



Geoscience BC Overview & Update Northeast

UBCM September 24, 2019

Non-profit organization

Generate and share high quality, unbiased earth science research and data

Collaboration between governments, communities, Indigenous groups, resource sectors, academia

... improves our collective level of geoscience knowledge

... informs responsible natural resource and investment decisions

.... catalyzes socio-economic opportunities

... stimulates innovation and geoscience technologies



Minerals



Energy



Water

Identifying New Natural Resource Opportunities

Understanding Water

Advancing Science & Innovative Geoscience Technologies

Facilitating Responsible Natural Resource Development

Enabling Clean Energy

Governance, Management
& Finance

Public Access &
Data Management

External Relations
& Communications

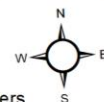
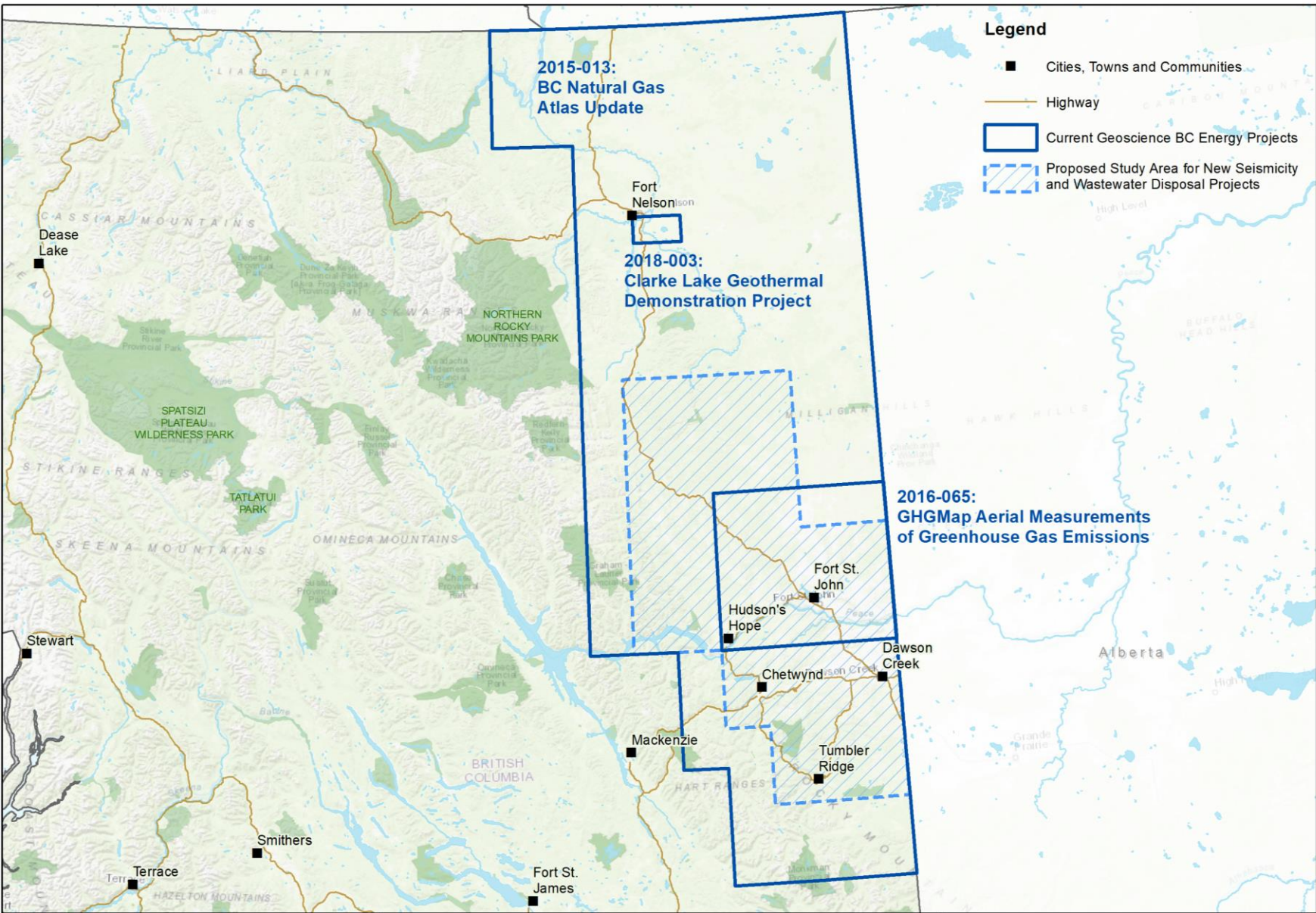


Geoscience BC

Completed & Current Research Projects

Strategic Research Area	Completed Research Projects	Current Research Projects
Minerals	127	29
Energy - Oil & Gas	24	11
Energy – Geothermal	10	2
Water	25	5
Total	186	47

- Geoscience BC has funded 233 projects, of which:
 - 186 are completed; and
 - 47 are currently underway
- Scientific Project Plan outlines current and future research projects
- Research findings and data available online and summarized in annual Summary of Activities:
 - Minerals; Energy and Water





**ENVIRONMENTAL IMPACTS OF SHALE GAS EXTRACTION
IN CANADA**

The Expert Panel on Harnessing Science and
Technology to Understand the Environmental
Impacts of Shale Gas Extraction



Council of Canadian Academies
Conseil des académies canadiennes

Science Advice in the Public Interest

**Canadian Council of
Academies, 2014**

Scientific Review of Hydraulic Fracturing in British Columbia

**Scientific Review of
Hydraulic Fracturing in
British Columbia**



**Scientific Hydraulic
Fracturing Review
Panel**

February 2019

**Scientific Hydraulic
Fracturing Review
Panel, 2019**

Current Projects: Understanding Water

Dr. Aaron Cahill,
EERI Director,
UBC



Dr. Roger Beckie
Professor, UBC

Groundwater quality – effects of
natural gas on an aquifer



Dr. Uli Mayer
Professor, UBC



Dr. Bernhard Mayer
Professor, University of
Calgary



Dr. Sean Crowe
Professor, UBC



Dr. Rachel Lauer
Professor, University of
Calgary



Dr. Andy Black
Professor, UBC



Dr. Laurie Welch
Hydrogeologist,
BC Oil and Gas Commission



Dr. Steve Hallam
Professor, UBC



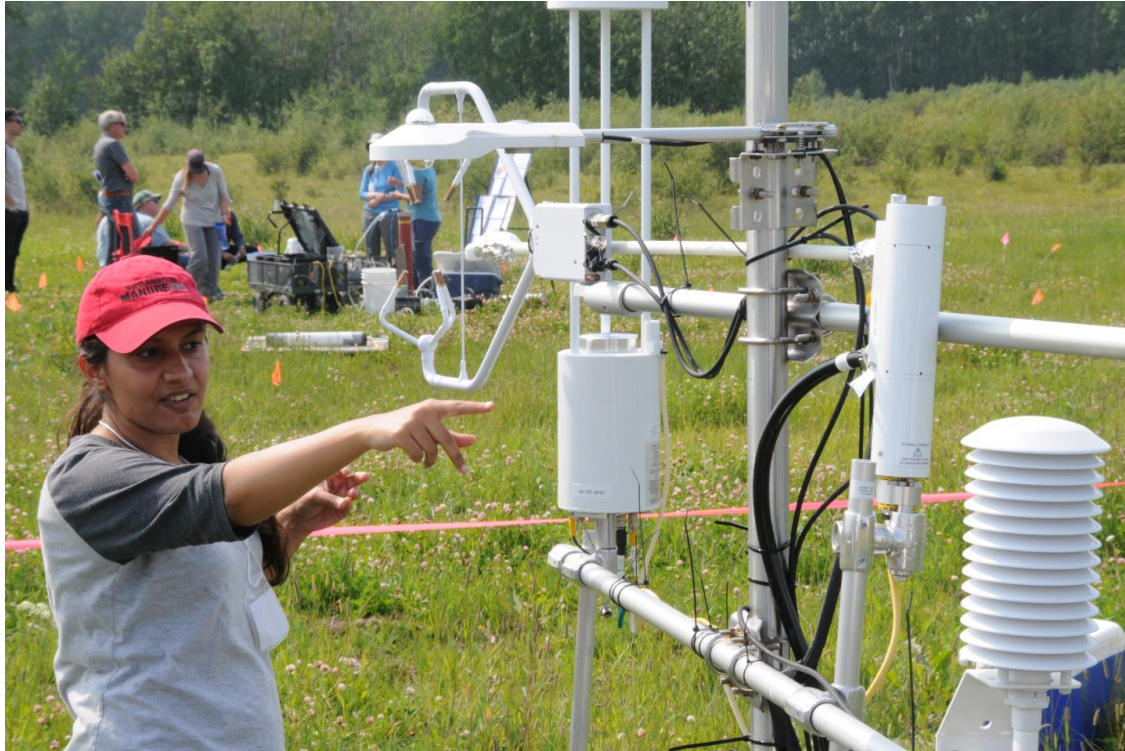
Dr. Dirk Kirste
Professor, SFU



Dr. Dwayne Tannant
Professor, UBC Okanagan



Groundwater quality – effects of natural gas on an aquifer



Assessment of Fugitive Natural Gas on Near-Surface Groundwater Quality (Drs. Aaron Cahill (Heriot-Watt) & Roger Beckie, (UBC))

Outcome:

- Effects of natural gas on an aquifer

(Tom Balke , 2016)

Current Projects: Understanding Water

Groundwater quality – effects of natural gas on an aquifer



Geochemistry
Biochemistry
Genomics
Hydrogeology
Geophysics
Surface flux

(Tom Balke , 2016)

Current Projects: Understanding Water

Groundwater quality – effects of natural gas on an aquifer

Peace Regional Groundwater Monitoring Network (Drs. Laurie Cahill (OGC) and Aaron Cahill (Heriot-Watt))

Outcomes

- Improved understanding of non-anthropogenic natural gas in aquifers
- Regional network of scientific-grade groundwater monitoring wells

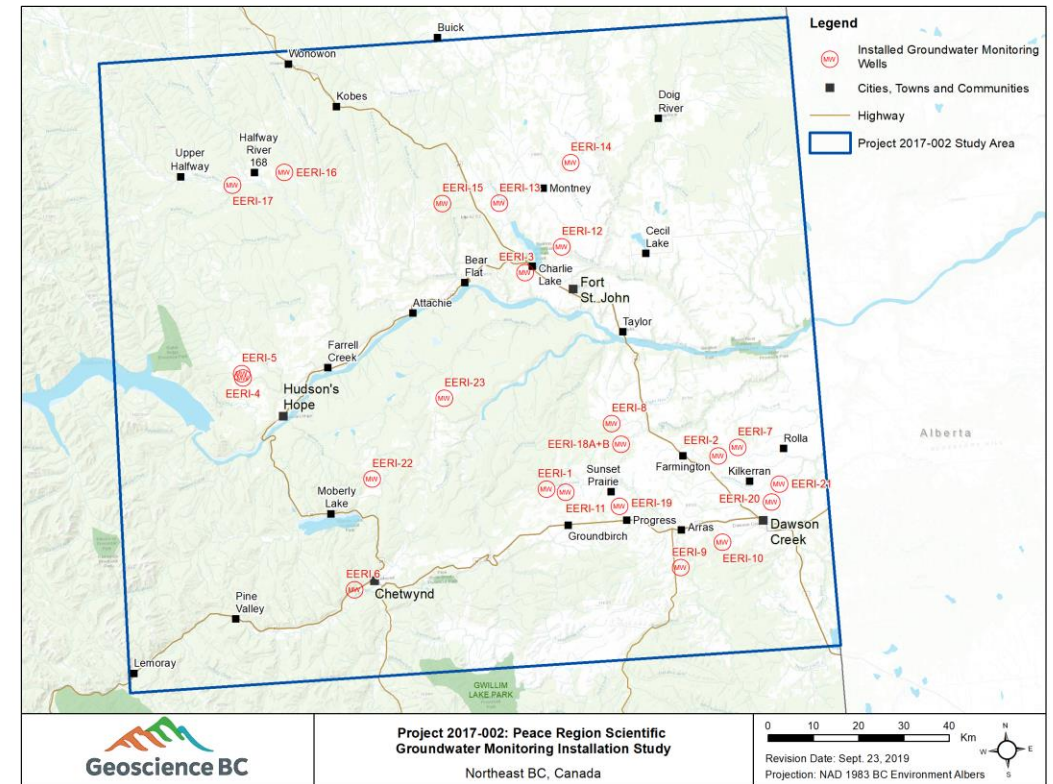
(EERI, 2018)



Current Projects: Understanding Water

Groundwater quality – effects of natural gas on an aquifer

- Install ~30 new scientifically-designed monitoring wells
- Increase understanding of groundwater system in the Peace



Current Projects: Facilitating Responsible Natural Resource Development

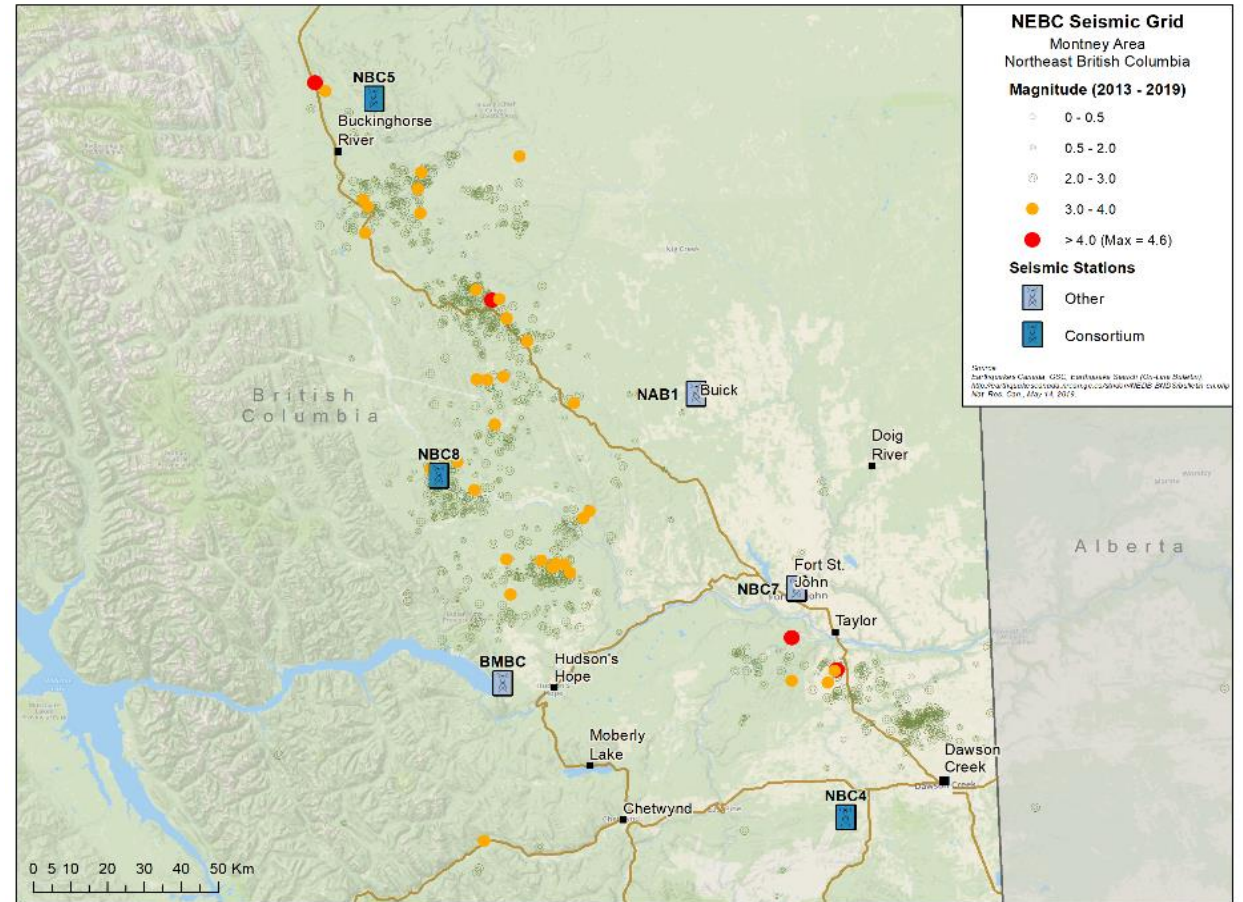
Induced Seismicity

BC Seismic Research Consortium

- 2 NRCan stations in 2012
- Now 22 stations in NEBC
- Dedicated project seismologist

Outcomes

- Enhanced seismic monitoring
- Improved decision making



Current Projects: Facilitating Responsible Natural Resource Development

Induced Seismicity

Monitoring and Risk Assessment of Anomalous Induced Seismicity due to Hydraulic Fracturing in the Montney (Dr. Amanda Bustin, UBC)



12 stations, each have:

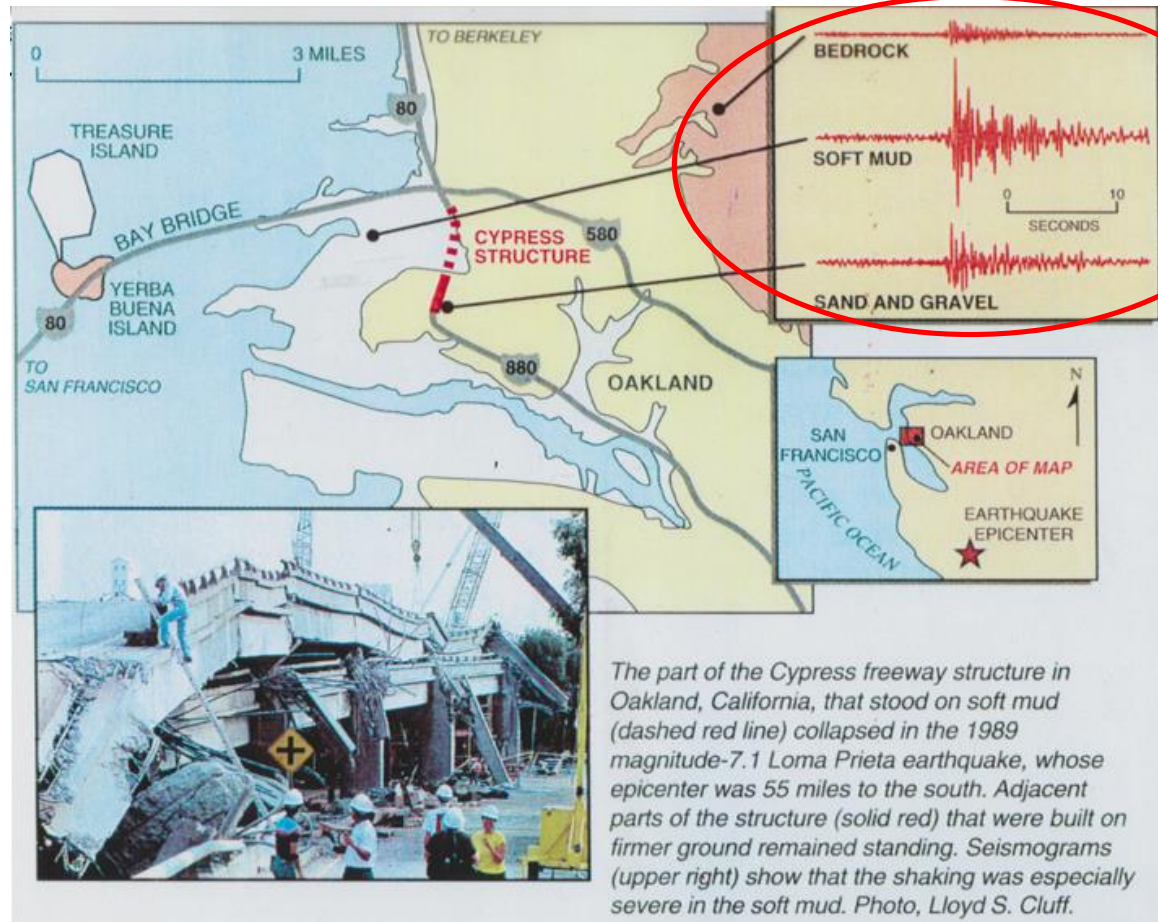
- Supped-up made-in-UBC ground motion and seismic sensors

Outcomes

- Mitigation – develop Traffic Light Protocol
- Prevention
- Create probabilistic hazard maps



Current Projects: Facilitating Responsible Natural Resource Development



Induced Seismicity

Ground Motion Amplification

- 1989 Loma Prieta earthquake
- Ground Motion amplified on soft soil

Hough et al., 1990 and Lloyd S. Cluff

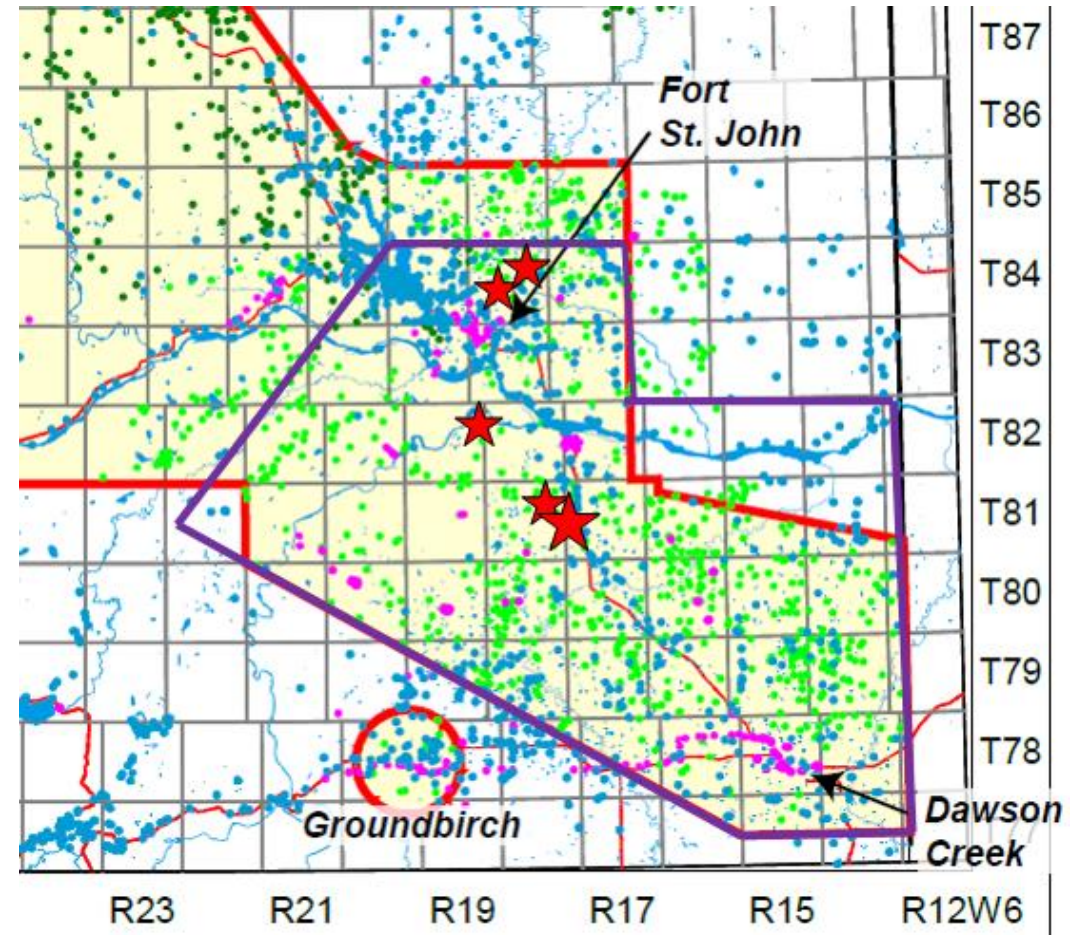
Current Projects: Facilitating Responsible Natural Resource Development

Induced Seismicity

Amplification of seismic ground motion mapping for the Fort St. John-Dawson Creek area (Dr. Pat Monahan)

Outcome

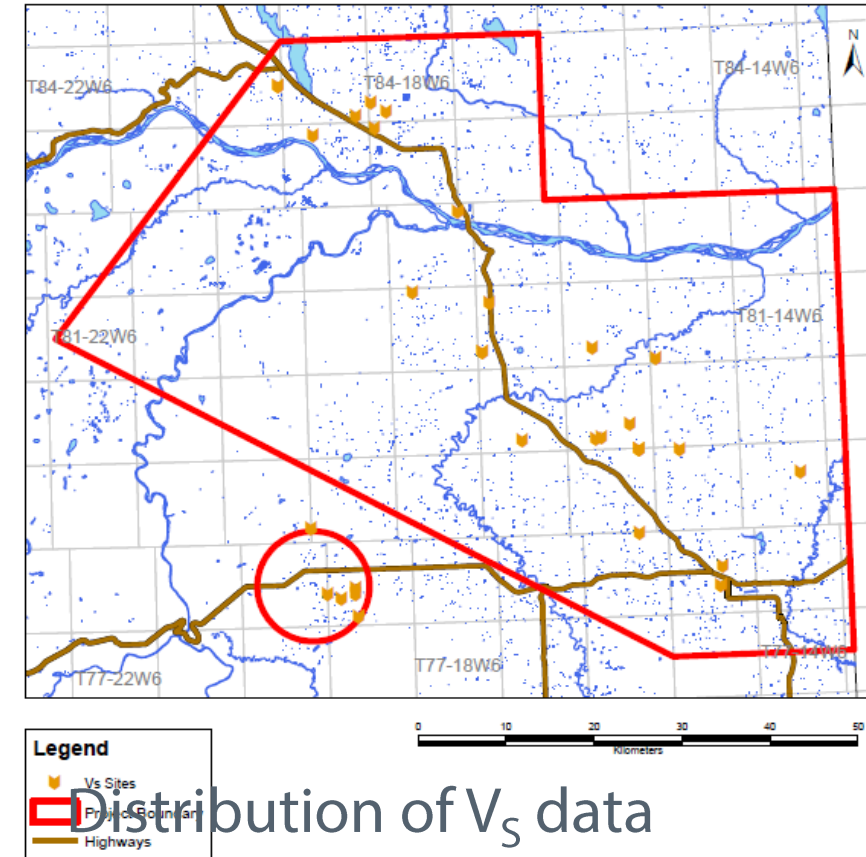
- Improved understanding of the effects of surface sediments on amplified ground motion



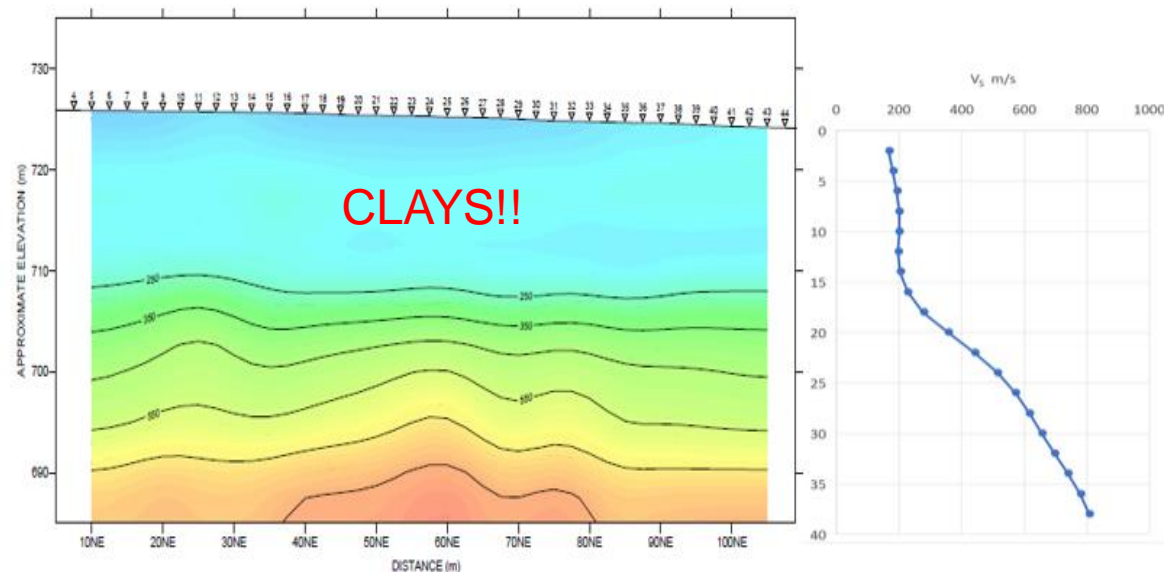
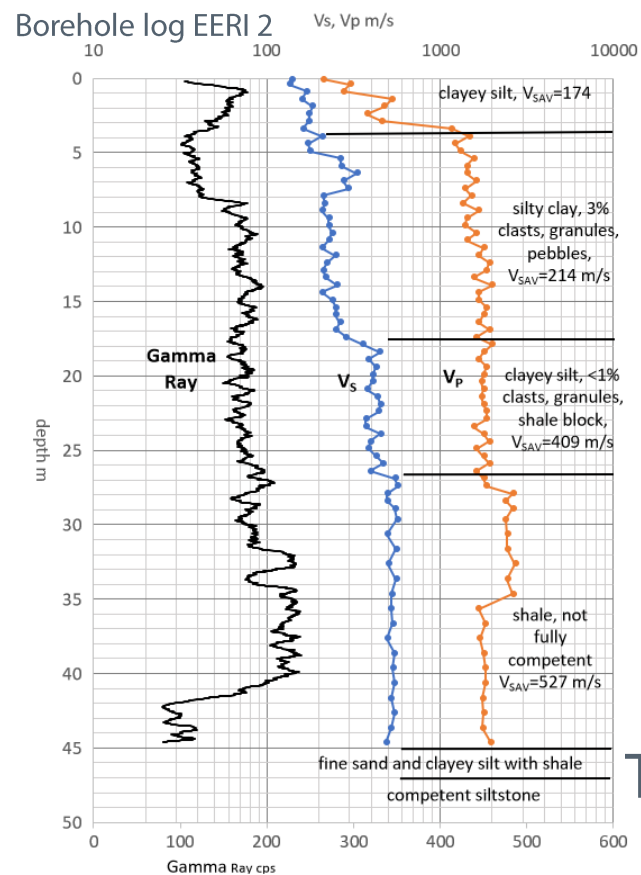
Current Projects: Facilitating Responsible Natural Resource Development



Dawson Creek Open House, May 29



Current Projects: Facilitating Responsible Natural Resource Development



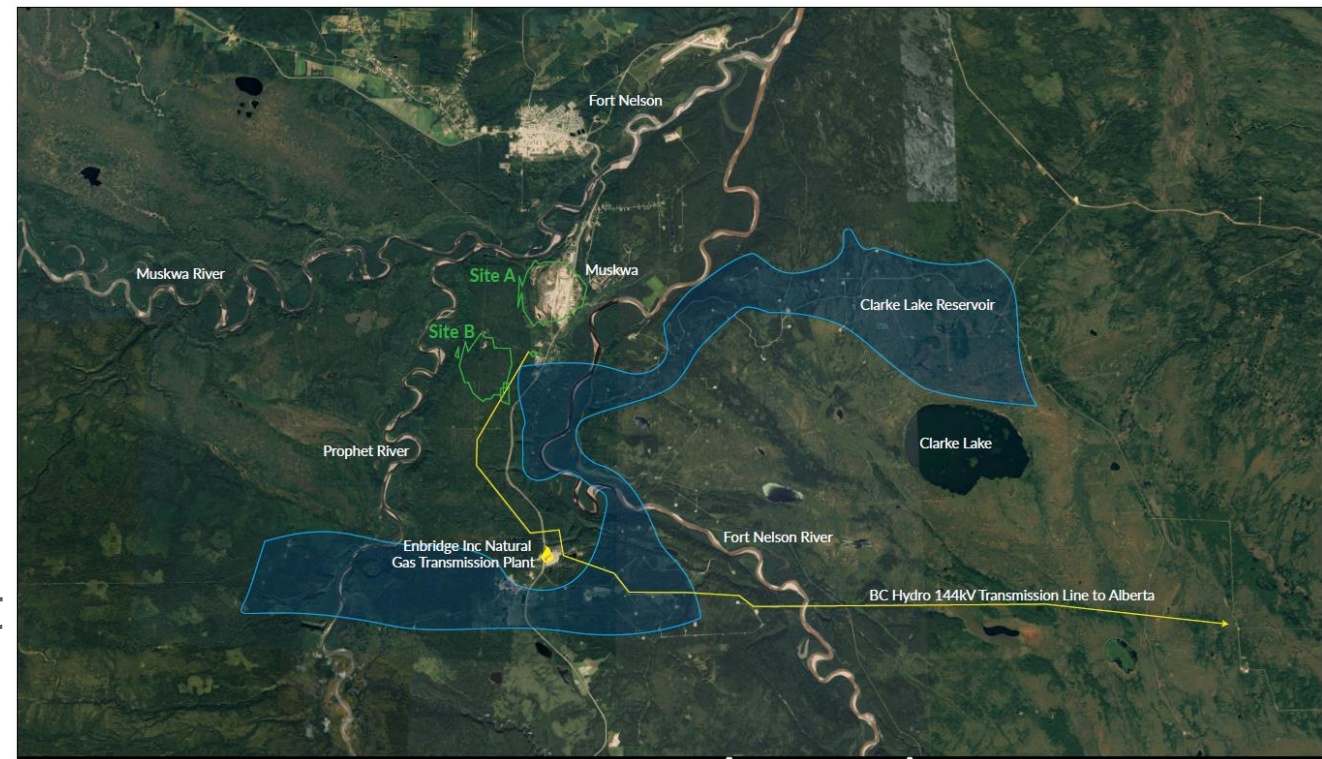
Thick low velocity shallow sediments are widespread

Current Projects: Enabling Clean Energy

Geothermal

Clarke Lake

- Repurposing mature oil & gas wells for geothermal power / heat
- Current study: Pre-Front-End Engineering Design (Pre-FEED) for a geothermal pilot plant
- **Update May 2019:** Fort Nelson First Nation federal funding to build a geothermal pilot plant



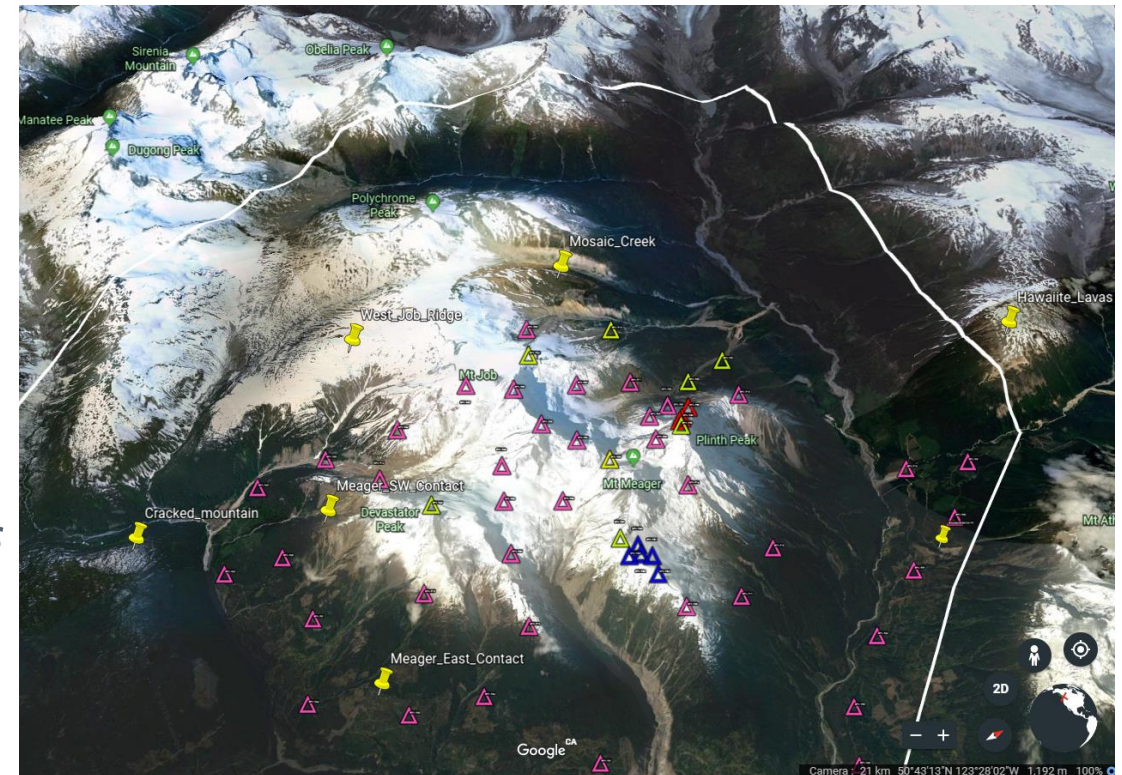
Current Projects: Enabling Clean Energy

Geothermal



Garibaldi Volcanic Belt

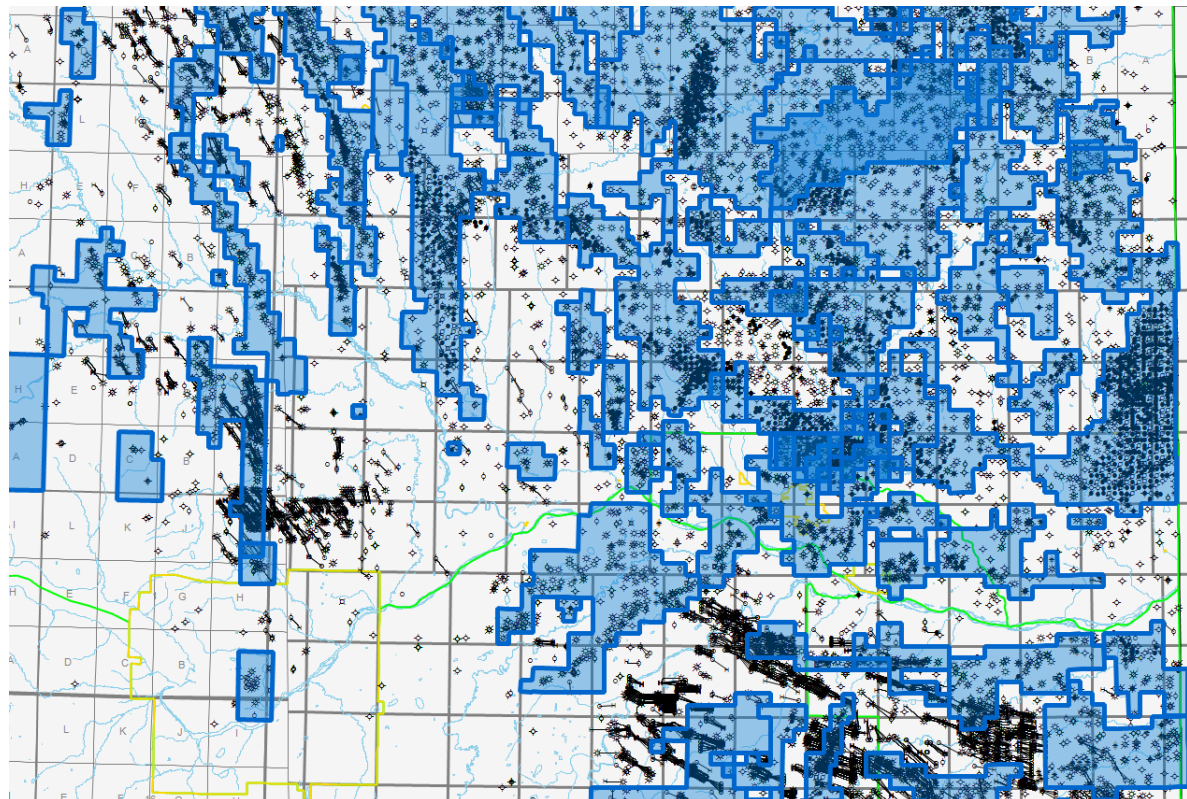
- Regional-scale assessment
- Collaboration with Geological Survey of Canada; input from communities and Indigenous groups



Current Projects: Enabling Clean Energy

BC Natural Gas Atlas

- 236 Oil & Gas Fields In BC
- Why sample them?
 - Will assign 'postal code' to each gas pool/field
 - Can help companies optimize economic drill sites



GHGMap

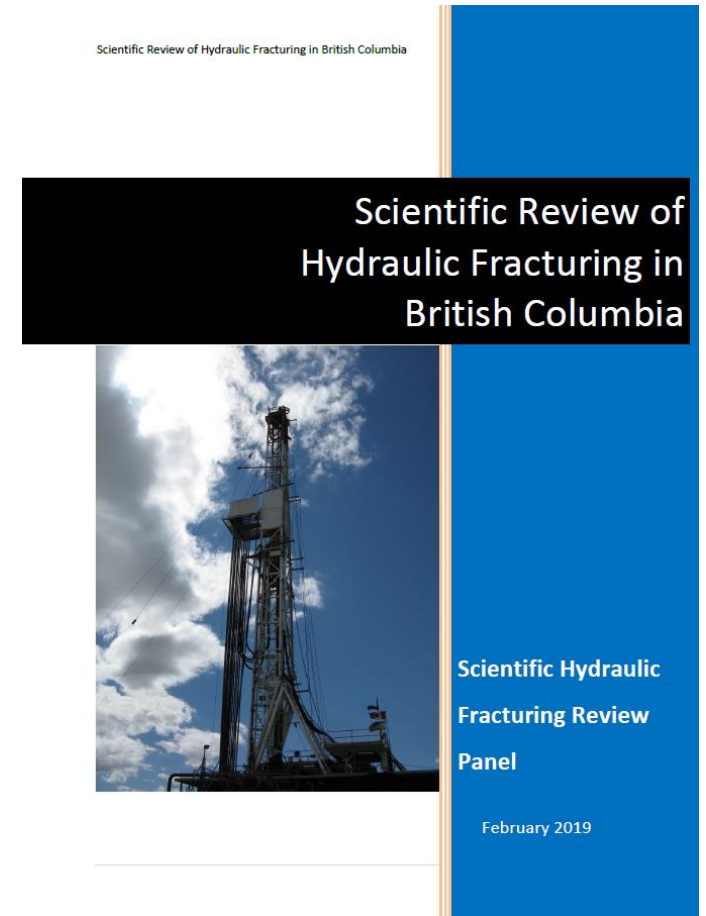
- Cost-effective and accurate real-time detection of methane, ethane, CO₂ concentration and fluxes
- Next version will have capability to read 'postal code' from fugitive gas



Scientific Review of Hydraulic Fracturing in British Columbia: more than 35 references to Geoscience BC

Key Knowledge Gaps:

- Induced Seismicity
- GHG measurement and monitoring
- Wastewater Disposal
- Surface & Groundwater



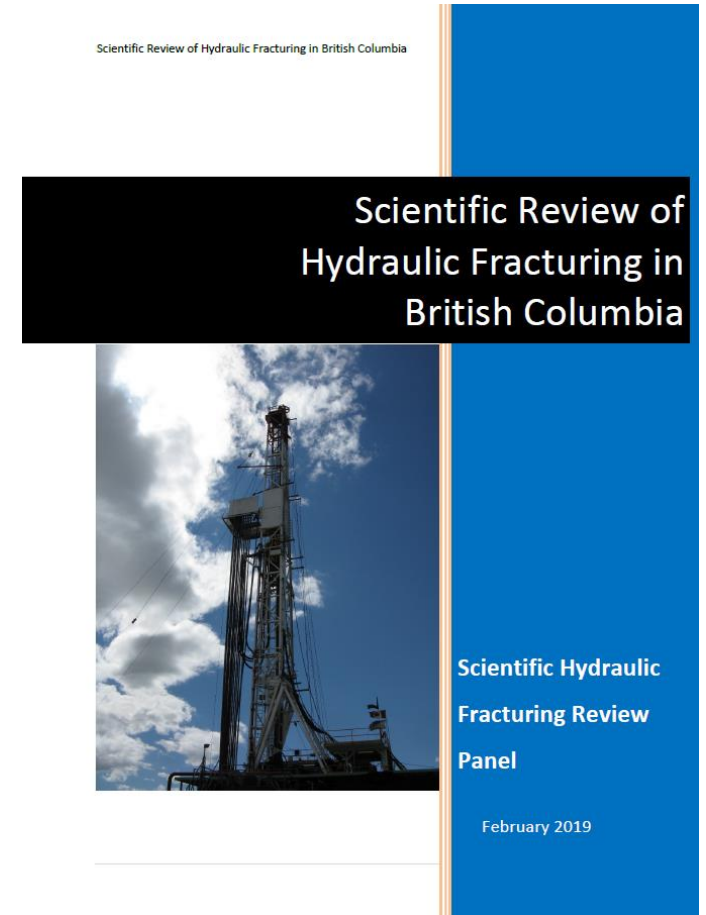
New Projects: Energy & Water

Request for Proposals sent out to address Panel's recommendations on:

- Induced Seismicity
- Wastewater Disposal

RFP Review Committees set up with reps from MEMPR, OGC, Energy/Service companies and CAPP

- 4 Induced Seismicity RFP's approved by Board
- 1 Wastewater Disposal RFP approved by Board



New Projects: Energy & Water

Induced Seismicity

- *Development of an Induced Seismicity Susceptibility Framework and Map for NEBC using an Integrated Machine Learning and Mechanistic Validation Approach.* (Dr. Erik Eberhardt, University of British Columbia)
- *Statistical Assessment of Operational Risks for Induced Seismicity from Hydraulic Fracturing in the Montney, Northeast BC* (Enlighten Geoscience Ltd.)
- *Comprehensive Investigation of Injection-Induced Earthquakes in Northeastern BC* (Dr. Hon Kao, Pacific Geoscience Center Natural Resources Canada/University of Victoria)
- *Understanding and Mitigating Induced Seismicity Risk in the Kiskatinaw Area, BC* (Dr. Dave Eaton, University of Calgary)

New Projects: Energy & Water

Water Disposal

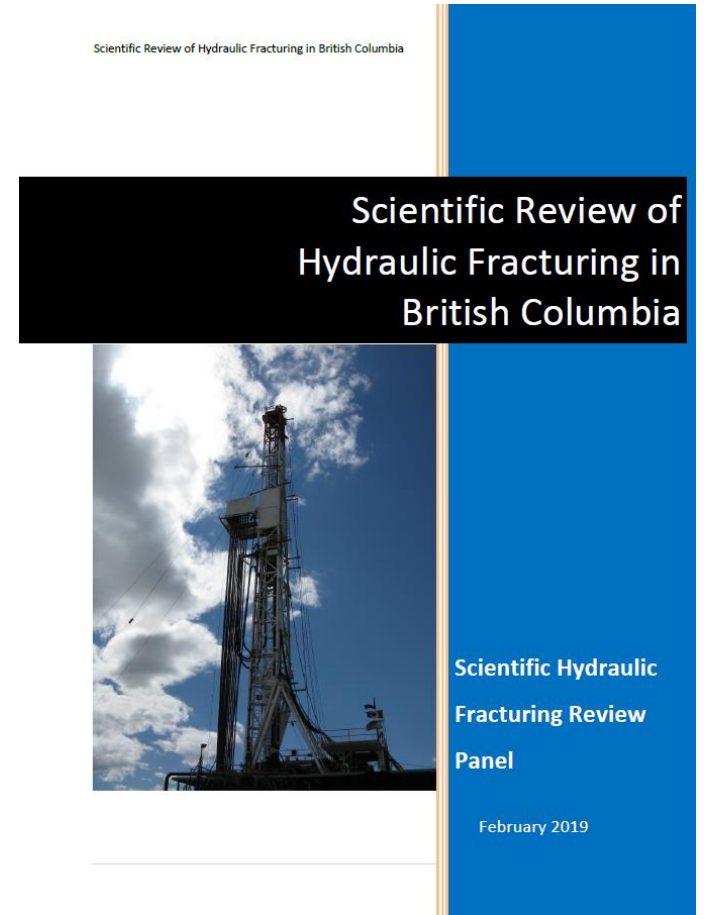
- *Wastewater Disposal in the Maturing Montney Play Fairway of NEBC* (Petrel Robertson Consulting Ltd.)

New Projects: Water



Coming soon:

- Request for Proposals will to address Panel's recommendations on water





Thank You

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