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NDGW / DNES

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

Canada A large, stylized word "Canada" in black, with a small red maple leaf icon integrated into the letter "a".

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)

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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)

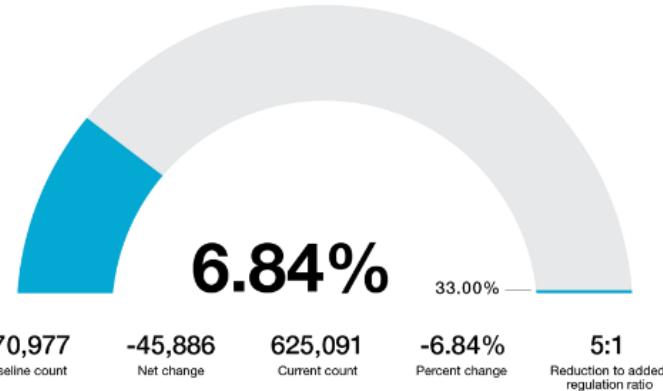
- RTR Act received royal assent on December 9, 2020 and will come into force on June 2, 2021.
 - Modernize the current regulatory environment
 - Reduce or eliminate regulatory burden
 - speed up regulatory approvals





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....

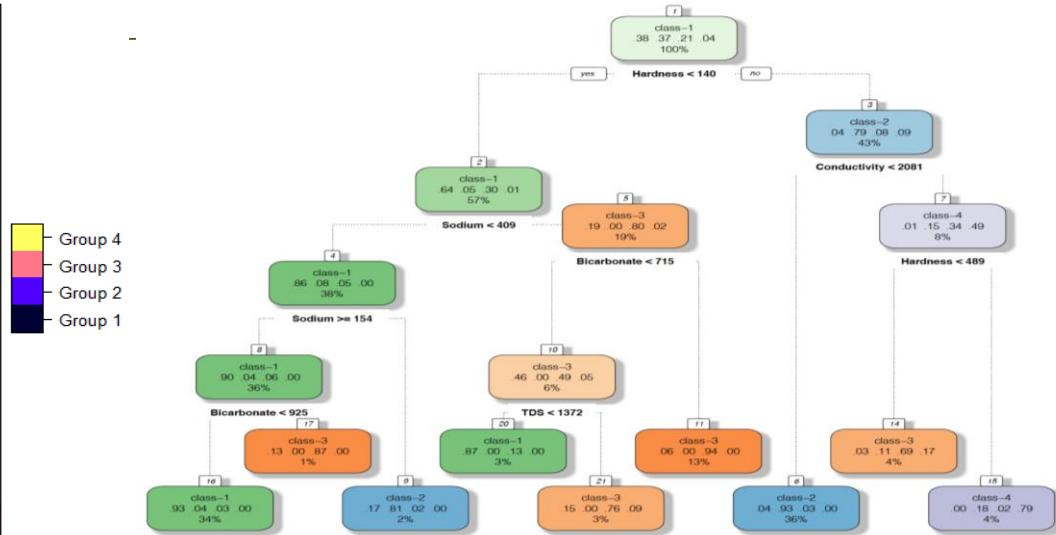
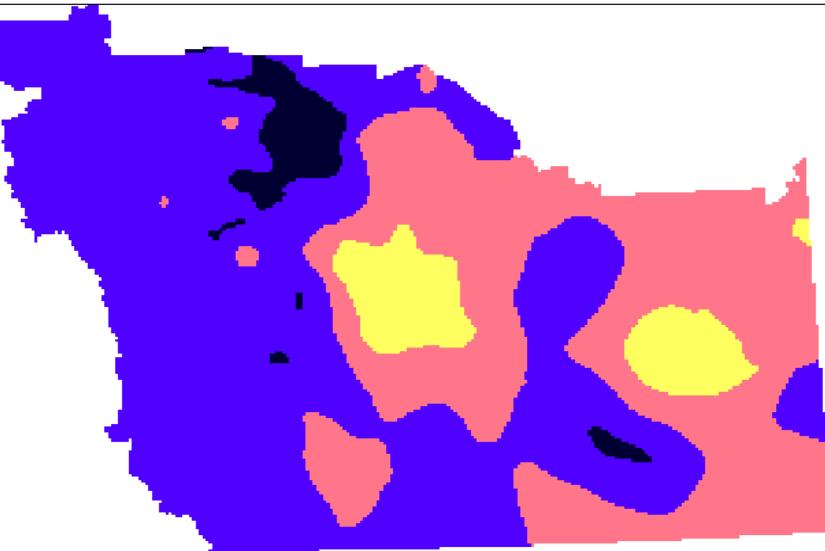
- Project-by-project regulation / allocation according to incremental effect
- Focus on preventing adverse effects
- Cumulative effects of smaller projects and non-regulated activity not directly addressed

To....

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

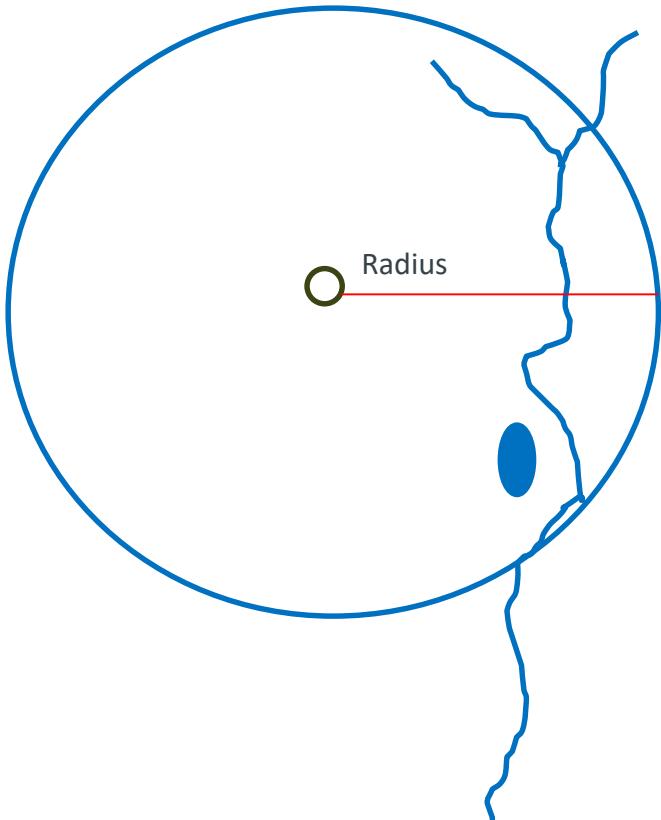
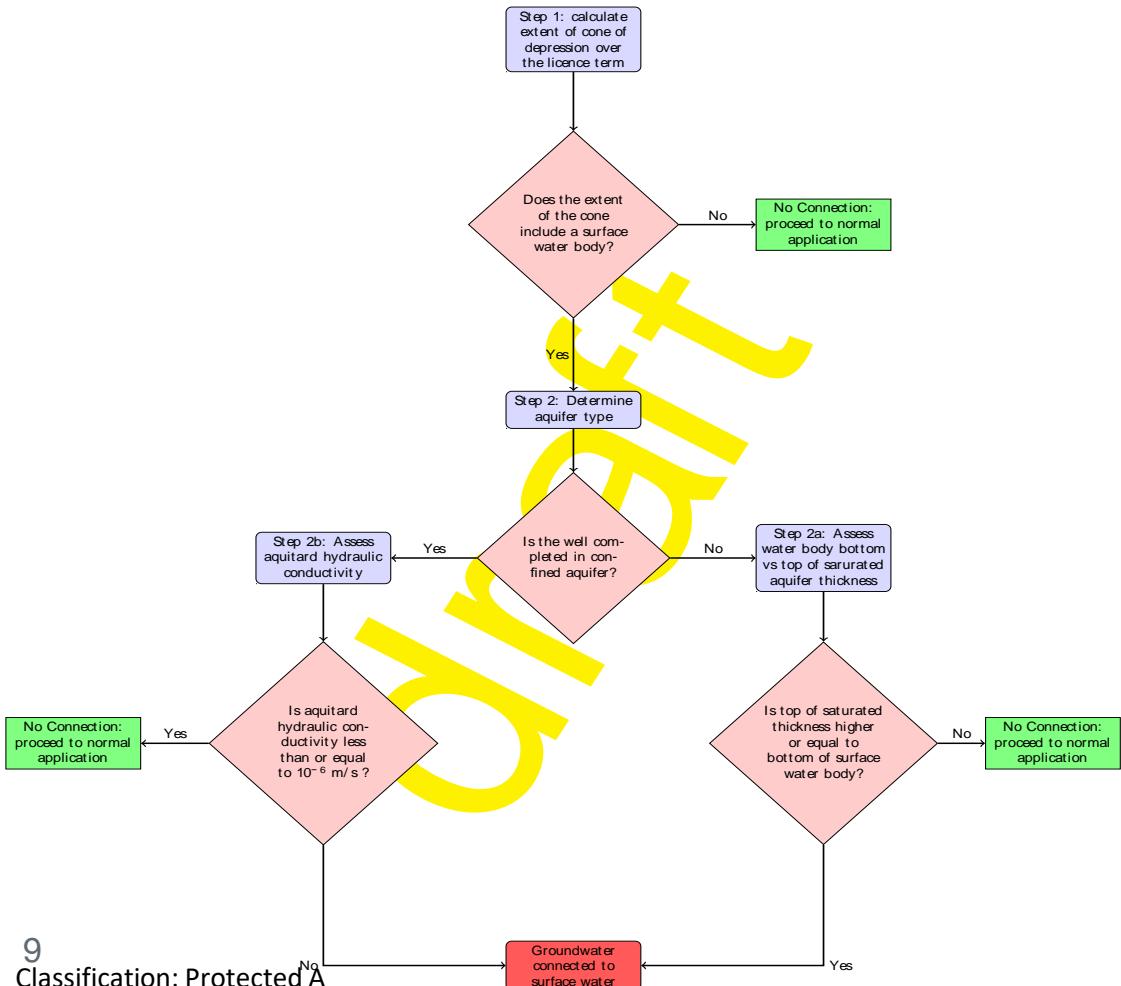


Groundwater in the CEM Context



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

GW-SW connectivity Assessment



Alberta

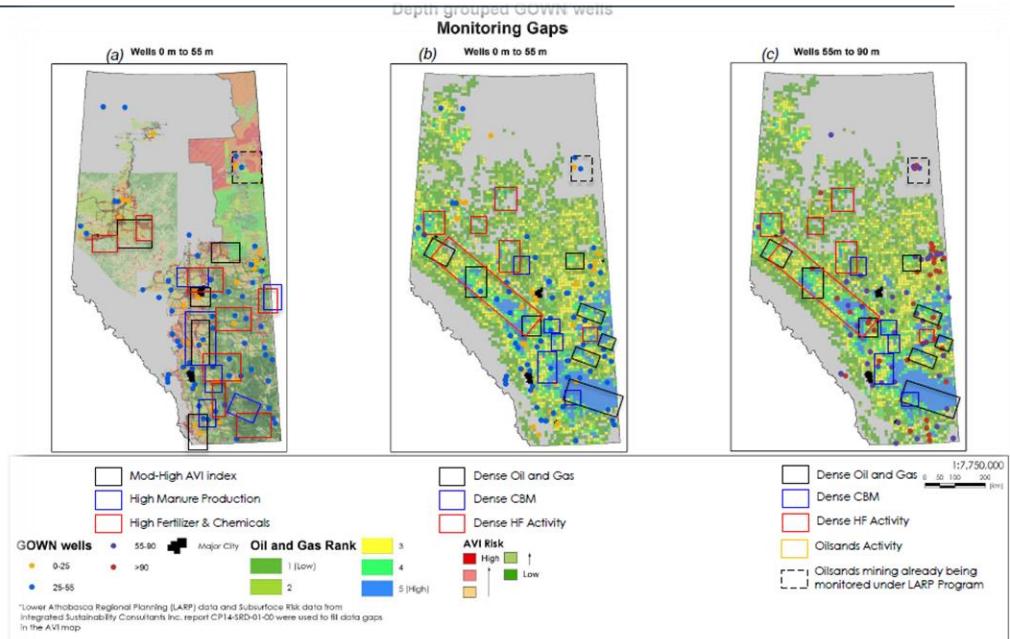
Groundwater Monitoring in the CEM Context

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

Classification: Protected A



Data gaps associated with areas at risk from surface and subsurface activities

SRK, 2015

srk consulting

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aemera.org

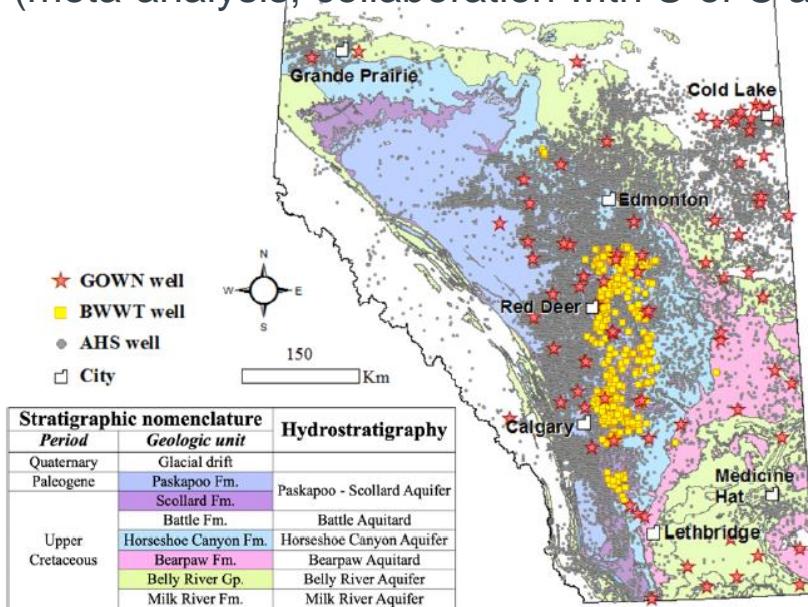
Alberta GW Monitoring Optimization

Provincial Groundwater Monitoring Optimization		
GOWN Wells Overlaying Areas with Data Gaps		
Date: Feb. 2015	Approved: XX	Figure: 41

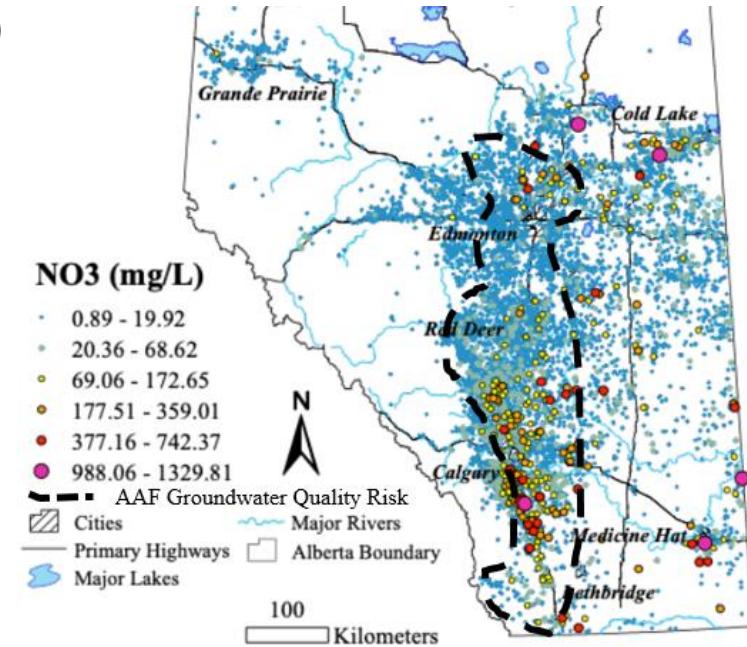
Alberta

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)



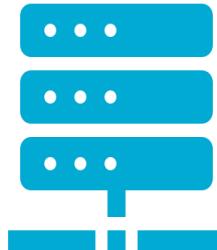
Elevated nitrate coincides with high groundwater quality risk



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:

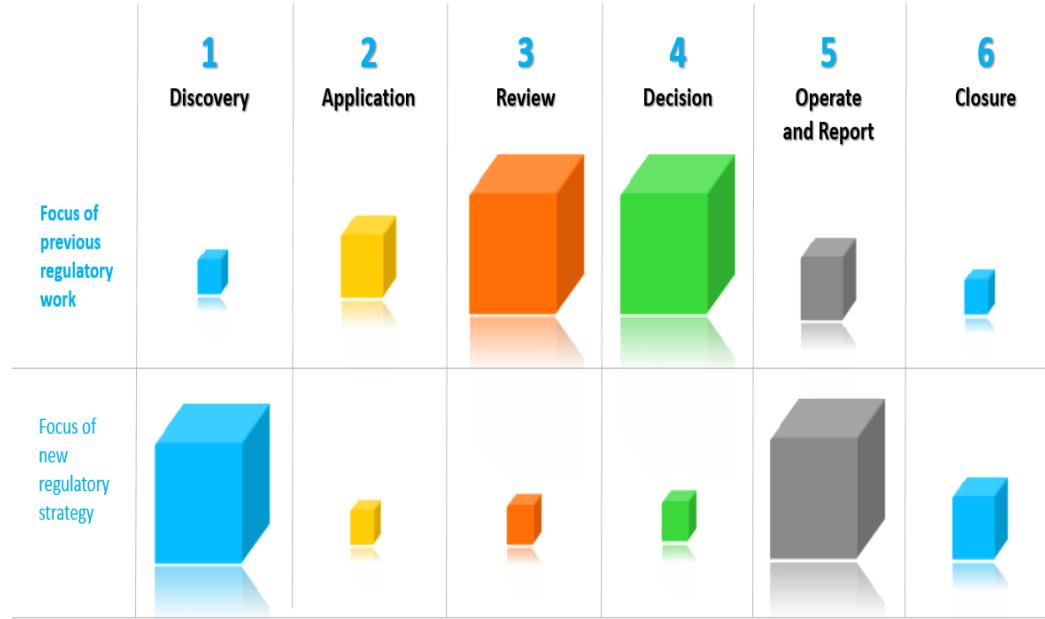
-  **Be a “one-window” portal for applicants:** one development, one application.
-  **Ensure application requirements are clear:** applications are complete and correct the first time; removing the “back and forth” between proponents and AEP.
-  **Streamline the approvals process:** the system will 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)





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

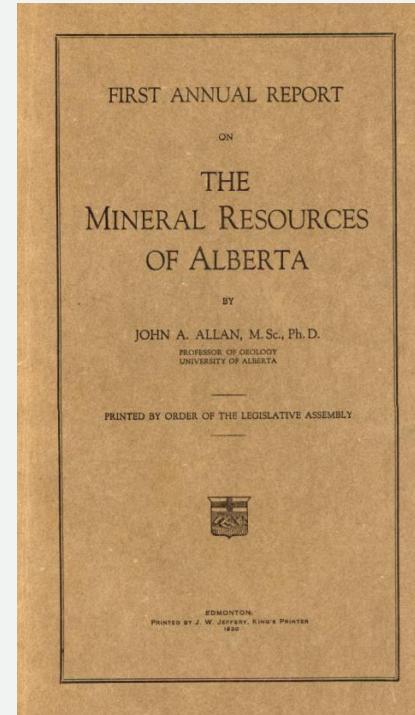


Outline

- » 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.



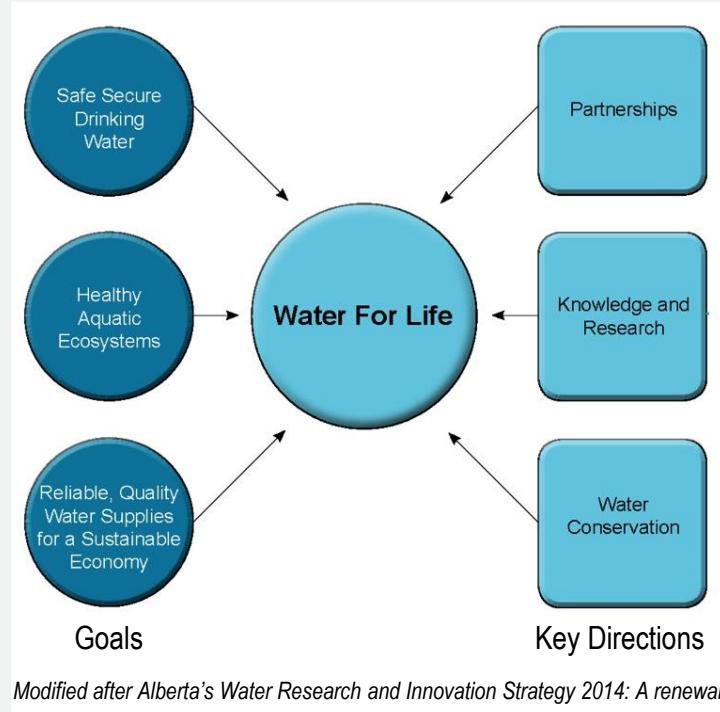
Groundwater Geoscience Program – Alignment with Regulatory & Policy Expectations

AER Strategic Plan: Outcomes & Measures



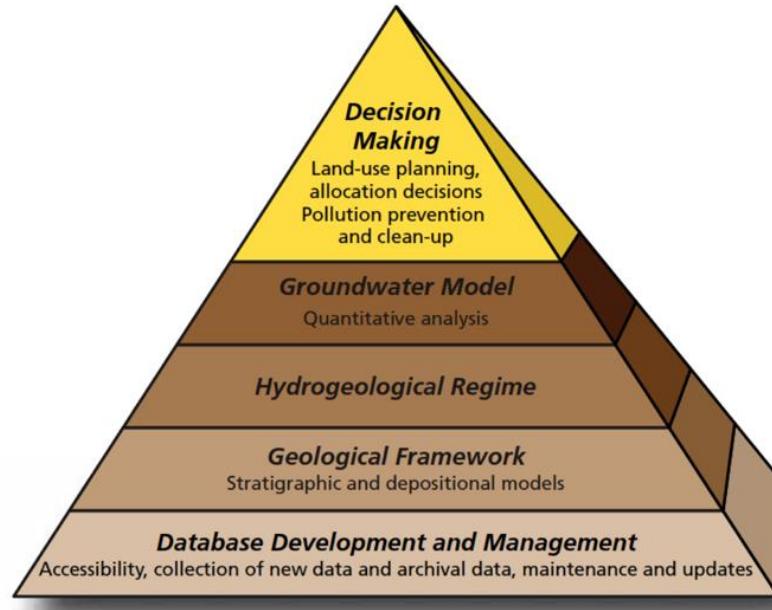
Available at aer.ca

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



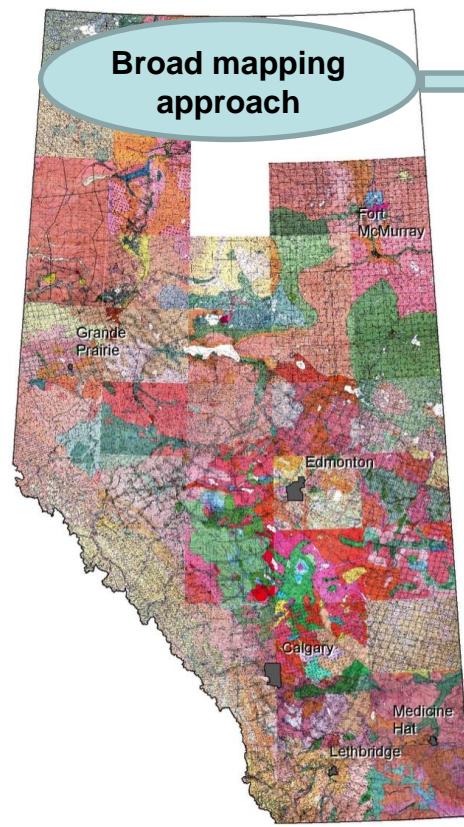
Canadian Council of Academies, 2009

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

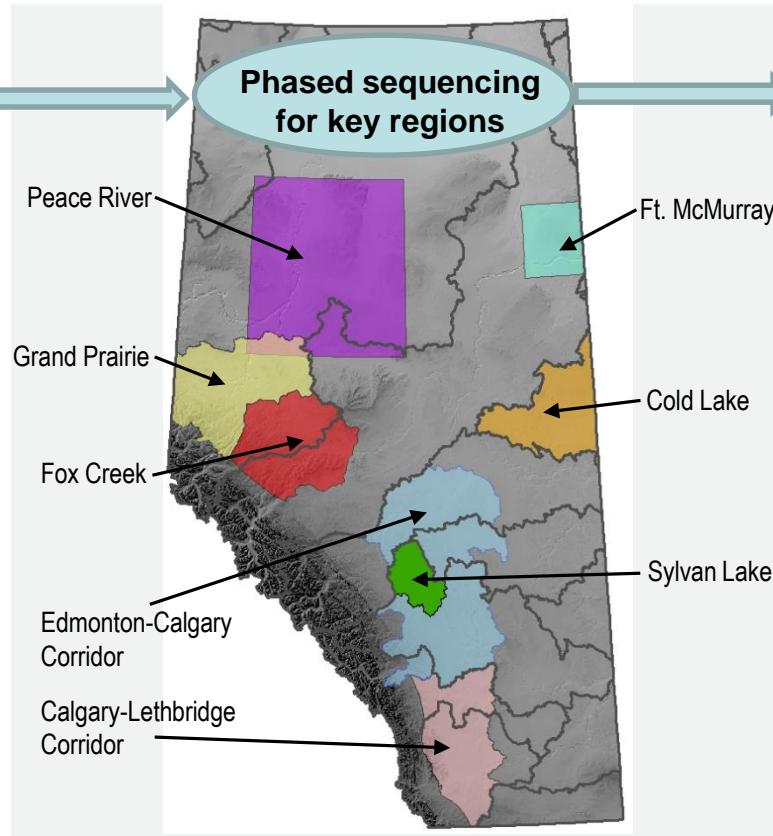
Purpose of the AGS Groundwater Geoscience Program

- 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)

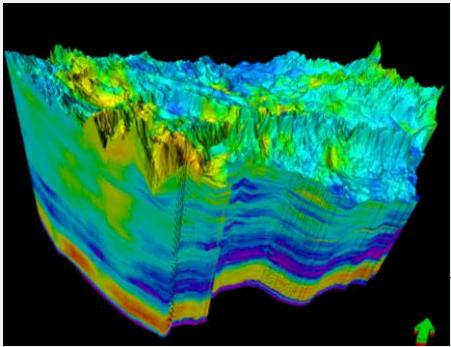


Groundwater Geoscience Program Timeline with Alberta Environment & Parks

Memorandum of Understanding with Alberta Environment & Parks

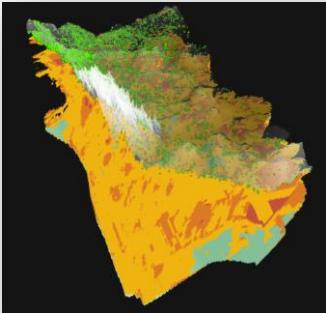
- 2007: Established to support *Water for Life* strategy
- 2011: MoU established scientific phases and roles
- 2017: MoU updated to align with AEP initiatives
- December 2020: Expanded MOU to strengthen collaboration, partnerships, and objectives

Example Geological Products

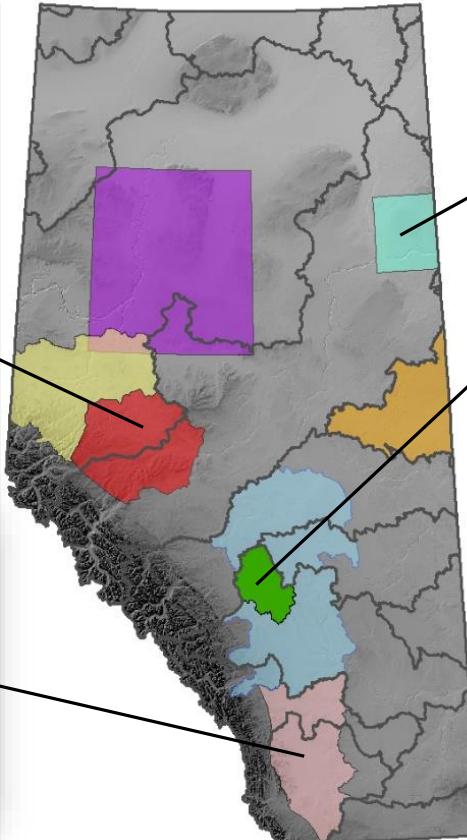


Property Modelling

- Illustrates zones that likely contain permeable sandstone bodies.



AGS



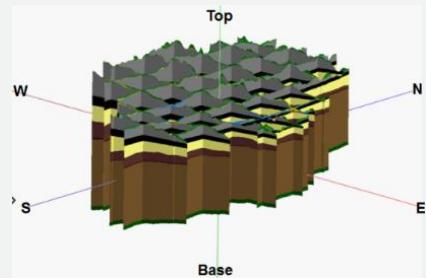
Modelling Top of Bedrock in Oil Sands

- Important for understanding caprock integrity and migration of fluids.

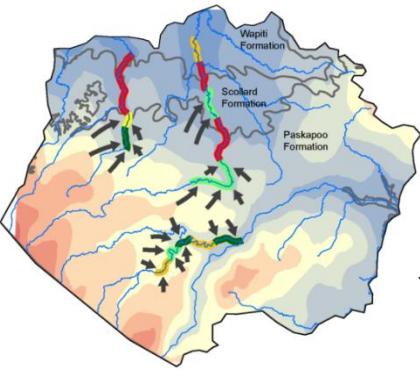


Geological Model

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

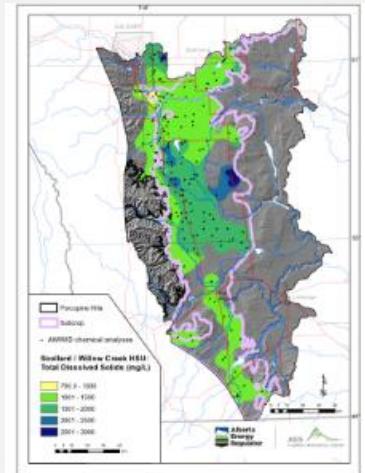


Example Hydrogeological Products



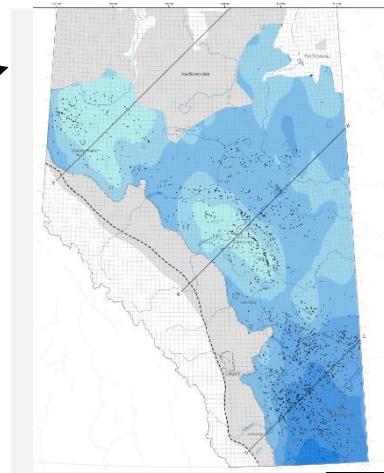
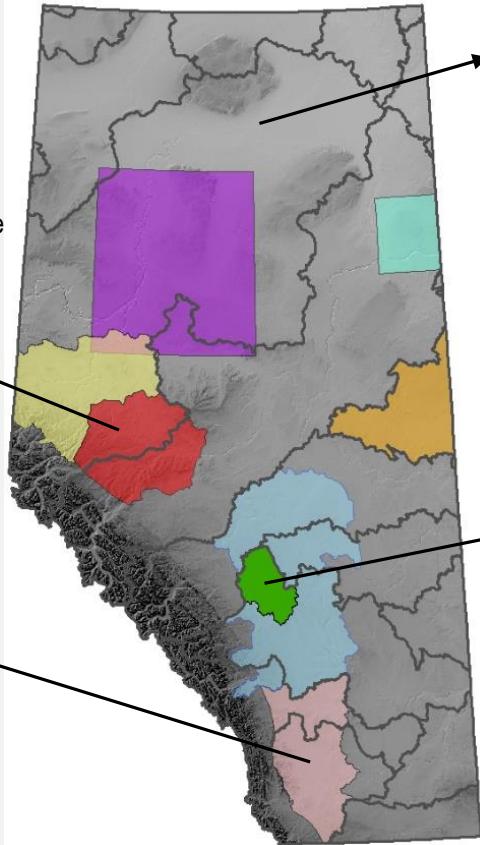
Surface water-groundwater interaction

- Regional groundwater circulation
- Potential hydraulic pathways and recharge areas



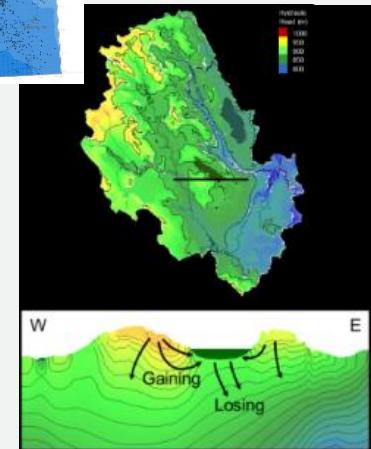
Groundwater chemistry

- Water quality



Groundwater models

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



Provincial Hydrogeological Mapping

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

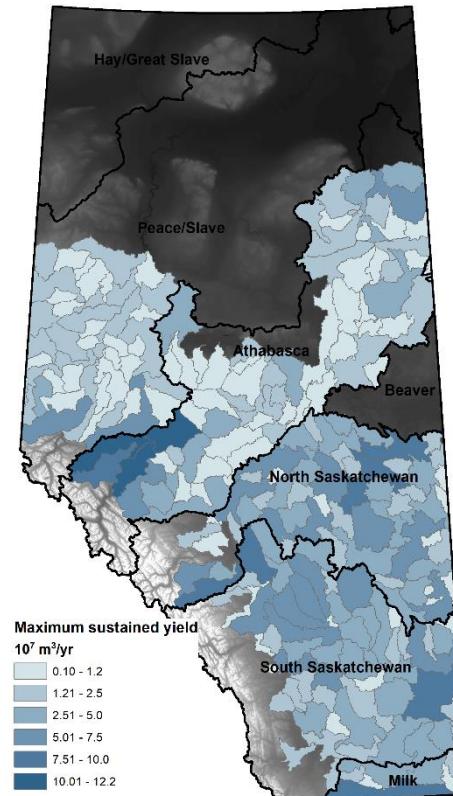
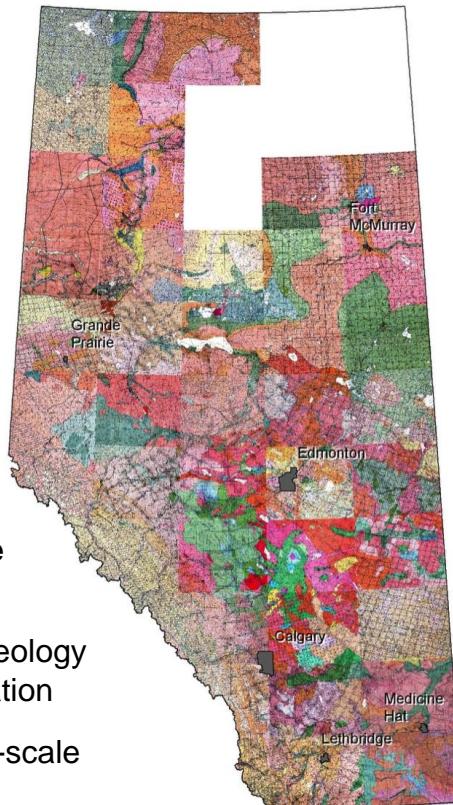
Groundwater Availability Assessments

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

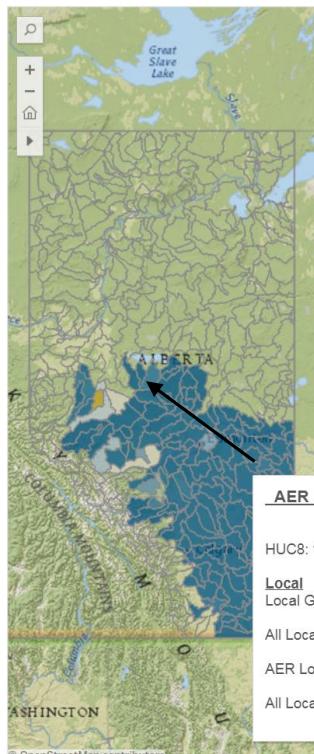


AGS Groundwater Availability Assessments

- » 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

Integration of Groundwater Availability Assessments into AER Water Use Reporting

Groundwater Availability and Allocation



Groundwater availability has been quantified by the Alberta Geological Survey for watersheds coloured gold/blue/etc. Work is ongoing to quantify availability in other parts of the province.

Reported groundwater availability is equivalent to average annual regional groundwater recharge. This value represents the average volume of water replenished by rainfall and snowmelt into the groundwater system within a watershed boundary. After moving through the groundwater system, recharge is often discharged into surface water bodies such as lakes, rivers, and wetlands.

Therefore, as groundwater withdrawals become closer to the value of groundwater

Available at aer.ca



Disclaimer Water Summary Nonsaline Water Use Summary Notes on Data Glossary

Alberta Water Use Report

2017 Water Summary

Overall in Alberta, AER experts have estimated that over 140 billion cubic metres of nonsaline water are available. Of this, about 10 billion cubic metres (or 7 per cent) are allocated for use through Water Act licences for municipal, agricultural, forestry, industrial, and other uses. Of this 10 billion cubic metres of water that is licensed for use, approximately 1 billion cubic metres is allocated for use in the energy development industry (10 per cent of the total licensed for use, or 0.7 per cent of all the water available in Alberta). The remaining 9 billion cubic metres (90 per cent) was allocated to other users such as agriculture, forestry, commercial (e.g., golf courses and gravel pit operations), and municipalities.

The maps below display the proportion of available water that is licensed for energy development. The boundaries represent Hydrological Unit Code 8 (HUC8) areas, as set by Alberta Environment and Parks (AEP). While data on groundwater allocation is available across the entire province, information on availability exists only for areas in south and central Alberta. Where availability information does not yet exist, the proportion that is allocated is represented as zero. Work is being conducted by the Alberta Geological Survey to develop groundwater availability information for more areas of the province.

Placing your mouse cursor over a specific HUC8 area will provide additional information on surface and groundwater availability and allocation, the proportion of the available water allocated (as a percentage) to all sectors of Alberta, and the proportion of the availability that is specifically allocated for energy development. Information is provided for the "local" area and as a "cumulative" total for surface water. (More information on the definition of local and cumulative is provided in the glossary.) Groundwater information is shown as "local" only.

Surface Water Availability and Allocation

Great Slave Lake

When companies apply to use water, they must state the maximum annual amount of water they need over the entire life cycle of their project. Companies estimate their maximum water use based on their project's needs, a general understanding of the hydrology in the area, as well as a contingency to ensure they have enough water for their energy development project.

Due to the need for large volumes of nonsaline water, oil sands mining is allocated the most nonsaline water in the industry (65 per cent), followed by by pipeline and reservoir (LCR) (10 per cent), in situ (6 per cent), and hydraulic fracturing (9 per cent). "Other" (9 per cent) accounts for other water that is allocated to other energy development activities including pipeline integrity testing and hydrocarbon processing.

Groundwater Availability and Allocation

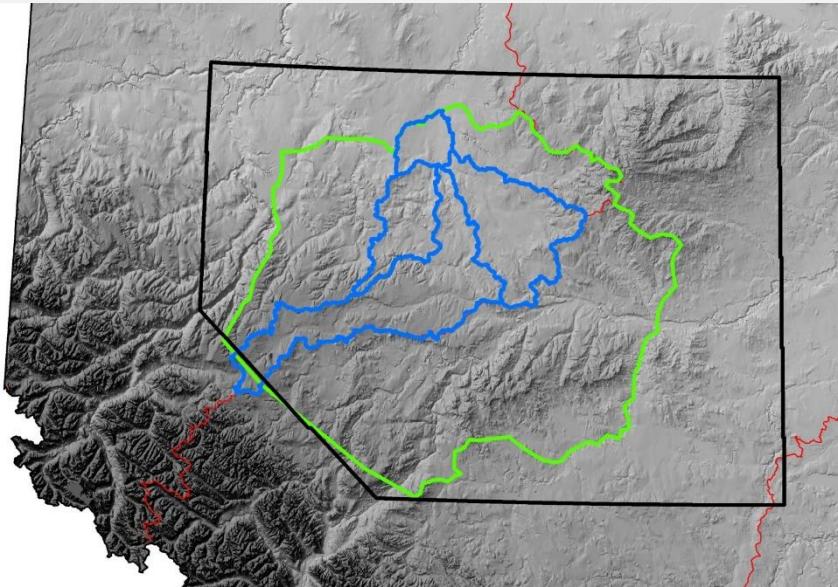
Great Slave Lake

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Reported groundwater availability is equivalent to average annual regional groundwater recharge. This value represents the average volume of water replenished by rainfall and snowmelt into the groundwater system within a watershed boundary. After moving through the groundwater system, recharge is often discharged into surface water bodies such as lakes, rivers, and wetlands.

Therefore, as groundwater withdrawals become closer to the value of groundwater availability, the less water is available for groundwater discharge. Less groundwater discharge could affect groundwater dependent

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

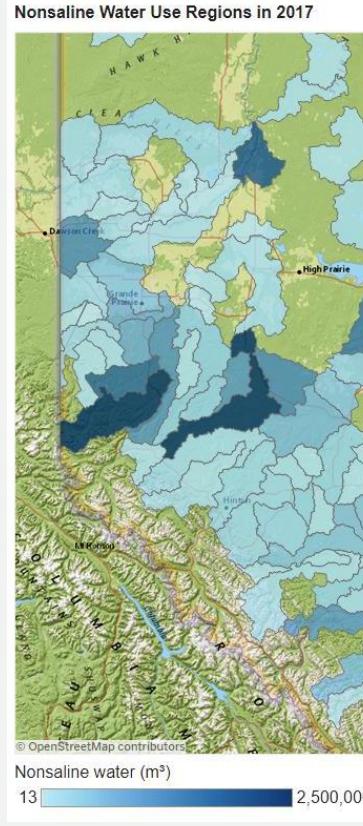
SW/GW model

Drivers for Study

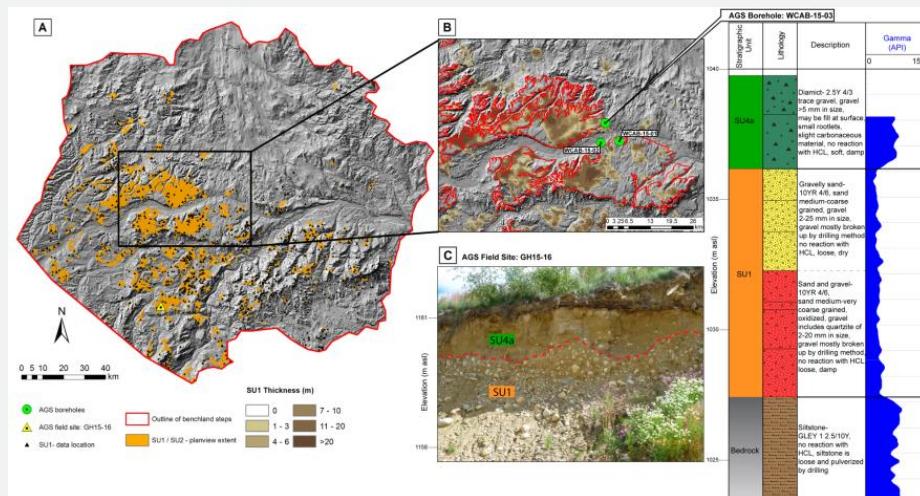
» Unconventional hydrocarbon development significantly increased in 2014

- Notable seismic activity
- ~30,000 to 50,000 m³ water per well for hydraulic fracturing
- Sourced from surface water and shallow groundwater

» Multi-disciplinary study covering the full-stratigraphic succession



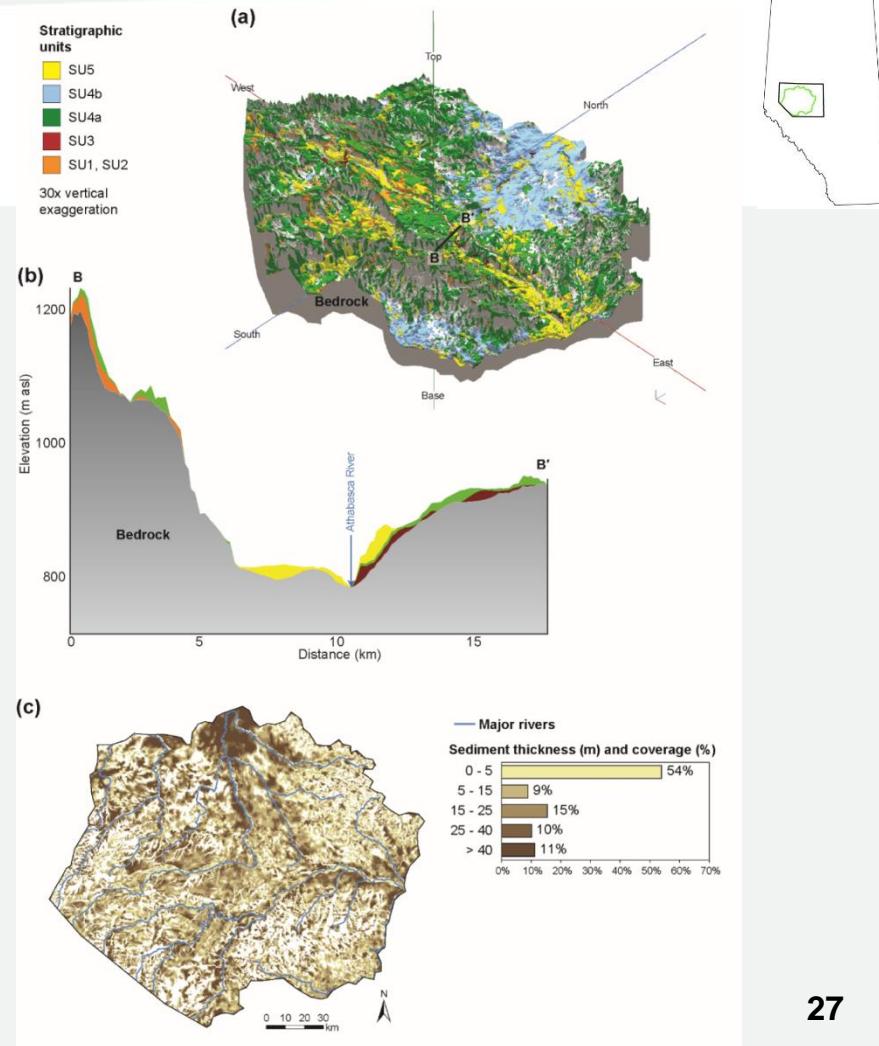
Paleogene–Quaternary Stratigraphy



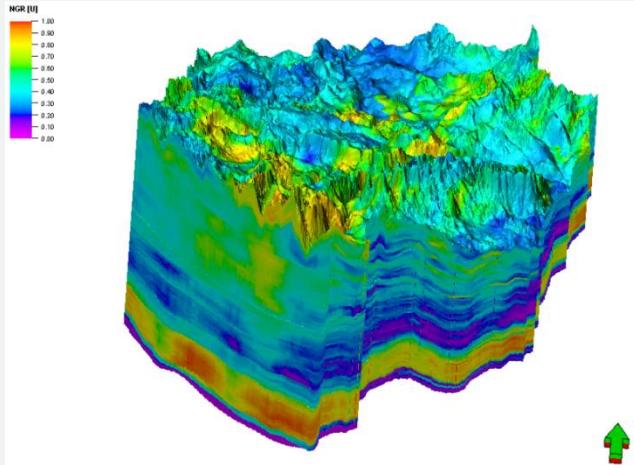
Atkinson and Hartman 2017; AGS Report 93

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

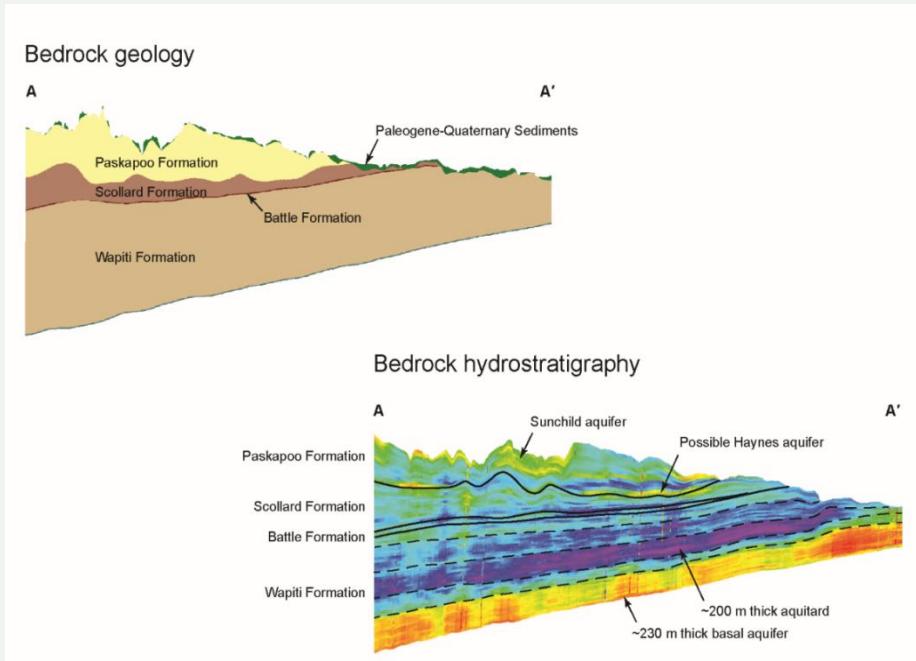
AGS



Upper Cretaceous–Paleogene Sandstone Abundance

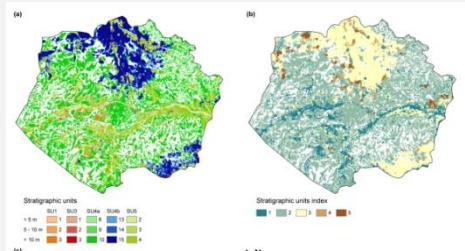


- » 3D model of net-to-gross sandstone ratio
 - » Developed from gamma logs & water wells
 - » Spans Wapiti, Battle, Scollard, and Paskapoo formations



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

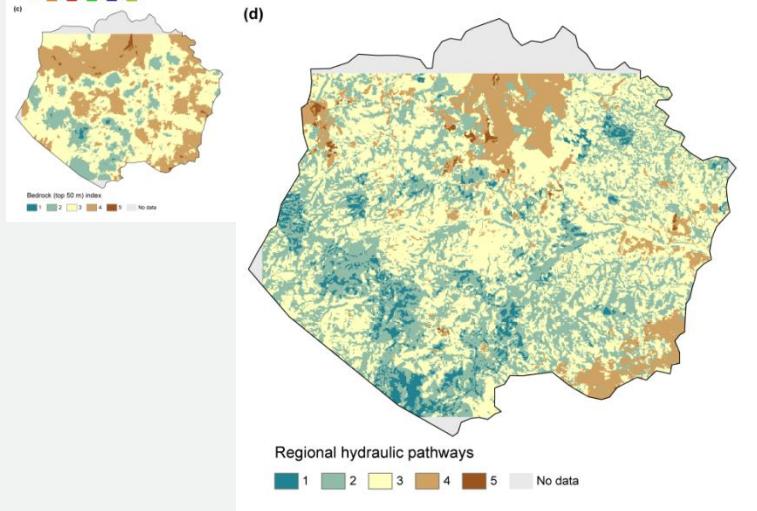
Groundwater Recharge



» GIS-based index

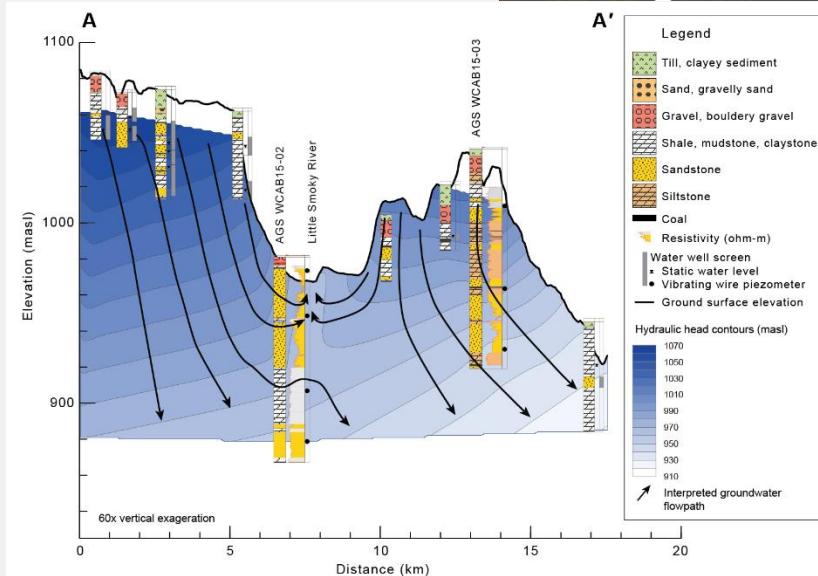
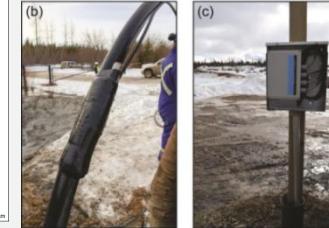
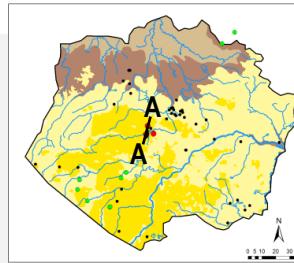
» Pg-Q HSU's

» Upper 50m bedrock NGR



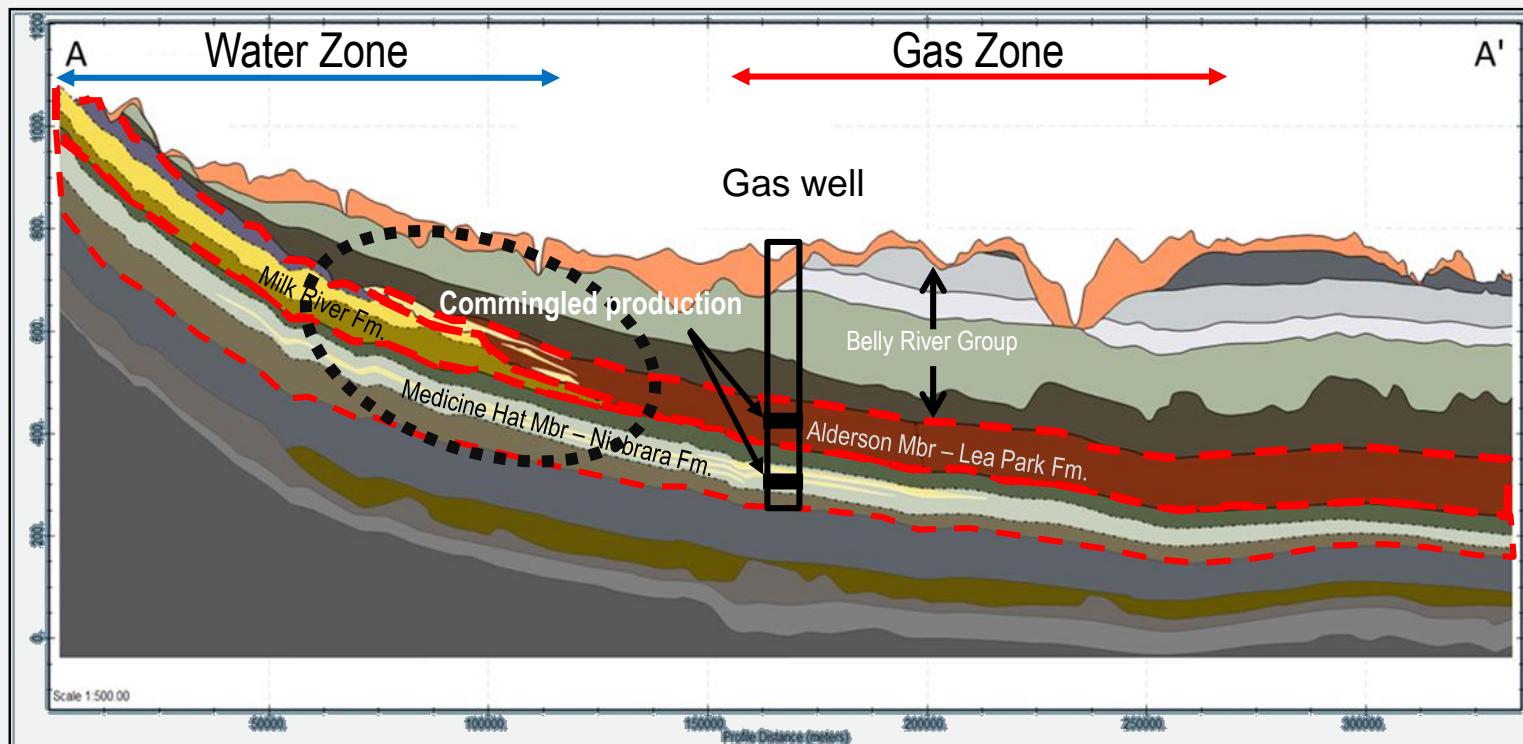
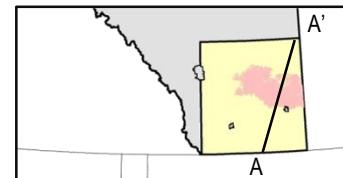
AGS

Smerdon et al. 2019; AGS Report 98

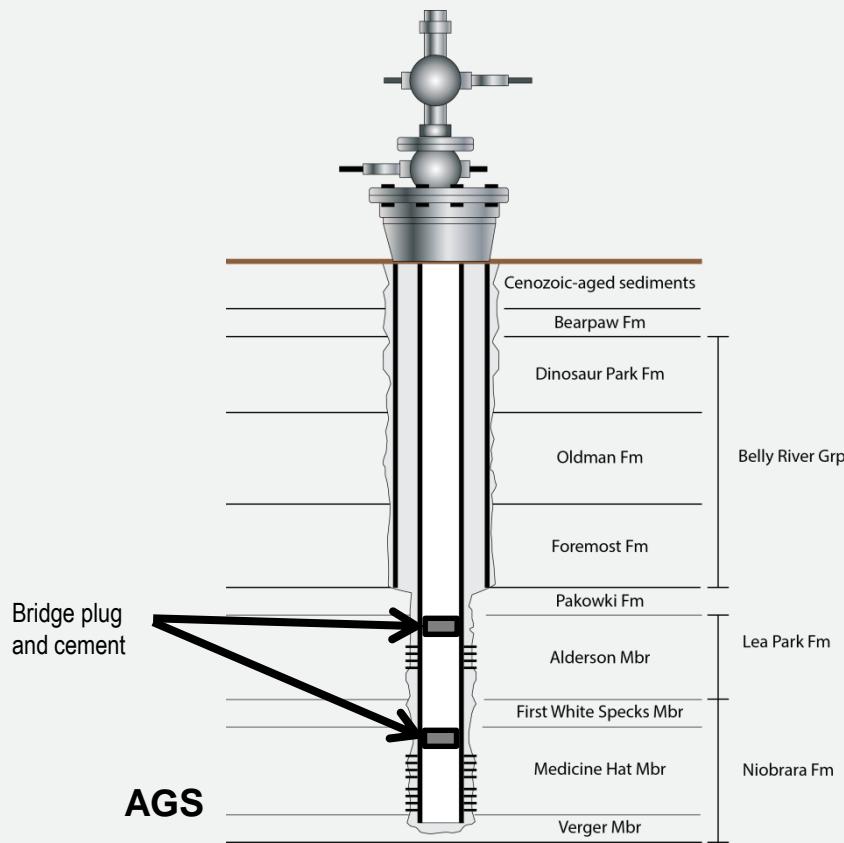
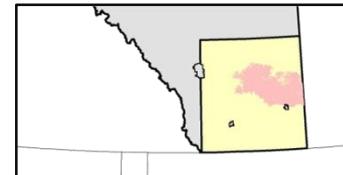


Smerdon et al. 2016; AGS Open File Report 2016-02

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

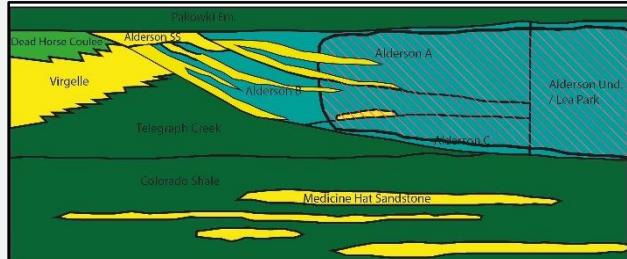
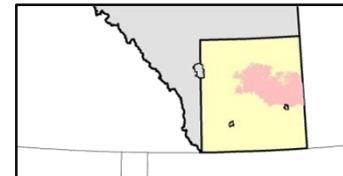


Regulatory Question

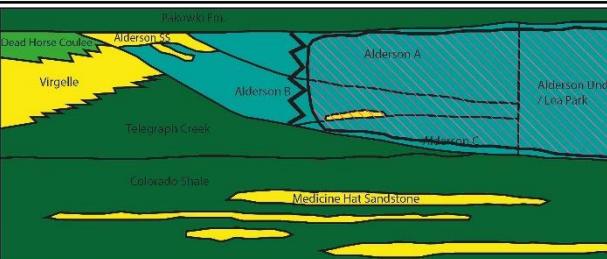


“Will residual natural gas in the Alderson and Medicine Hat gas zones escape through the natural petroleum trap up-dip to the Milk River aquifer if the two zones are left commingled in abandoned energy wells after the fields are permanently closed?”

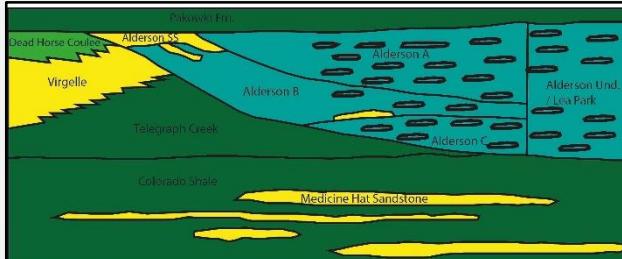
Multiple Conceptual Models



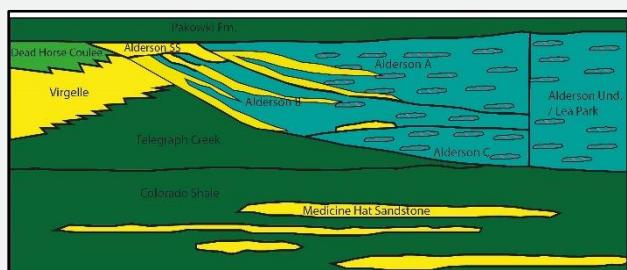
Model elements 1, 4, 5 and 7



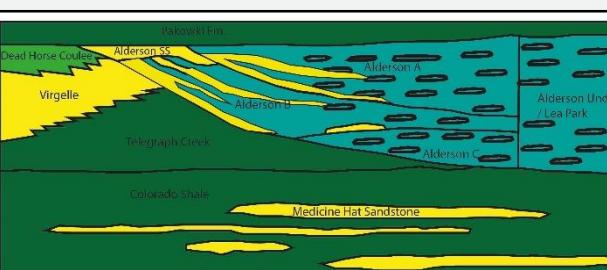
Model elements 1, 3, 5 and 8



Model elements 2, 3, 5 and 8



Model elements 2, 4, 6 and 7

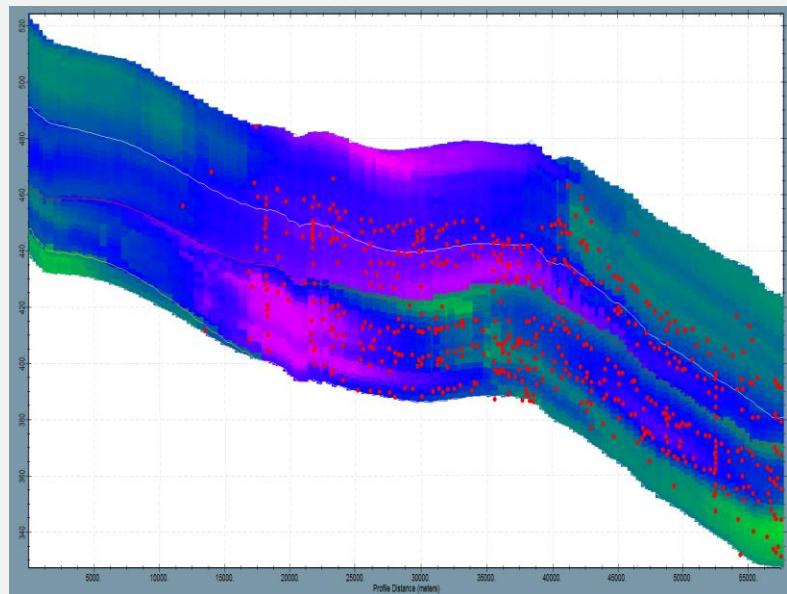
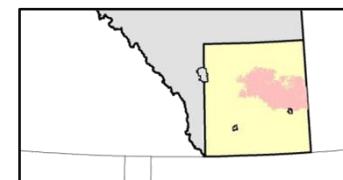


Model elements 2, 3, 5 and 8

Model elements

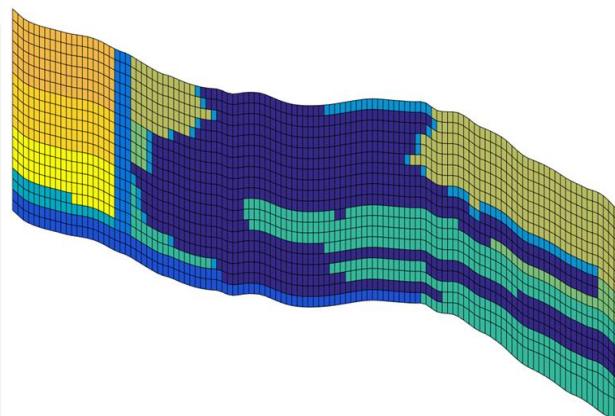
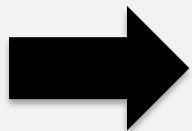
1. Connected reservoir
2. Disconnected reservoir
3. Strong internal seals
4. Weak internal seals
5. Strong boundary seals
6. Weak boundary seals
7. Connected to the south
8. Disconnected to the south

Hydrogeological Model: Multi Phase

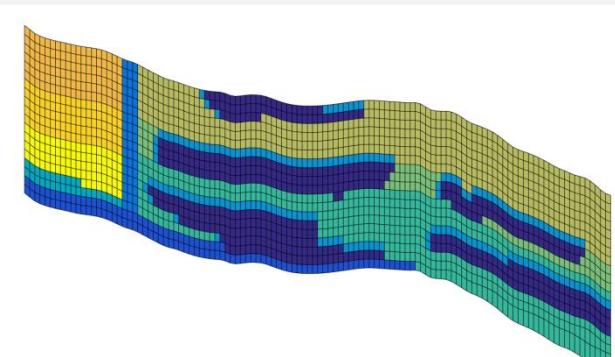


Property Model

AGS



connected
reservoir

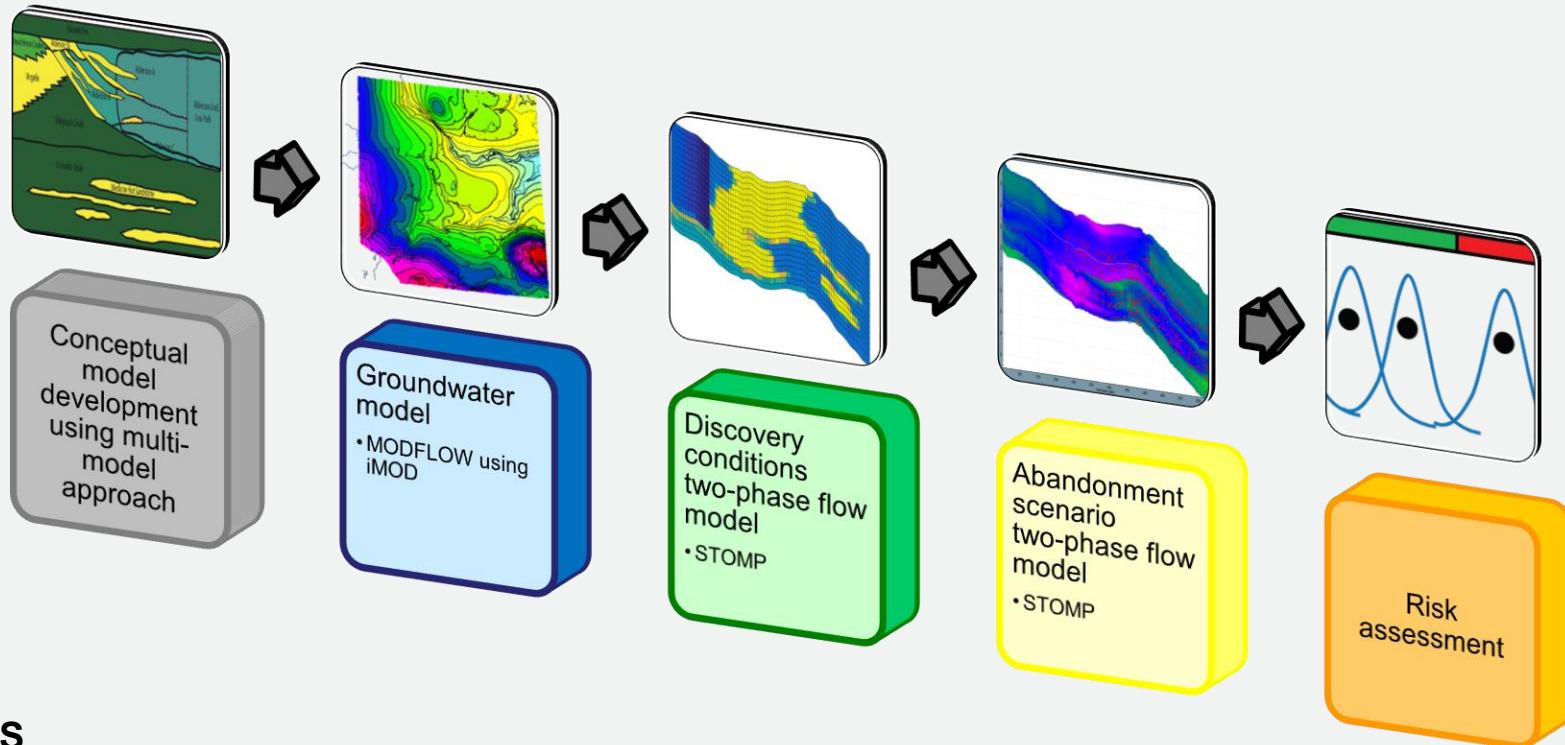
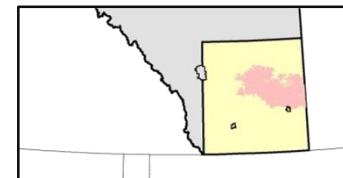


disconnected
reservoir

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

Multi phase numerical model

Multi-model Workflow for Regulatory Decision Making



AGS 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

Contacts for Groundwater Geoscience Program

Dan Palombi (Dan.Palombi@aer.ca)

Brian Smerdon (Brian.Smerdon@aer.ca)



Photo: B.Smerdon

AGS Study References

- [Atkinson, L.A. and Hartman, G.M.D. \(2017\): 3D rendering of the regional stratigraphy of Paleogene–Quaternary sediments in west-central Alberta; Alberta Energy Regulator, AER/AGS Report 93, 44 p.](#)
- [Atkinson, L.A., Liggett, J.E., Hartman, G., Nakevska, N., Mei, S., MacCormack, K.E. and Palombi, D. \(2017\): Regional geological and hydrogeological characterization of the Calgary-Lethbridge Corridor in the South Saskatchewan regional planning area; Alberta Energy Regulator, AER/AGS Report 91, 175 p.](#)
- [Babakhani, M., Mei, S., Atkinson, L.A. and Smerdon, B.D. \(2019\): 3D property modelling of the bedrock hydrostratigraphy in the Fox Creek area, west-central Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Open File Report 2019-03, 19 p.](#)
- [Klassen, J. and Liggett, J.E. \(2019\): First-order groundwater availability assessment for the upper Peace region; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Open File Report 2019-10, 28 p.](#)
- [Lemay, T.G., Singh, A., Parks, K., Wiersma, A., Palombi, D., Babakhani, M., Berhane, H., Hathway, B., Vermeulen, P. and Marsman, A. \(2019\): A risk-based methodology for commingled well abandonment – southeastern Alberta gas field case study; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Open File Report 2019-06, 76 p.](#)
- [Ligget, J.E. and Singh, A. \(2018\): Numerical groundwater flow model of the Sylvan Lake sub-basin in the Edmonton-Calgary Corridor, central Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Report 96, 25 p.](#)
- [Smerdon, B.D., Atkinson, L.A., Hartman, G.M.D., Playter, T.L. and Andriashuk, L.D. \(2016\): Field evidence of nested groundwater flow along the Little Smoky River, west-central Alberta; Alberta Energy Regulator, AER/AGS Open File Report 2016-02, 34 p.](#)
- [Smerdon, B.D., Klassen, J. and Gardner, W.P. \(2019\): Hydrogeological characterization of the Upper Cretaceous–Quaternary units in the Fox Creek area, west-central Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Report 98, 35 p.](#)
- [Uutting, D.J. and Andriashuk, L.D. \(2020\): Revised bedrock topography and characterization of Quaternary sediments in the Fort McMurray region, northeastern Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Report 101, 171 p.](#)

Groundwater Management and Research in Nova Scotia

An overview of current activities

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

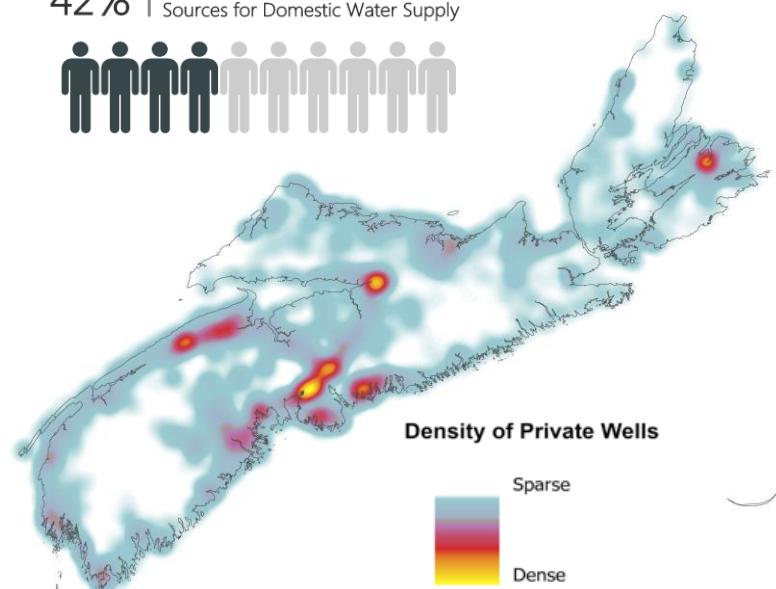
Gavin Kennedy, M.Sc., P.Geo, Nova Scotia Geological Survey

Groundwater Resources in Nova Scotia

40

- ▶ Bedrock geology is heterogeneous 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

42% | Nova Scotians Using Private Water Sources for Domestic Water Supply



Key Groundwater Issues in Nova Scotia

41

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

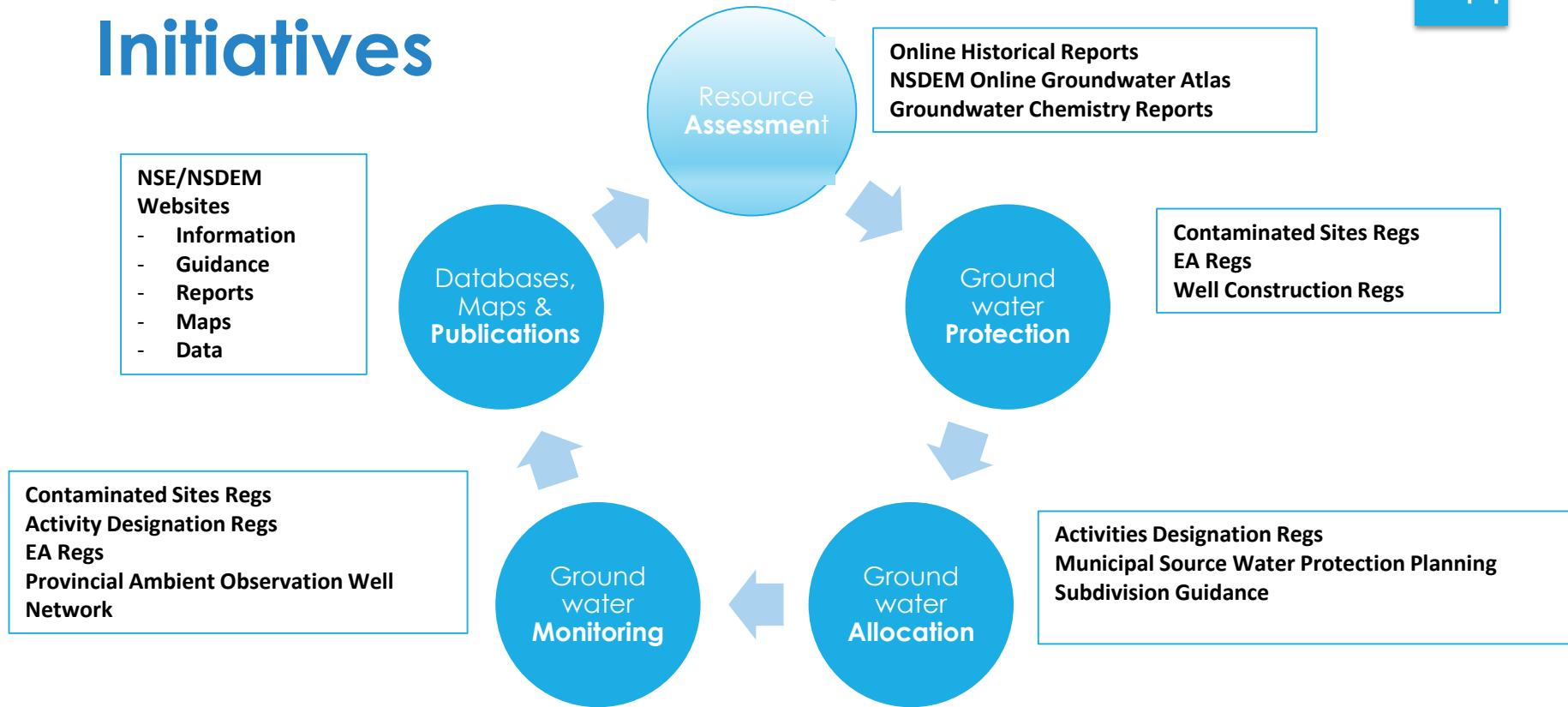
- ▶ In NS, we manage and protect groundwater with a combination of:
 - Acts & Regulations
 - Management initiatives, information and research programs
 - Regulatory enforcement and compliance activities
- ▶ Nova Scotia Environment (NSE) and the Nova Scotia Geological Survey regularly collaborate on data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

44



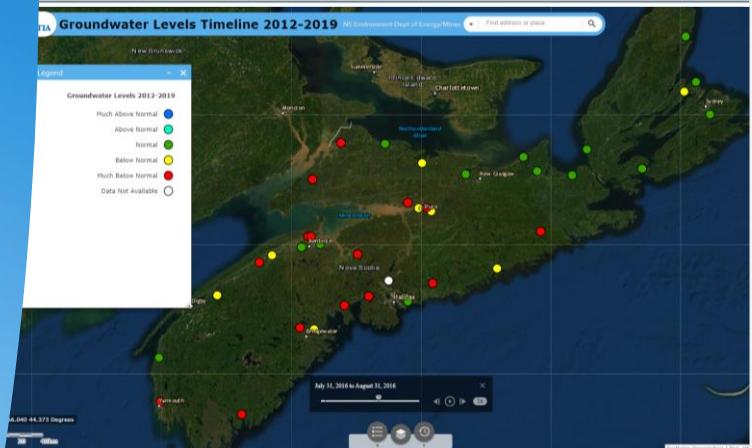
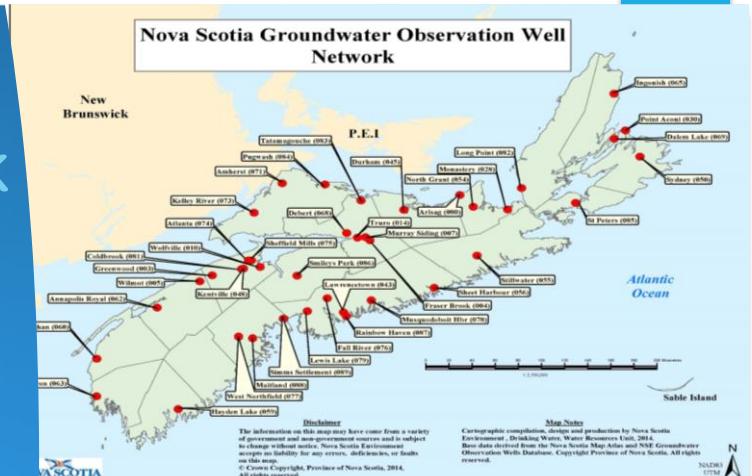
Water Data and Data Tools: Observation Well Network

NSE GW Ambient Monitoring Network

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

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



Drinking Water Interpretation Tool

The screenshot shows two pages of the Nova Scotia Drinking Water Interpretation Tool:

- Homepage:** Features the Nova Scotia Environment logo and a "How to use this tool" section. It includes instructions for entering water test results and a list of steps: 1. Enter your water test results into the boxes below. If you do not have a value for a particular parameter, leave the space blank. 2. Click "Compare your results" at the bottom of the page. 3. Scroll to the bottom of the results page and read the explanations given. 4. Click the "Reset" button to start over or enter data for a new water sample, or click your browser's "Back" button to add a new chemical, but keep entered data.
- Results Page:** Titled "Drinking Water Interpretation Tool - Results". It displays results for various parameters:
 - Total Coliform Bacteria:** Your results: 0 (CFU/100 mL), Drinking water standard (MAC): 0 (CFU/100 mL). Status: ✓ (green checkmark). Message: "Results MEET the drinking water standard (MAC)".
 - Lead:** Your results: 8 (µg/L), Drinking water standard (MAC): 5 (µg/L). Status: ✗ (red X). Message: "Results DO NOT MEET the drinking water standard (MAC)".
 - Chloride:** Your results: 300 (mg/L), Drinking water standard (AO): None. Status: ✗ (red X). Message: "Results DO NOT MEET the Aesthetic Objectives (AO)".
 - Turbidity:** Your results: 1 (NTU), Drinking water standard (AO): 1 (NTU). Status: ✗ (red X). Message: "Results DO NOT MEET the Aesthetic Objectives (AO)".
 - Volatile Organic Chemical Compounds (VOC's):** Your results: None, Drinking water standard (AO): 250 (µg/L). Status: ✗ (red X). Message: "Results DO NOT MEET the Aesthetic Objectives (AO)".

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

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

NSE “On the Horizon”

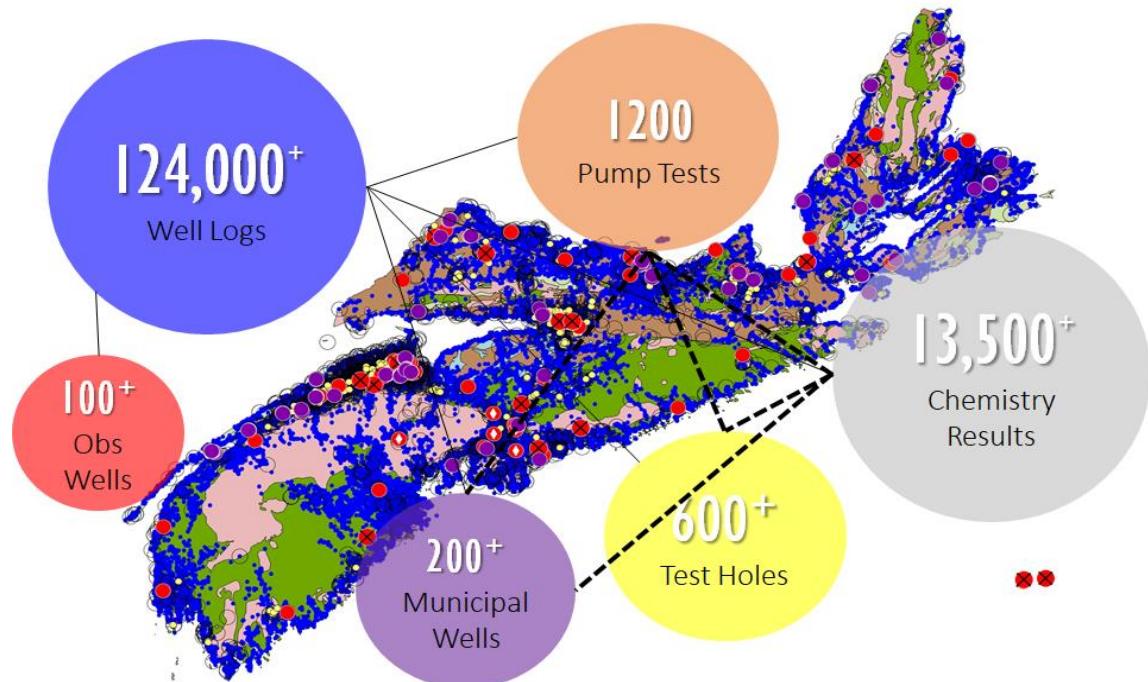
- ▶ Modernization of water resources data management into an enterprise platform - collaborative initiative with NS Geological Survey
- ▶ Review Municipal Systems GUDI Protocol
- ▶ More focus on Improving Private Well Water Supplies
 - Behavioural Insights analysis
 - Mitigations – Regulatory to Incentives 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

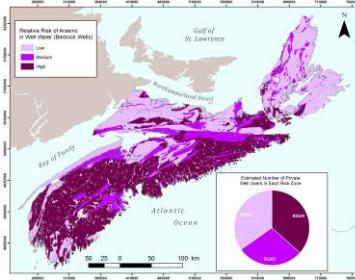
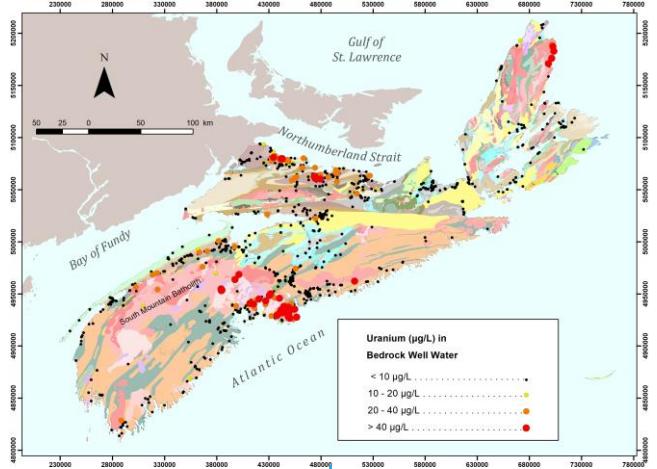
- ▶ Initiated in 2007, the Hydrogeology Program mandate:
Produce scientific information on the quality, availability and vulnerability of groundwater in Nova Scotia and make this information available to decision makers and the public.
- ▶ In collaboration with NSE, program manages province's groundwater 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

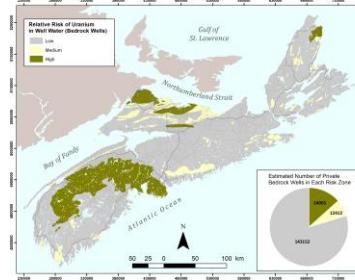
- ▶ Groundwater data are compiled into a relational centralized database from various sources:
 - Well Construction Regs
 - Observation Well Network
 - Public Water Supplies
 - Research Projects
 - Water Withdrawal Approvals
 - Subdivision groundwater assessments



Current Area of Research

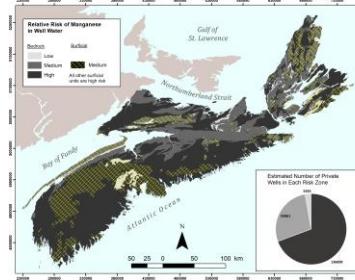


Arsenic in bedrock
water wells hazard

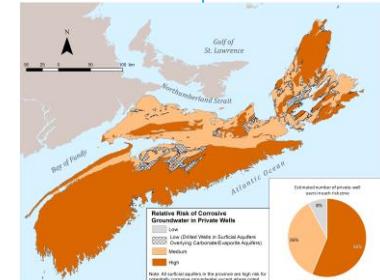


Uranium in bedrock water

- 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.



Manganese in
water wells hazard

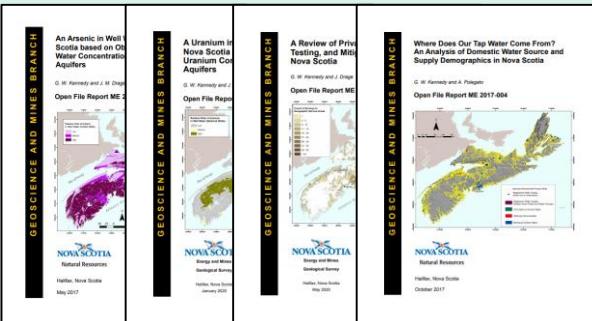


Groundwater
corrosivity hazard

Publications

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

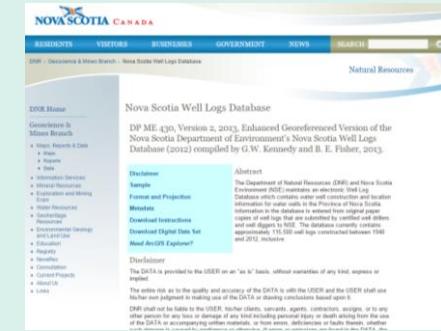
Reports



Web Layers and Applications

The screenshot shows the homepage of the Nova Scotia Uranium Risk in Bedrock Water Wells website. The main feature is a map of Nova Scotia with various geological layers and symbols indicating the presence of uranium and the locations of bedrock water wells. A legend on the left provides information about the symbols used. To the right of the map, there is a sidebar with a search bar, a 'Sign In' button, and a 'Help' link. Below the map, there is a section titled 'Uranium in Nova Scotia' with a detailed description of the geological context and potential risks. At the bottom, there are links for 'Staff Contact' and 'Guest Feedback'.

Digital Products (.shp, .gdb etc.)



Story Maps

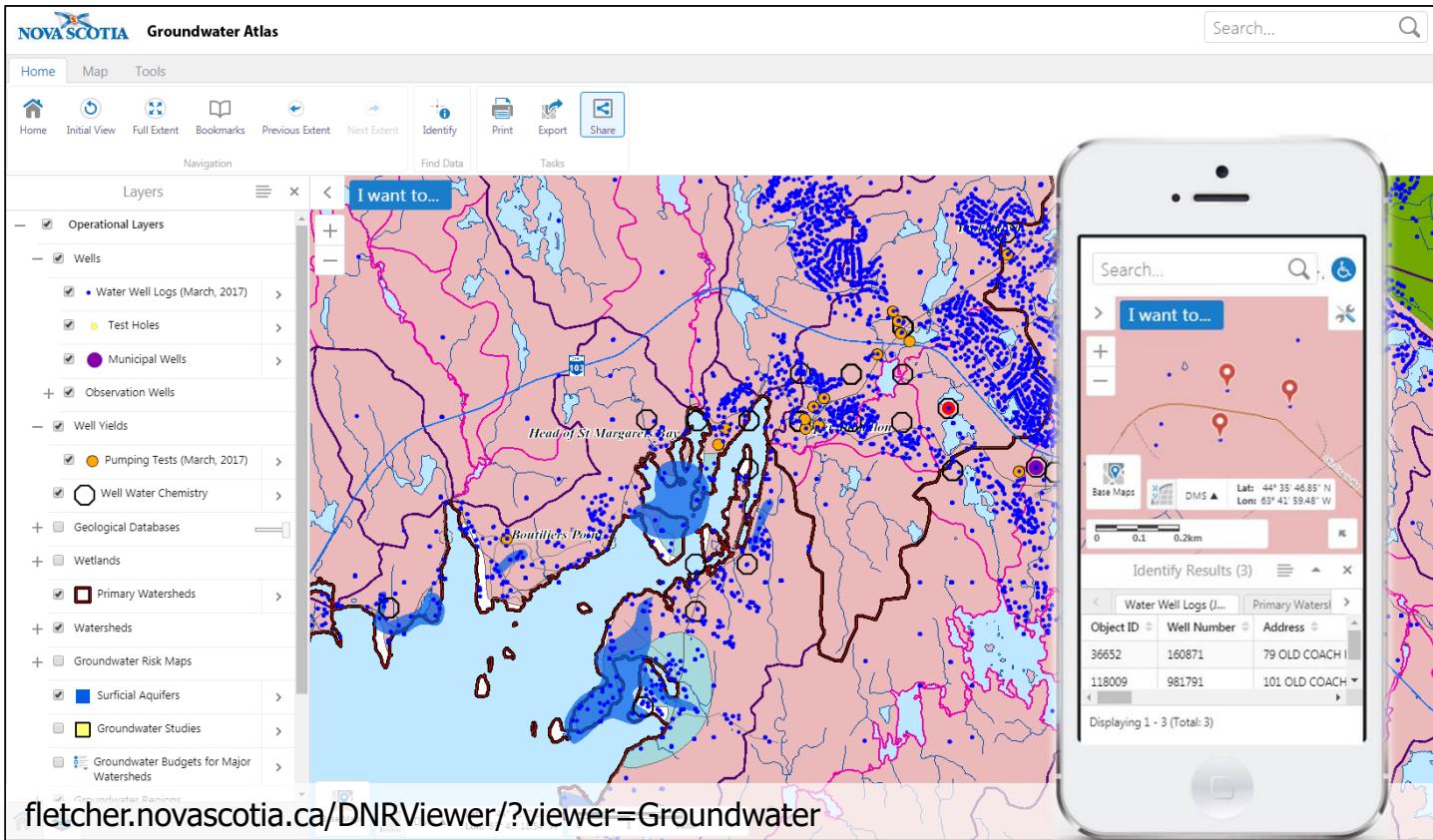
How do I test the quality of my well water?

Consult the provincial government's water well testing webpage for detailed instructions on testing your water well.

Nova Scotia Groundwater Atlas

52

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



Thank-you!

Gordon Check, M.A.Sc. P.Geo
Hydrogeologist
Nova Scotia Environment, Halifax
Gordon.Check@novascotia.ca
(902) 497-4853

Gavin Kennedy, M.Sc. P.Geo
Hydrogeologist
Nova Scotia Geological Survey, Department of Energy and
Mines
Gavin.Kennedy@novascotia.ca
(902) 424-2516

Questions?