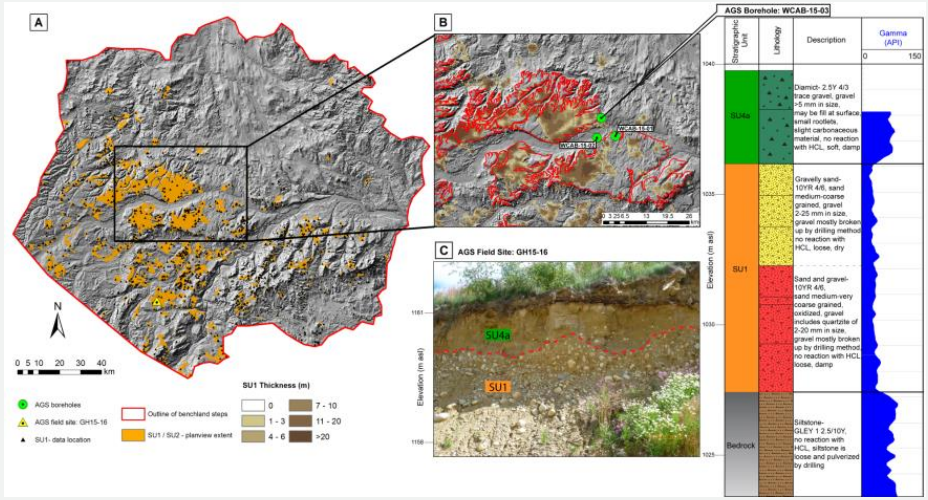
Drivers for Study

- Unconventional hydrocarbon development significantly increased in 2014
  - Notable seismic activity
  - ~30,000 to 50,000 m^3 water per well for hydraulic fracturing
  - Sourced from surface water and shallow groundwater
- Multi-disciplinary study covering the full-stratigraphic succession

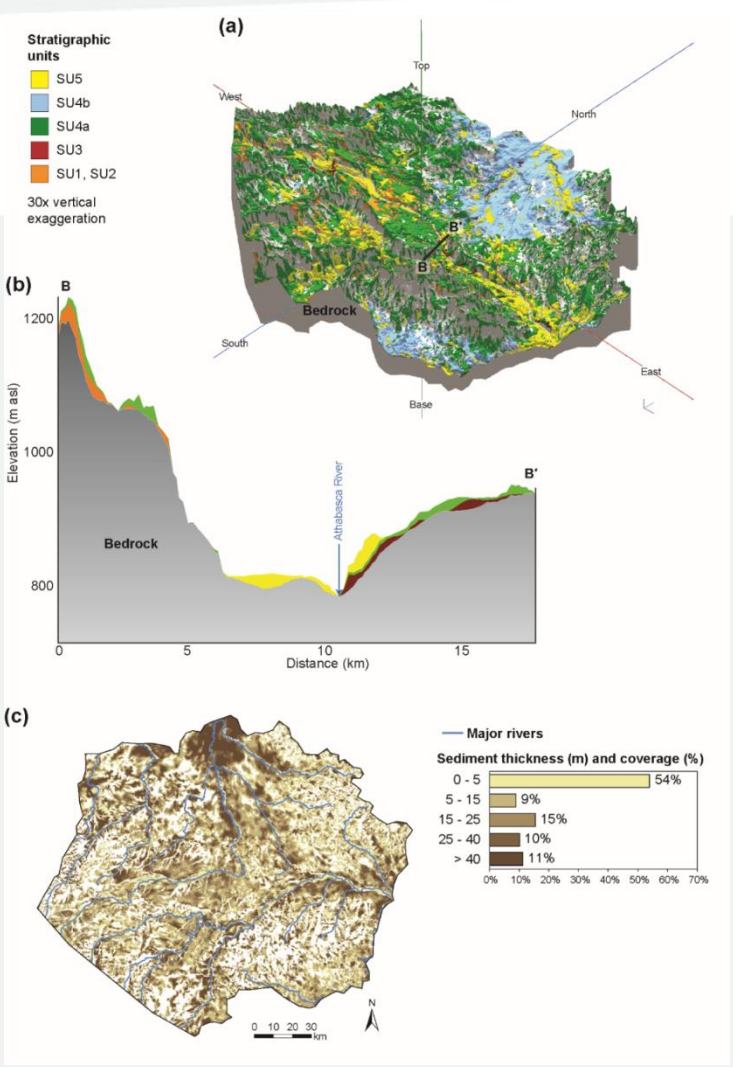


Available at aer.ca

Paleogene–Quaternary Stratigraphy

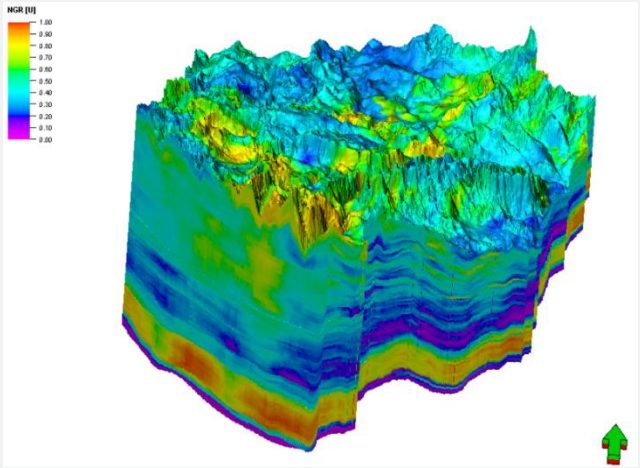


Atkinson and Hartman 2017; AGS Report 93

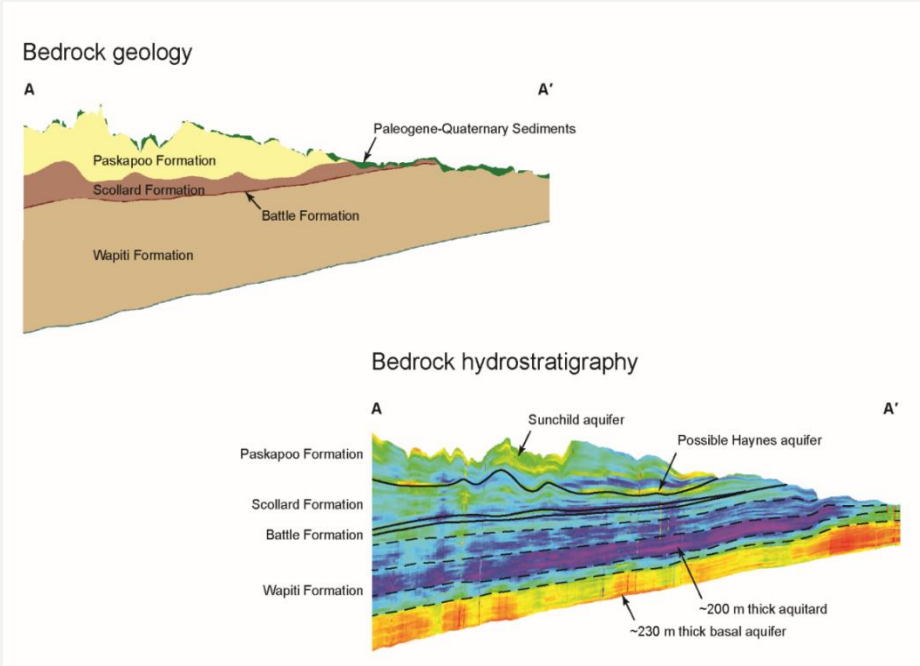


- 3D model of Pg-Q units
  - Developed from HQ boreholes, field observations, water well database
  - Refined bedrock topography

Upper Cretaceous–Paleogene Sandstone Abundance



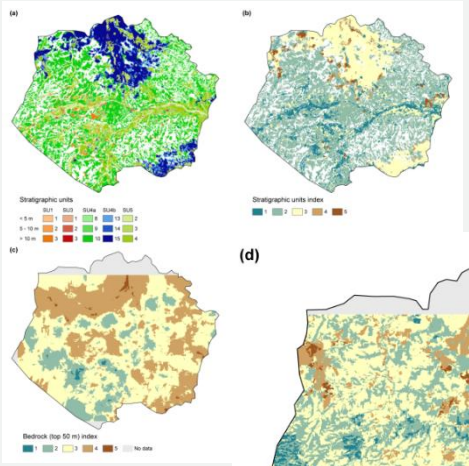
- 3D model of net-to-gross sandstone ratio
  - Developed from gamma logs & water wells
  - Spans Wapiti, Battle, Scollard, and Paskapoo formations

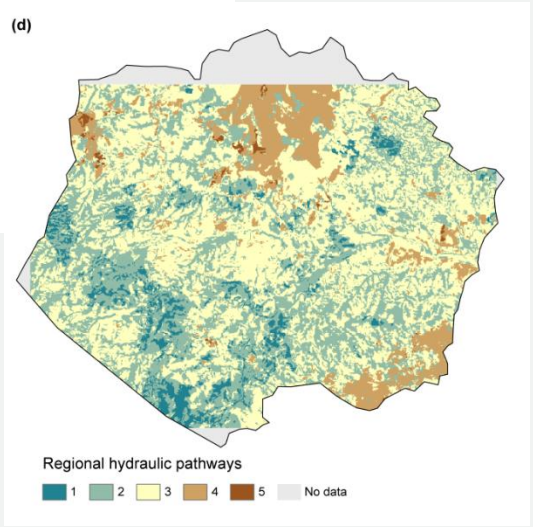


Babakhani et al. 2019; AGS Open File Report 2019-03

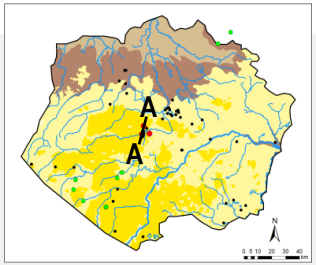
Groundwater Recharge

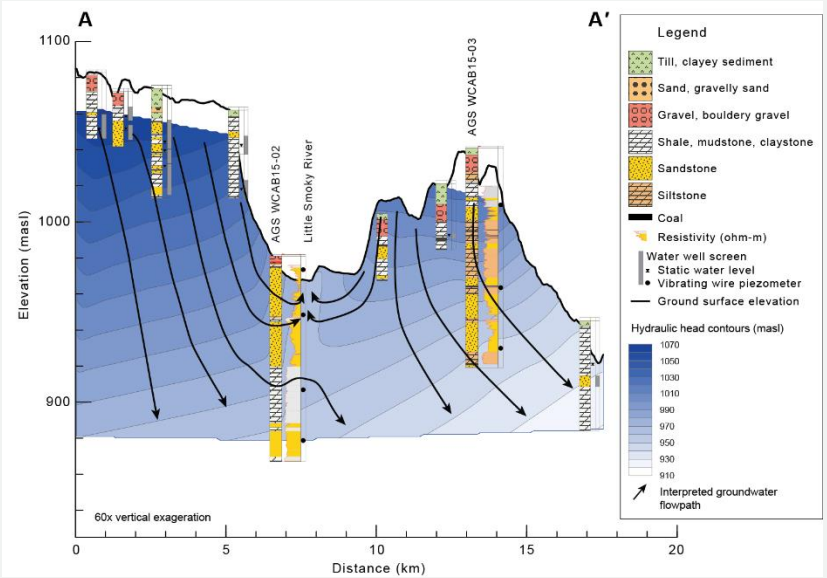
- GIS-based index
  - Pg-Q HSU's
  - Upper 50m bedrock NGR





Smerdon et al. 2019; AGS Report 98

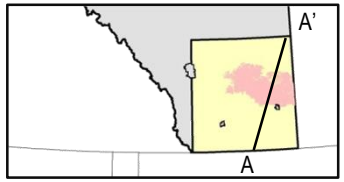


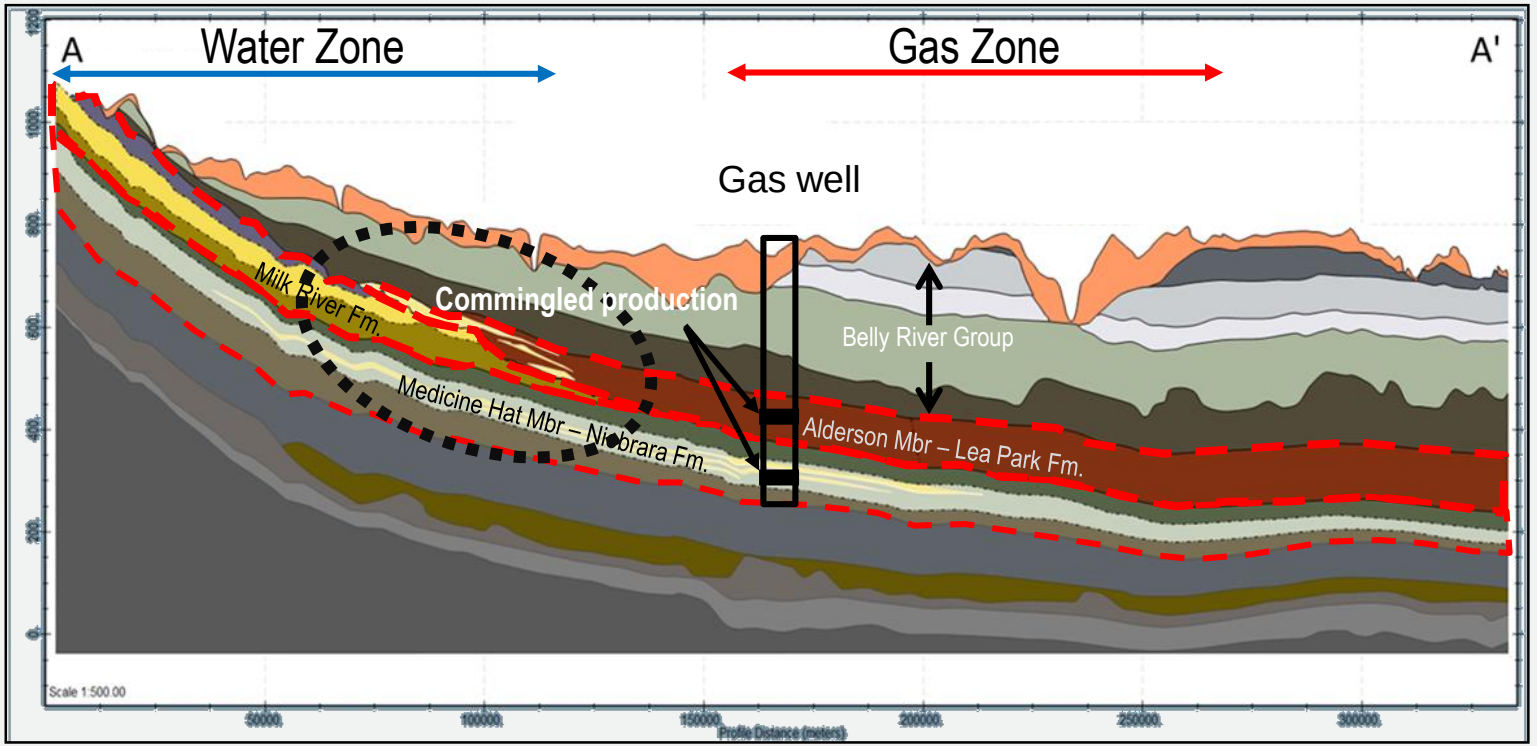


Smerdon et al. 2016; AGS Open File Report 2016-02

AGS

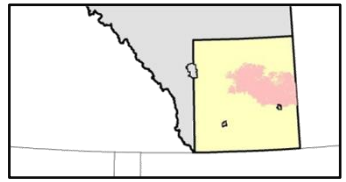
Regulatory Case Study - Investigating Safe, Permanent Closure of Commingled Gas Fields in Southeastern Alberta: Groundwater-gas migration

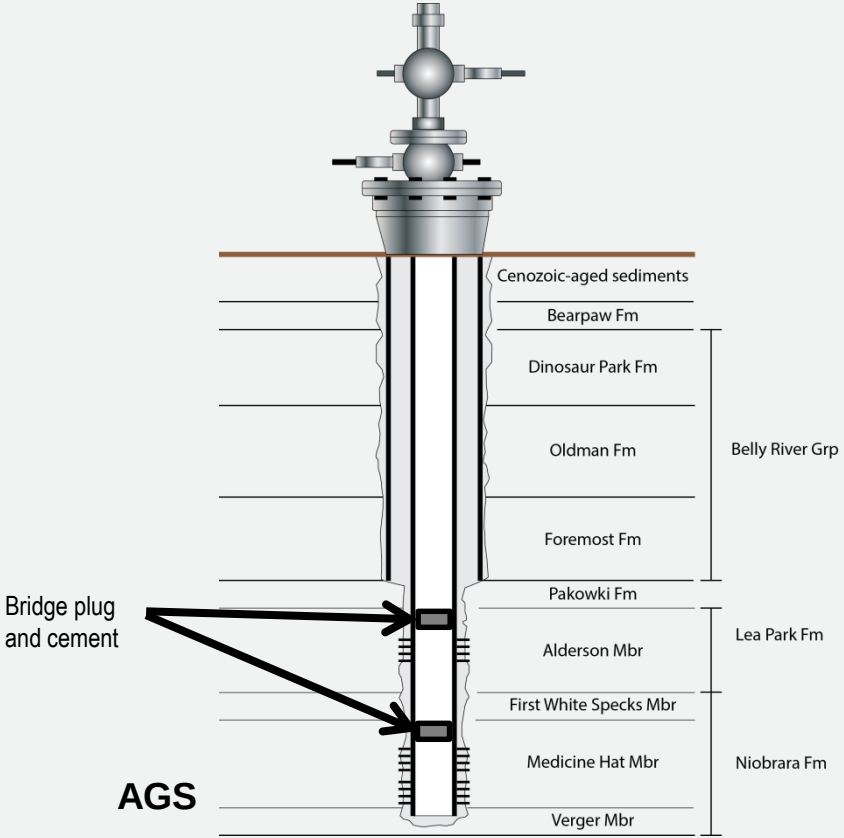




Lemay et al. 2019; AGS Open File Report 2019-06

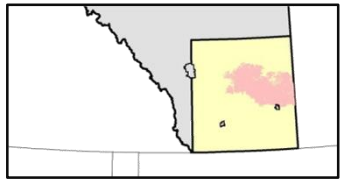
Regulatory Question

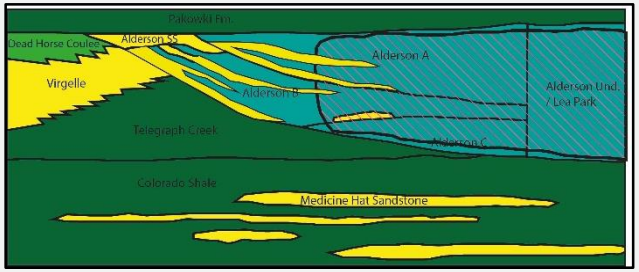




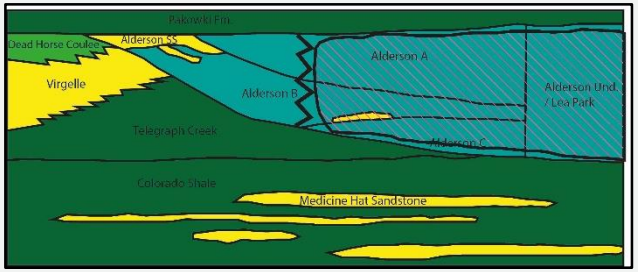
"Will residual natural gas in the Alderson and Medicine Hat gas zones escape through the natural petroleum trap up-dip to the Milk River aquifer if the two zones are left commingled in abandoned energy wells after the fields are permanently closed?"

Multiple Conceptual Models

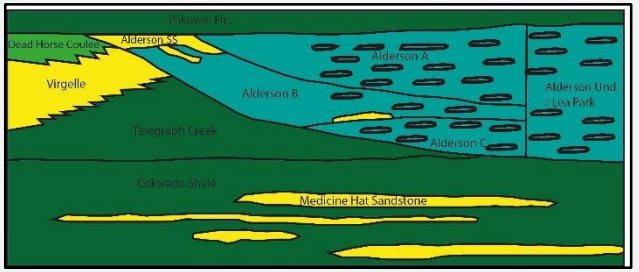




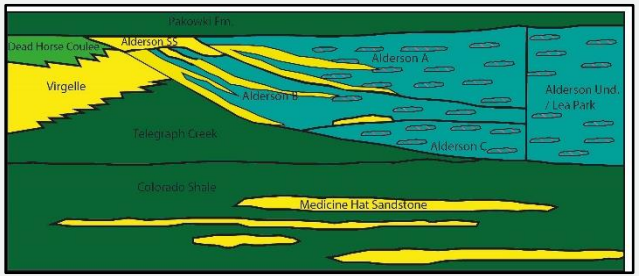
Model elements 1, 4, 5 and 7



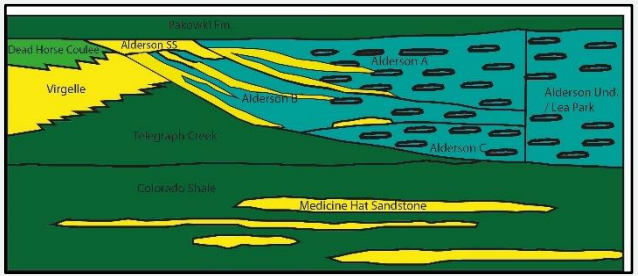
Model elements 1, 3, 5 and 8



Model elements 2, 3, 5 and 8



Model elements 2, 4, 6 and 7

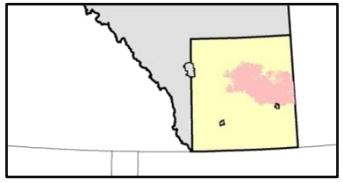


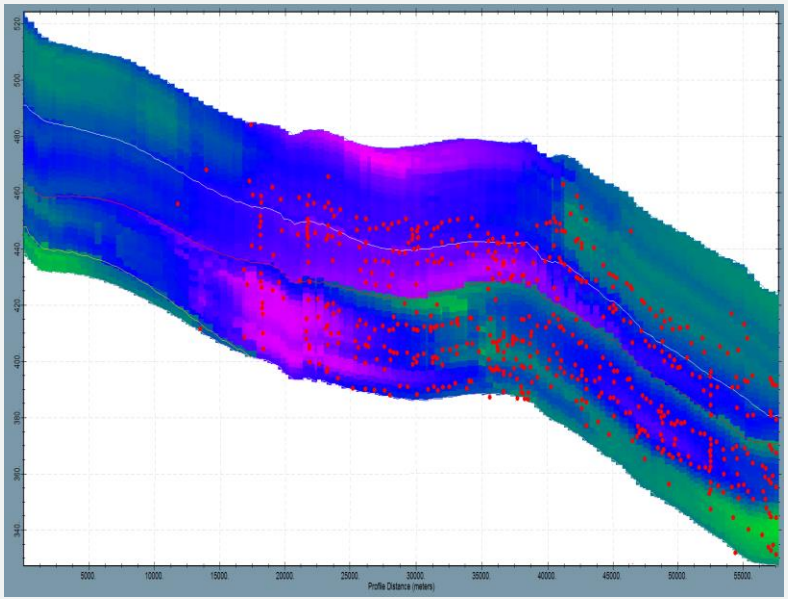
Model elements 2, 3, 5 and 8

Model elements
1. Connected reservoir
2. Disconnected reservoir
3. Strong internal seals
4. Weak internal seals
5. Strong boundary seals
6. Weak boundary seals
7. Connected to the south
8. Disconnected to the south

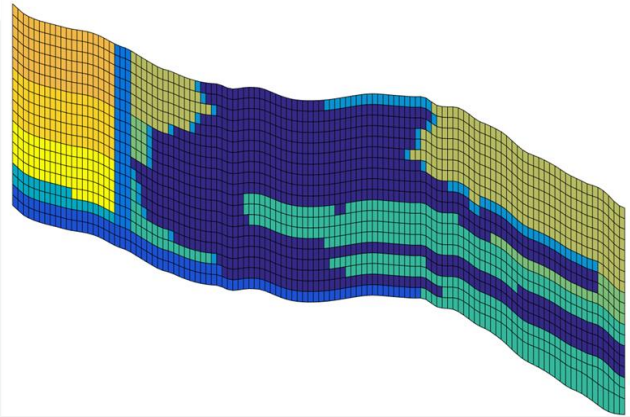
Lemay et al. 2019; AGS Open File Report 2019-06

Hydrogeological Model: Multi Phase

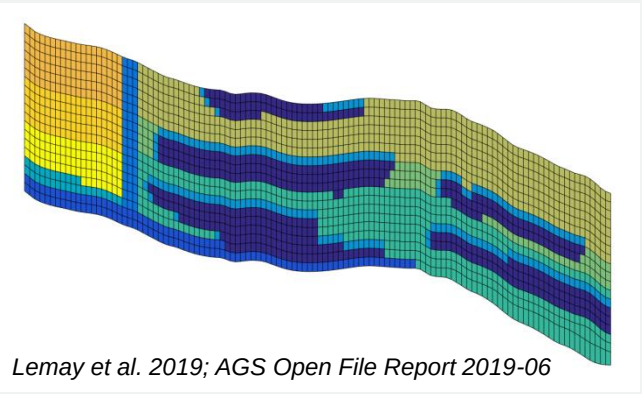




Property Model



connected reservoir

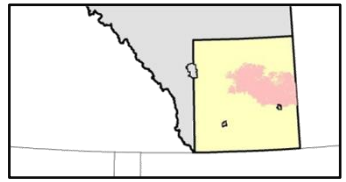


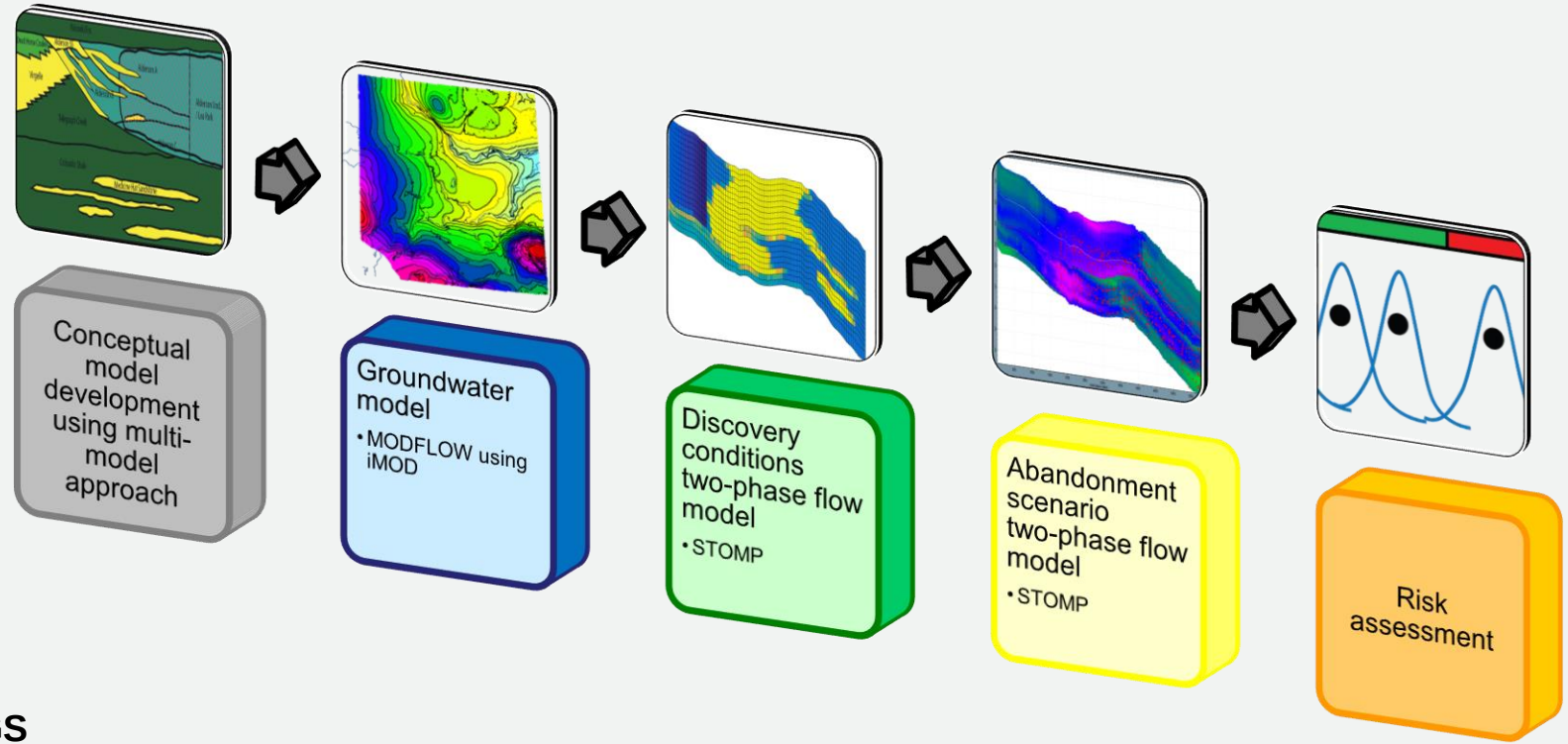
disconnected reservoir

Lemay et al. 2019; AGS Open File Report 2019-06

Multi phase numerical model

Multi-model Workflow for Regulatory Decision Making





AGS

AGS Groundwater Geoscience Program - Summary

- Our program supports regulatory outcomes focused on orderly energy development and environmental protection.
- We provide knowledge and research to Alberta Environment & Parks with an emphasis on devising groundwater management frameworks and delivering on projects to support Alberta's Water Research & Innovation Strategy.
- From 2007-2017, our focus was predominantly on hydrogeological characterization
- In the last 3 years, we have been increasing our work on province-wide hydrogeological mapping, estimating regional groundwater availability, quantifying surface water-groundwater interaction, focused investigations to support regulatory decision making, and building partnerships.

AGS Groundwater Geoscience Program - Future Focus Areas

- Completion of province-wide groundwater availability assessments and provincial-scale hydrogeological mapping products (saline and non-saline aquifers).
- Definition and classification of hydrogeological regions, hydrostratigraphic units, groundwater management areas, and aquifer management units.
- New work on regional-scale approaches for delineating groundwater susceptibility from surface and subsurface risks.
- Building provincial and national partnerships with universities and government agencies

Thank you

Alberta Energy Regulator

AGS 100 YEARS
ALBERTA GEOLOGICAL SURVEY

Contacts for Groundwater Geoscience Program

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Brian Smerdon (Brian.Smerdon@aer.ca)

Photo: B.Smerdon

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Groundwater Management and Research in Nova Scotia

An overview of current activities

Gordon Check, M.A.Sc., P.Geo, Nova Scotia Environment

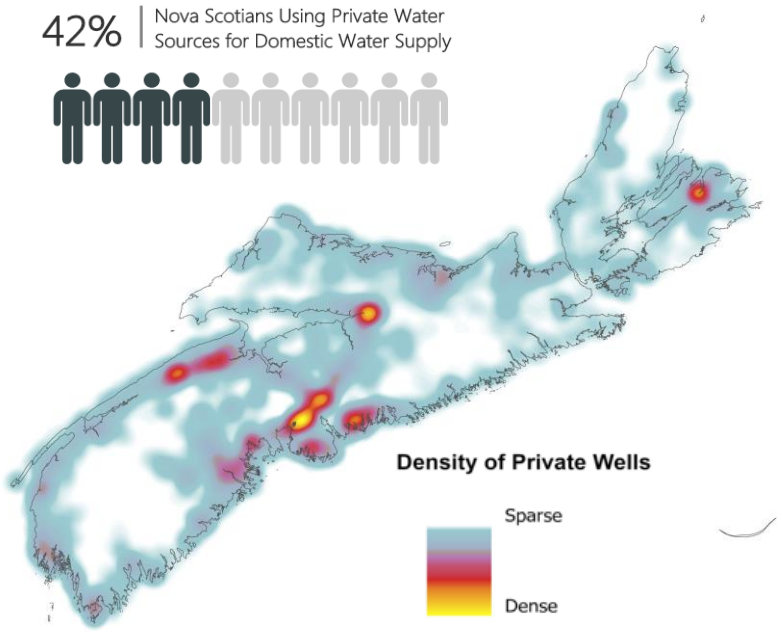
Gavin Kennedy, M.Sc., P.Geo, Nova Scotia Geological Survey

January 19, 2019

NOVA SCOTIA

Groundwater Resources in Nova Scotia

- Bedrock geology is heterogenous in NS
- Highest potential aquifers in sedimentary basins, which supply most municipal, agricultural and industrial wells
- Most of NS covered by thin, discontinuous till, but surficial aquifers can occur as ice-contact materials, controlled by bedrock
- About half of Nova Scotians use groundwater for drinking water, of which ~85% comes from bedrock aquifers
- About 42% of domestic water use is supplied by private wells, mostly concentrated in suburban and coastal areas



Key Groundwater Issues in Nova Scotia

Groundwater sustainability:

- Groundwater recharge generally far exceeds demand but water shortages can occur in suburban areas of Halifax with a high density of private wells, or dry summers in intensive agricultural areas or areas that have a reliance on shallow dug wells.
- Climate models predict increased frequency of summer droughts.

Groundwater and human health:

- In NS there is a high reliance of private wells and there are several naturally occurring contaminants, such as As, U, and Mn that may be present in groundwater.
- Epidemiological studies have linked these groundwater contaminants to elevated rates of disease.

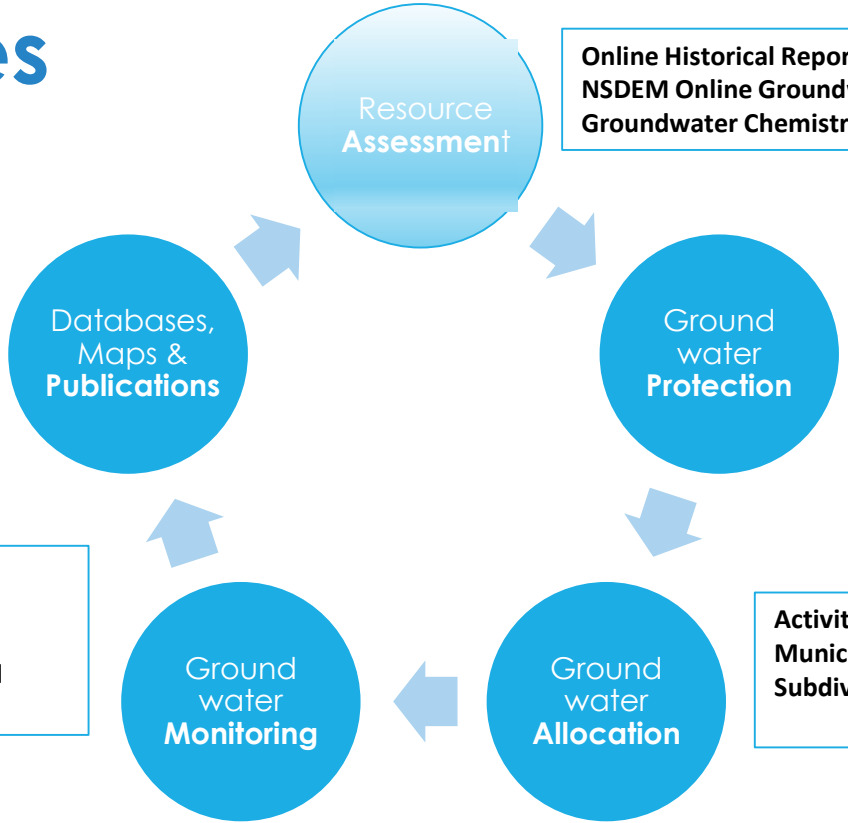
Groundwater Management

- In NS, we manage and protect groundwater with a combination of:
  - Acts & Regulations
  - Management initiatives, information and research programs
  - Regulatory enforcement and compliance activities
- Nova Scotia Environment (NSE) and the Nova Scotia Geological Survey regularly collaborate on data management and research

Groundwater Legislation

- Nova Scotia Legislative Acts:
  - Environment Act
  - Water Resource Protection Act
  - EGSPAct – update pending
- NSE Regulations:
  - Well Construction Regulations
  - Activity Designation Regulations
  - Contaminated Sites Regulations
  - Water and Wastewater Facilities/Public Drinking Water Supplies Regulations
  - Environmental Assessment Regulations

Groundwater Management Initiatives



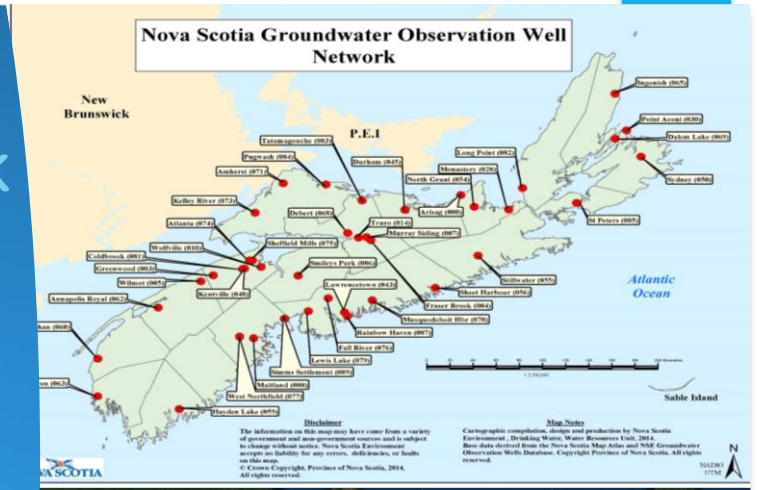
Water Data and Data Tools: Observation Well Network

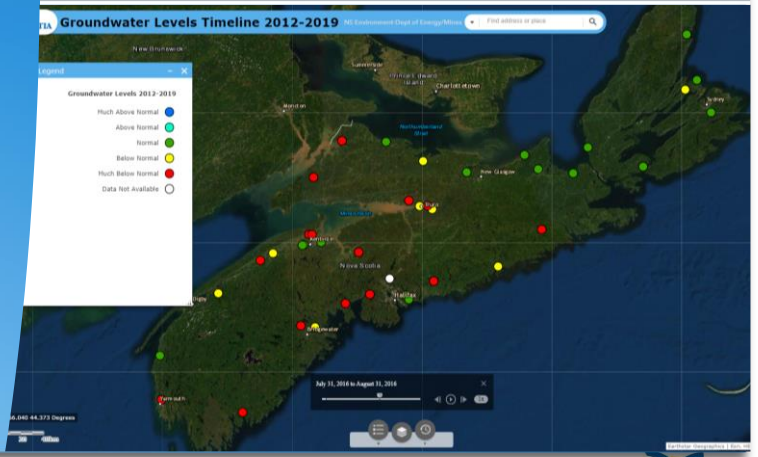
NSE GW Ambient Monitoring Network

- **GW Observation Well network**
  - - established 1960's now with 40 wells
  - - water level and water

Data Presentation and Interpretation

- NSE Website – view graphs, download data
- **NSE Groundwater Timelines Animation Map** online
  - - time-series animation of changing historical groundwater levels in Nova Scotia 2012-2019





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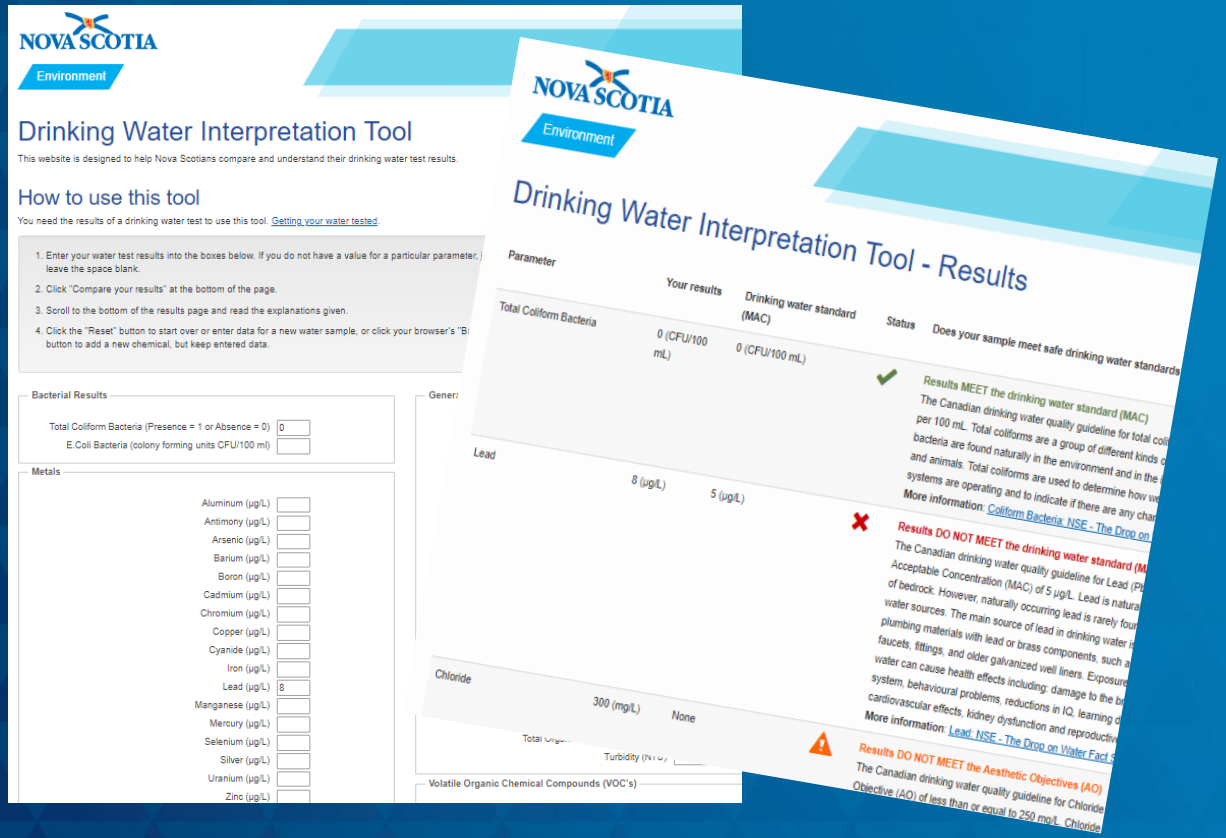
Drinking Water Interpretation Tool



Popular online interactive tool designed primarily for homeowners/ private well users

https://novascotia.ca/nse/dwit/

NOVA SCOTIA

NSE "On the Horizon"

- Modernization of water resources data management into an enterprise platform - collaborative initiative with NS Geological Survey
- Review Municipal Systems GUDI Protocol
- More focus on Improving Private Well Water Supplies
  - Behavioural Insights analysis
  - Mitigations – Regulatory to Incentives to Educational
- More and more on climate change adaptation – Droughts, Flooding
- Pressure of Activity Approvals – T&C, Monitoring
- SDGA (Sustainable Development Goals Act)

Nova Scotia Geological Survey

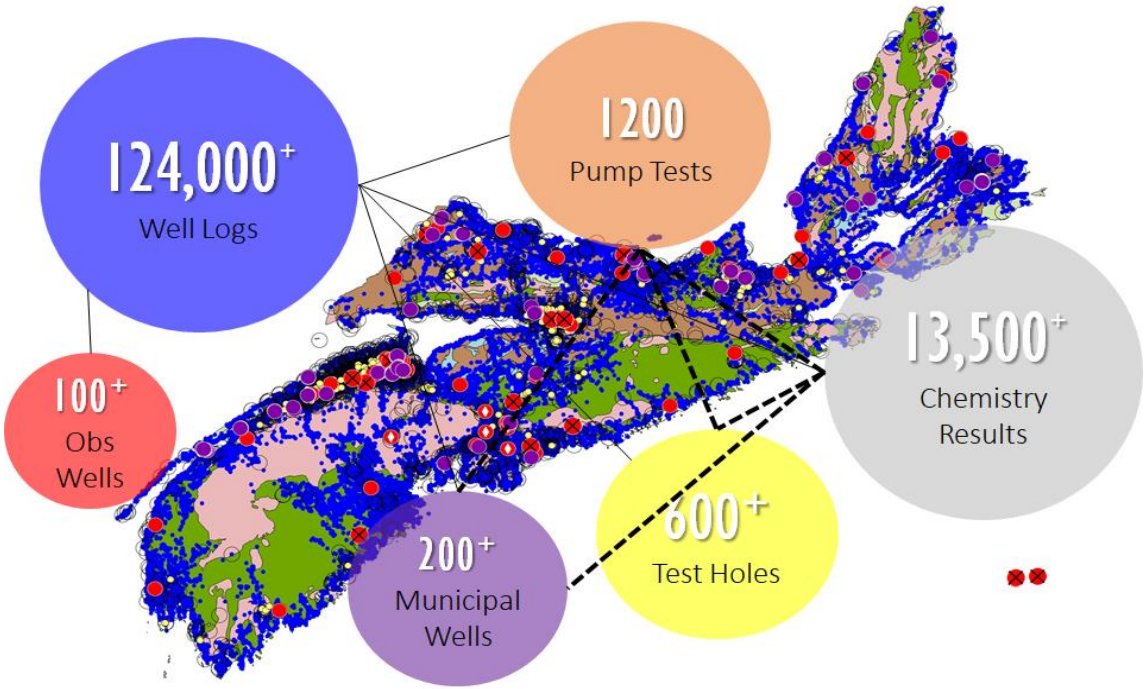
- Initiated in 2007, the Hydrogeology Program mandate:

  Produce scientific information on the quality, availability and vulnerability of groundwater in Nova Scotia and make this information available to decision makers and the public.

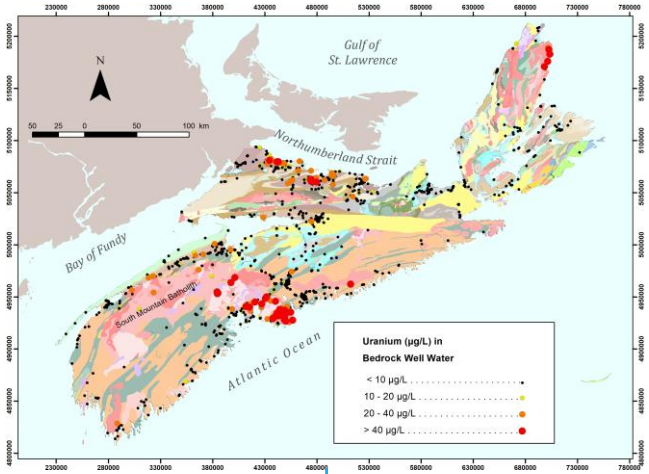
- In collaboration with NSE, program manages province's groundwater data and conducts research
- Research projects tend to be provincial in scale and rely heavily on secondary data sources. Principal thematic areas of research include:
  - Aquifer mapping/ characterization
  - Groundwater sustainability/ climate change
  - Private well water safety
- Program also supports provincial university-led research, e.g. Dalhousie's Coastal Hydrology Lab

Groundwater Data Management

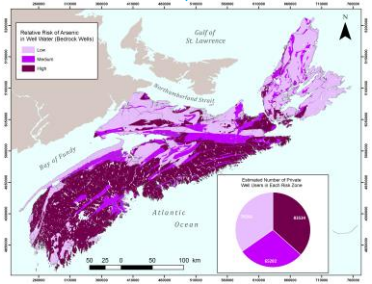
- Groundwater data are compiled into a relational centralized database from various sources:
  - Well Construction Regs
  - Observation Well Network
  - Public Water Supplies
  - Research Projects
  - Water Withdrawal Approvals
  - Subdivision groundwater assessments



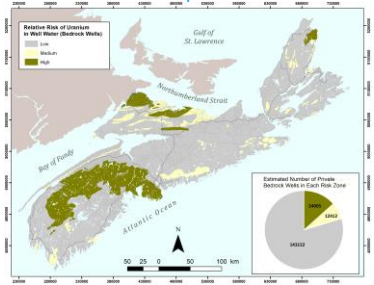
Current Area of Research



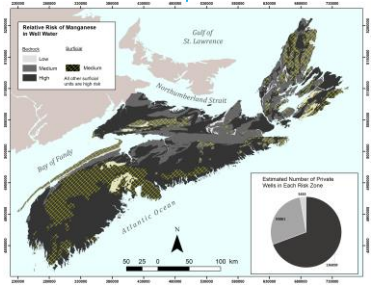
- Distribution/ exposure of naturally occurring contaminants in private well drinking water.
- Hazard maps produced for common naturally occurring groundwater contaminants in well water based on exceedance frequencies for various geologic units.



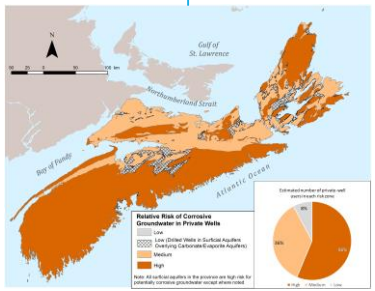
Arsenic in bedrock water wells hazard



Uranium in bedrock water



Manganese in water wells hazard

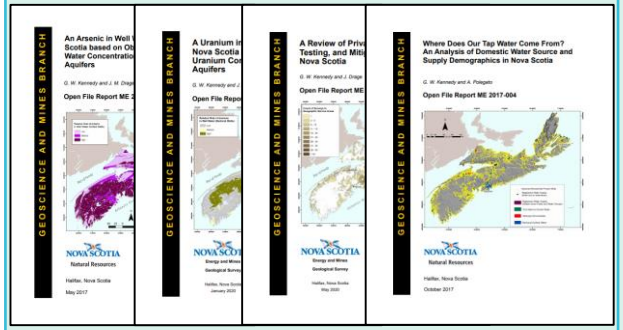


Groundwater corrosivity hazard

Publications

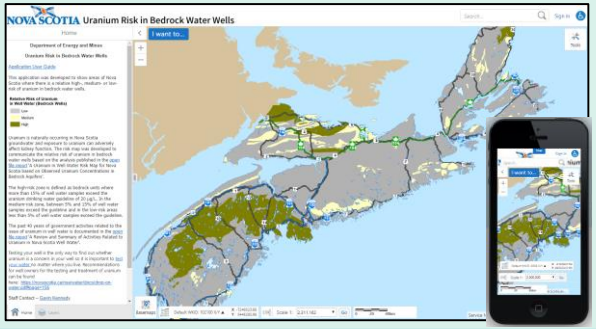
- Geological Survey publishes research in various formats, for various audiences
- Data are available as reports, digital products, web layers and applications

Reports



Digital Products (.shp, .gdb etc.)

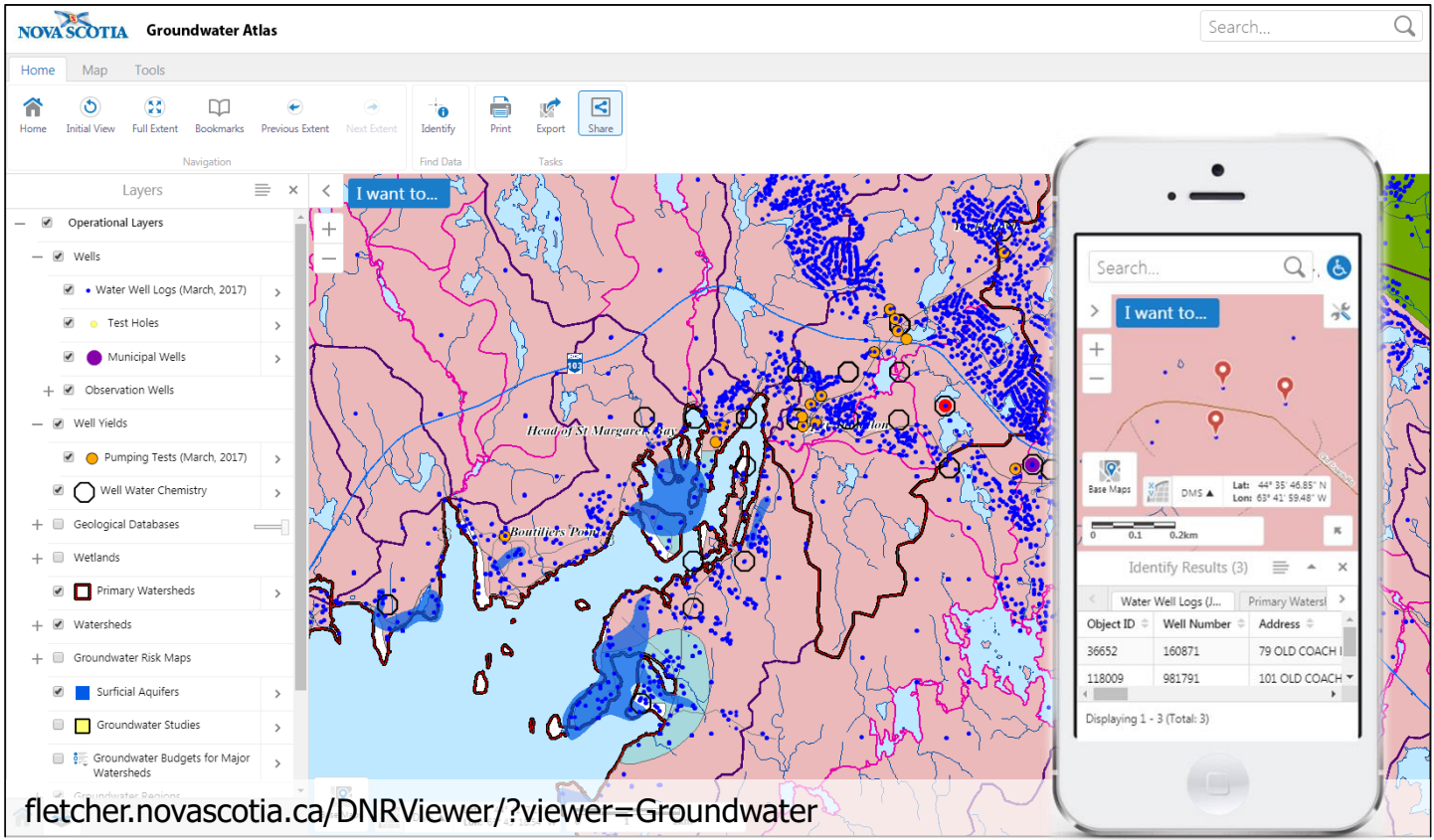
Web Layers and Applications



Story Maps

Nova Scotia Groundwater Atlas

- All publicly available groundwater data are published in the NS Groundwater Atlas Application



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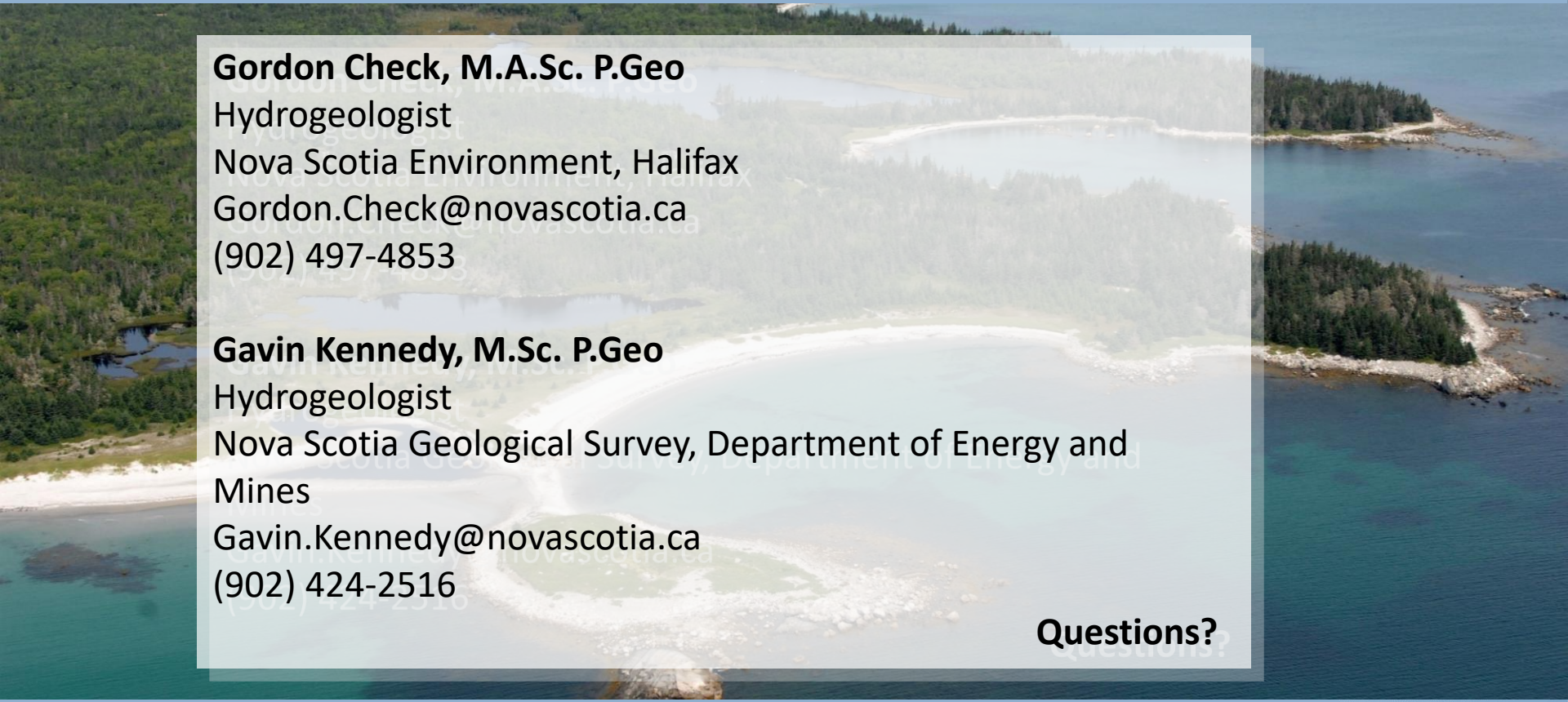

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Questions?

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