# Deep Saline Groundwater Extraction in the Horn River Basin – Guidance for Groundwater Information for an Environmental Assessment

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Randa Sultan, M.Sc., P.Geol. (AB), P.Geo. (BC)
Waterline Resources Inc.

# Presentation Outline

- Unconventional Natural Gas
- Horn River Basin – Overview
- BC Groundwater Regulation Triggers
- Reviewable Projects - EA Process
- Saline GW - Exemption *Requirements*
- New Guidance Document (BC MOE, December 2012) - Explained
- Summary
- Questions?

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# Unconventional Natural Gas

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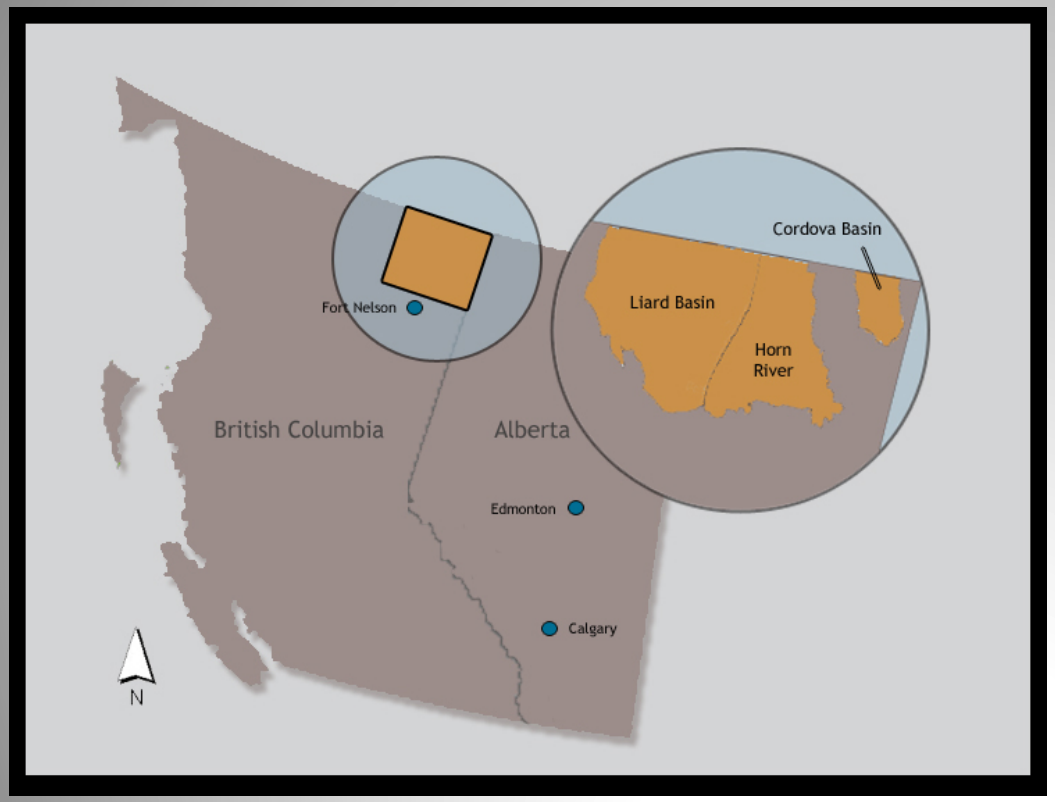
# NE BC – Unconventional (Shale) Gas




- 3rd largest natural gas deposit in North America
- Estimates of 250-500 tcf
- 10-20% recoverable

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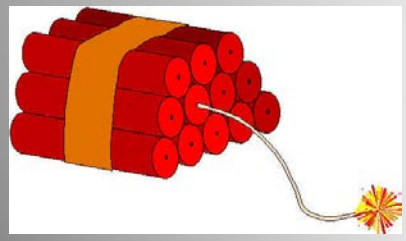
# Shale Gas and Hydrofracturing

- Gas deposits stored in deep shale-bearing formations
- To produce natural gas from these formations, hydraulic fracture stimulation (hydrofracturing) methods are used
- Fluid injected at high pressure to fracture the shale formation
- Hydrofracturing = large water needs

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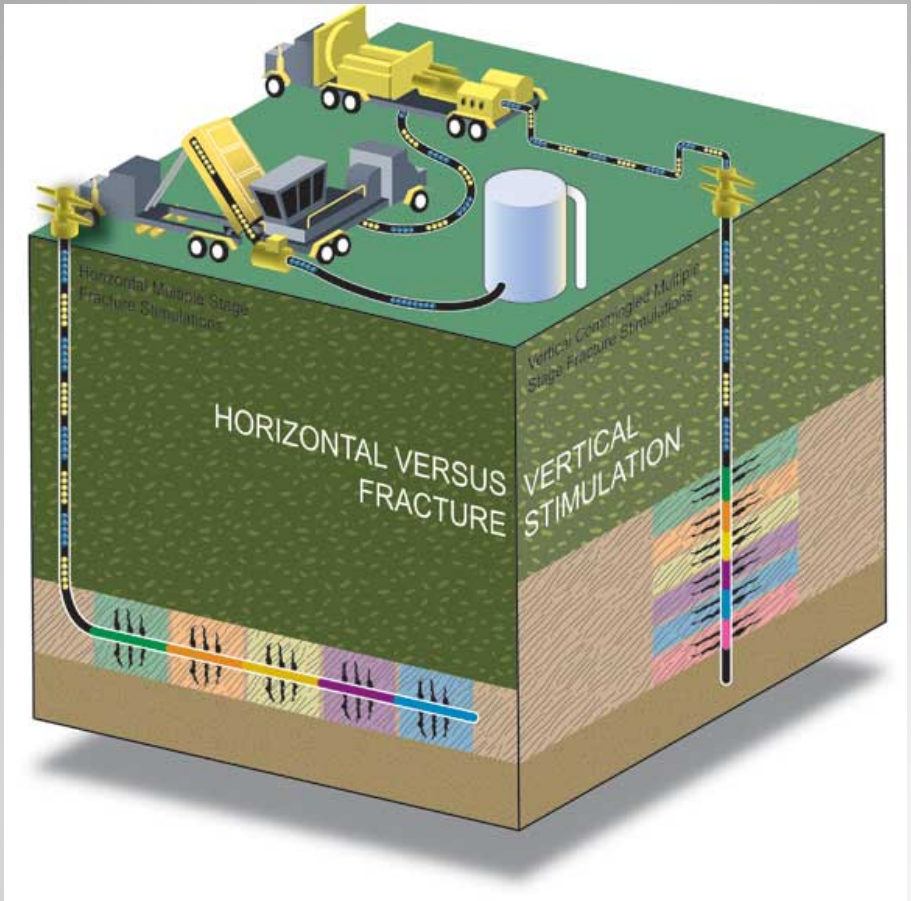
# Shale Gas and Hydrofracturing

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# Horn River Basin - Location

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# Horn River Basin…

- 1.3 million hectares
- ~20 companies currently operating
- **HUGE WATER NEEDS**
- Camps
  - 200-400 people per camp @ 1,200 L/person/d
- Drilling and Fracturing
  - 40,000 $m^3$ per well for frac'ing over several days
- Current water use = SW, shallow non-saline GW, deep saline GW

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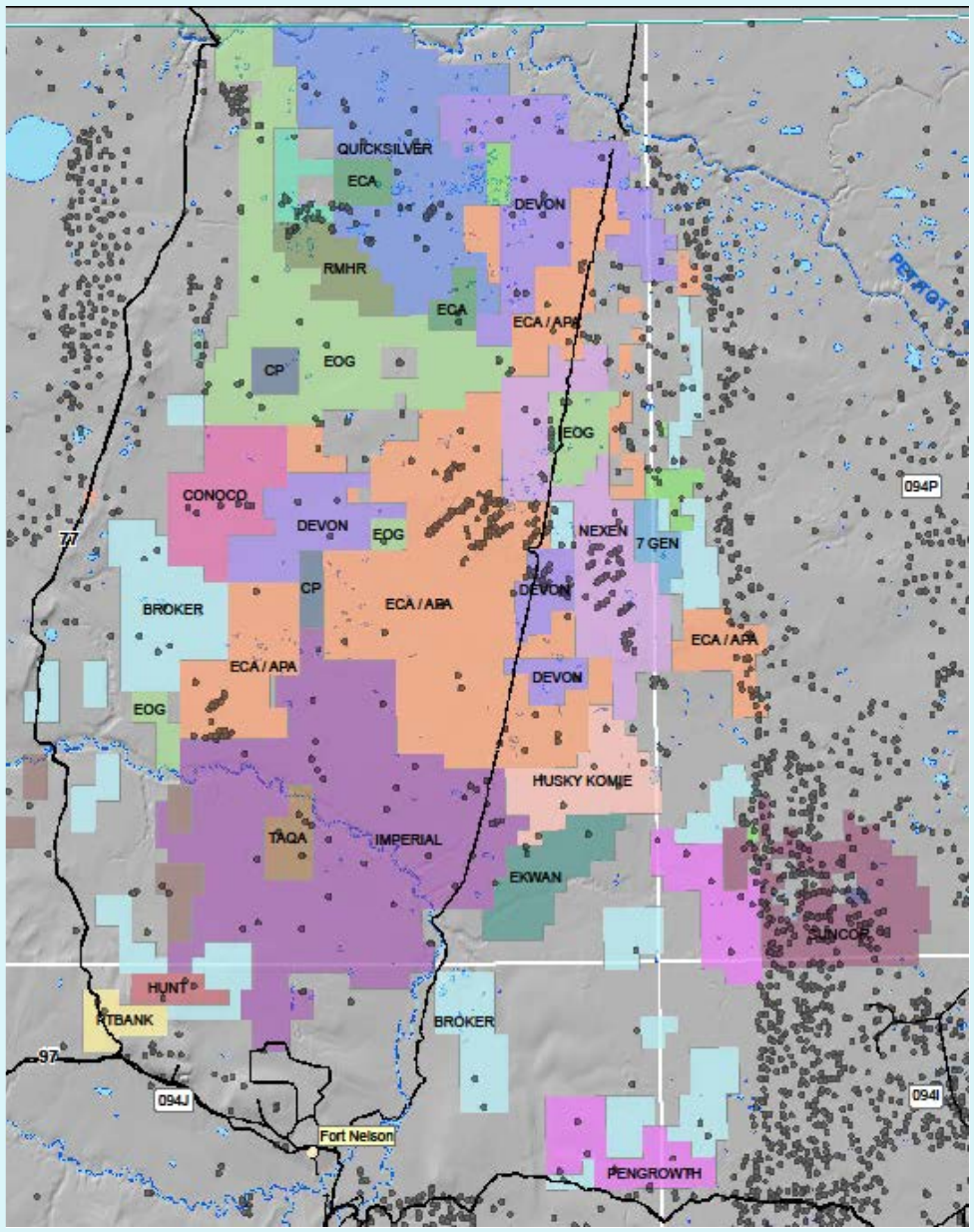
# …Horn River Basin

- 2012: >500 horizontal gas/experimental wells drilled to date
- Up to 50,000 gas wells may be developed in the Horn River Basin
- Shallow non-saline and deep saline GW needs will be increasing




# Horn River Basin – Energy Wells

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# Horn River Basin - Saline GW…

- Mattson sandstones
  - Isolated to the west
- Basal Cretaceous sandstones
  - Thin and isolated
- Debolt-Rundle platform
  - Regionally extensive
  - Debolt Fm – karstic limestone aquifer

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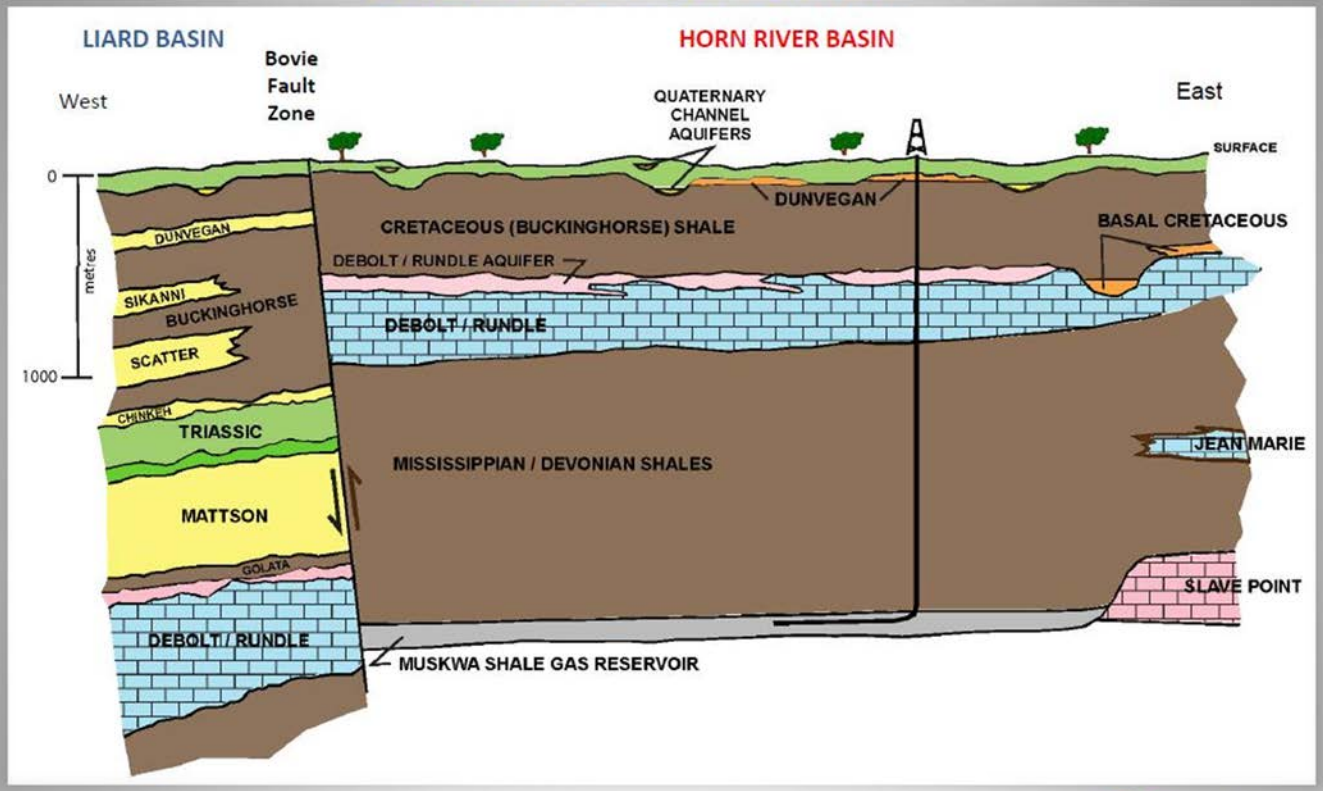
# Horn River Basin – Schematic Cross-Section




Source: Petrel Robertson Consulting, Horn River Basin Aquifer Characterization, Geoscience BC Report 2010-2011

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# …Horn River Basin - Saline GW

- Debolt Formation Aquifer
  - 600-900 mbgl
  - Regionally isolated from surficial aquifers (thick Cretaceous shale deposits)
  - TDS >15,000 to <40,000 mg/L
  - H2S concentrations (may be >100 mg/L)
  - Estimated up to 10 billion $m^3$ GW in Debolt Fm
  - Variable yield (may be >20,000 $m^3$/d)

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# Horn River Basin - Lease Location Map and Debolt Isopach Map

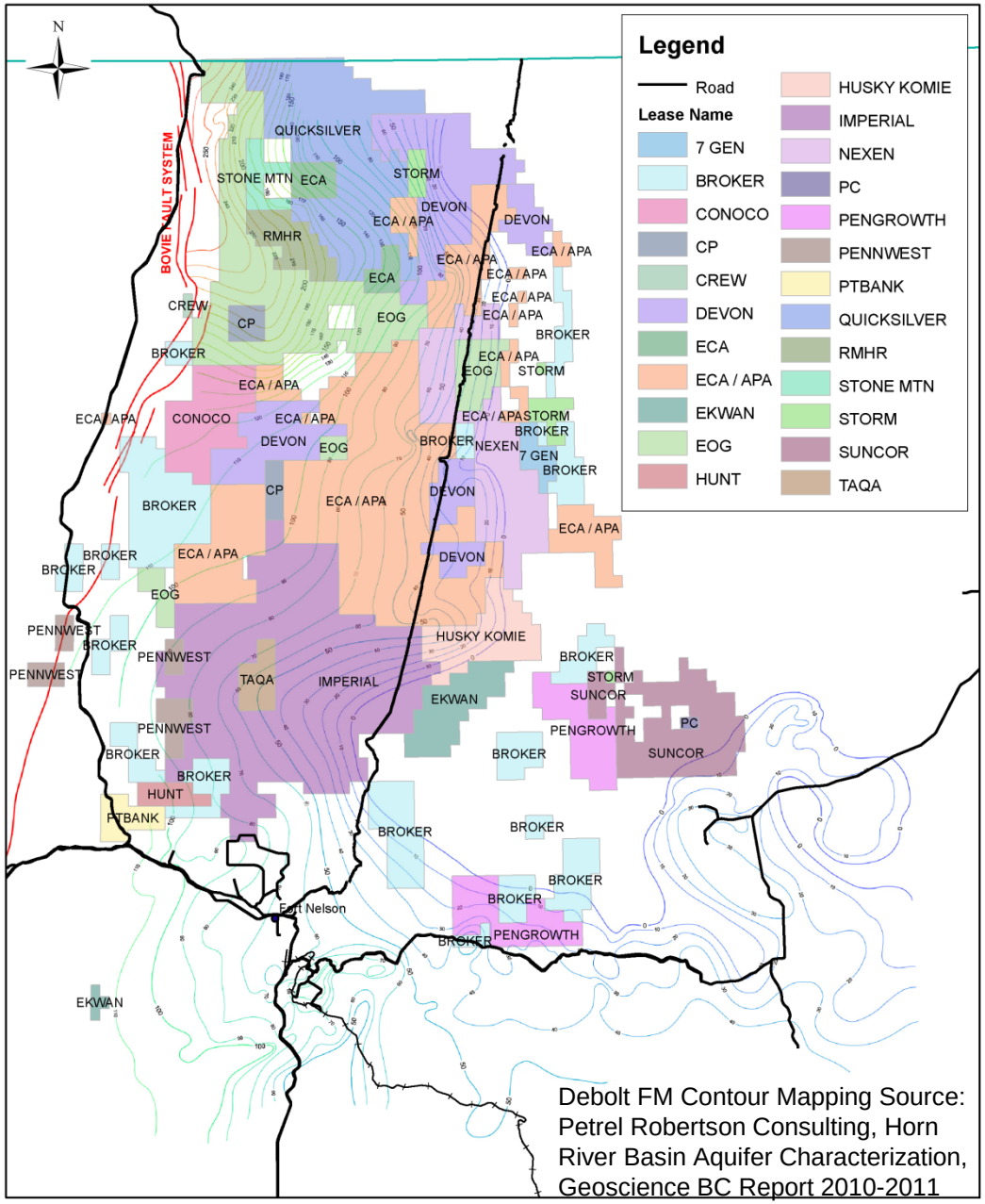


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Figure 1 - Lease Location Map (DeBolt Contours)

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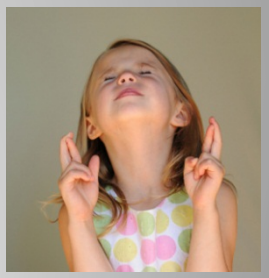
# BC GW Diversion Regulation Triggers

- Environmental Assessment Act (BC EAO)
  - Reviewable Project Regulation
  - Groundwater extraction >75 L/s (6,500 $m^3$/d)
  - Does not distinguish between saline and non-saline GW
  - Currently the only Regulation in BC that relates to groundwater diversion volumes or licensing

- Water Act Modernization Process (2014?)
  - Groundwater Licensing Component release
  - (currently in public consultation process)



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# Reviewable Project Regulation

Large GW Extraction Projects (>75 L/s) =“Reviewable Project”

- Environmental Assessment (EA) certificate may be required prior to construction
- EA = lengthy process including assessment of all GW users, potential cumulative effects, etc.
- Non-saline GW (<4,000 mg/L TDS)
- Saline GW (>4,000 mg/L TDS)

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# "Exemption from EA Certificate"

IF:

***"the Executive Director considers that a reviewable project will not have a significant adverse environmental, economic, social, heritage or health effect, taking into account practical means of preventing or reducing to an acceptable level any potential adverse effects of the project"***

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# EA Required…?

1) Application for an EA Certificate Exemption

2) Project Description

- Basis for EAO's decision on whether an EA required (*Section 10(1)(b) of EA Act*)
- Sufficient information w.r.t. potential adverse environmental, heritage, health, economic, social effects
- Details available in *Guideline for Preparing a Project Description for an EA in BC* (and in consult with EAO)

3) Supporting Documentation

- Groundwater-specific

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# Project Description – GW Specific

- <u>GW-related information requirements:</u>
  - Hydrogeological data to demonstrate hydraulic separation of target saline Fm from:
    - Shallow groundwater
    - Surface water
  - Potential effects on other saline GW users
  - Potential effects to aquifer (quality)
  - Proposed monitoring plan
  - Mitigative/adaptive management measures

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# Reviewable GW Extraction Projects – Deep Saline Aquifers (HRB)

- Deep Saline Aquifers (*e.g.*, Debolt Fm or deeper)

*"Deep Saline Groundwater Extraction in the Horn River Basin – Guidance Document for Groundwater Information for an Environmental Assessment."*

*(BC MOE, December 18, 2012)*

Authored/technical guidance – Waterline Resources Inc. and Gordon Groundwater Consulting

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# BC MOE Guidance Document - Why

- Provide clarity on information that can be used to assess hydraulic separation between target saline formation and shallow GW and SW
- Confusion between reservoir and hydrogeological terminology
- Bridge the gap between reservoir engineering data and hydrogeological data
- Current review process is inefficient and cumbersome
- Streamline review process (for both proponent and reviewer)
- Currently aimed at deep saline aquifer in HRB, and can be carried over for similar projects in other areas of BC

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# BC MOE Guidance Document – Explained

- What is it?
  - Outline of components related to groundwater that are to be included
  - Types of information that can be used as supporting data

- Intent:
  - To focus on available information that the energy company would already have on hand, while recognizing that some data sources may not be available for all project sites

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# 1. Project Description Overview

- Shale Gas Development Plan
  - High-level
- Water Development Plan
  - Project water use and disposal needs
  - Proposed source wells
  - Proposed disposal wells
  - GW extraction/injection volumes
  - Proposed saline GW storage, treatment, transport, reuse, recycling, disposal

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# 2. Regional Hydrogeologic Setting

- Geologic, hydrogeologic, hydrologic overview
  - Regional information available
  - Aquifer characteristics
  - Hydrogeologic interpretation
  - SW bodies and shallow aquifers within 5km radius of Debolt wells
- Existing users (saline and non-saline GW)
  - 5km radial search
  - OGC, Accumap, GeoScout, BC Water Resources Atlas website, BC MOE WELLS database, EAO

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# 3. Local Description Setting…

- Interpreted Site Geology
  - Drilling records, logs, maps…
- Source/disposal well completion/integrity testing
  - Loss of circulation incidents
  - Cement returns
  - Cement bond logs
  - Pressure integrity/leakoff testing
  - Casing vent monitoring

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# …3. Local Setting Description

- Hydrogeological Testing
  - Drill stem or swab tests
  - Injection tests
  - Pumping tests
  - Other data (temperature, tracer…)
  - Aquifer/reservoir monitoring data
  - GW flow/reservoir modeling (Guidance document, BC MOE)
- GW quality assessment

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# 4. Potential Adverse Effects Assessment from GW Extraction

- Potential hydraulic connection with shallow water resources – assessment and interpretation
  - Geological evidence (aquifer/aquiclude)
  - Pressure head/water levels
  - Water quality
  - Well integrity and isolation
  - Monitoring/operational data
- Water source well/aquifer capacity assessment
  - Long-term well capacity predictions
- Potential impact analysis
  - Predicted drawdown effects to users within 5km
  - Effects of mixing on water quality

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# 5. Proposed Monitoring Program

*"…to obtain additional data to verify performance of aquifer and confirm lack of hydraulic connection with overlying shallow aquifers and lack of impacts to other users."*

- Monitoring wells
- Water extraction and levels
- Water quality
- Proposed Monitoring Reporting

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# 6. Adaptive Management/Mitigation Plan

- Monitoring data to set baseline GW data
- Threshold based triggers developed in discussion with EAO
- Review and revision of approach as more data collected
- Mitigation plan – recommend operational changes of mitigative actions that could be undertaken based on anticipated risks for an adverse effect that was not predicted

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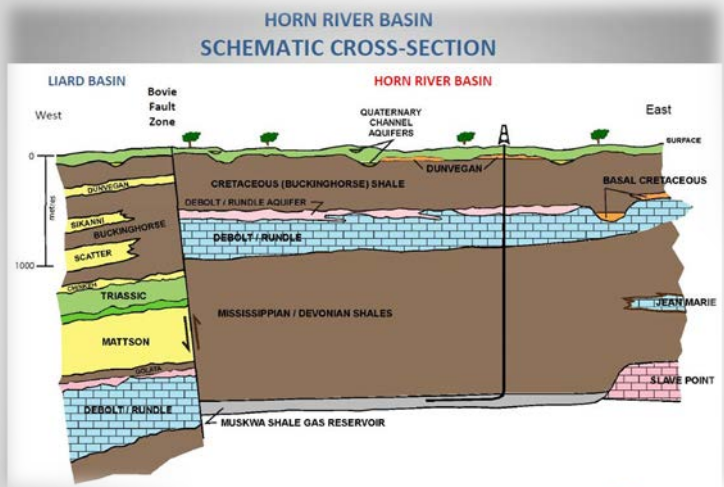
# (Shhhh…Debolt Formation…Aside…)

- Confined karstic limestone aquifer
- 600-900 mbgl
- Regionally isolated from surficial aquifers by thick Cretaceous shale deposits
- TDS >15,000-<40,000 mg/L
- H2S may be >100 mg/L

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# In Summary

- If you want to use saline Debolt Water for shale gas:
  - <6,500 $m^3/d$ – Well permit, OGC
  - >6,500 $m^3/d$ – Reviewable Project, BC EAO
    - Follow steps from this presentation to apply for an EA exemption to show no adverse effects expected
- New BC GW Regulations expected in 2014 and beyond to manage groundwater in BC and take the confusion out of needs

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# Questions?

Thank You!!



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