Responsible Development in Alberta: 

*Hydraulic Fracturing*

January 2014

*Alberta Environment and Sustainable Resource Development*
Outline

• Context

• Evolving Management Approach

• Engaging Albertans

• Policy Direction
Albertans demand a healthy environment
Table 1. Summary of estimates of Alberta shale- and siltstone-hosted hydrocarbon resource endowment.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Adsorbed Gas Content %*</th>
<th>Natural Gas (Tcf)</th>
<th>Natural-Gas Liquids (billion bbl)</th>
<th>Oil (billion bbl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duvernay P50</td>
<td>6.8</td>
<td>443</td>
<td>11.3</td>
<td>61.7</td>
</tr>
<tr>
<td>Duvernay P90–P10</td>
<td>5.6–8.5</td>
<td>353–540</td>
<td>7.5–16.3</td>
<td>44.1–82.9</td>
</tr>
<tr>
<td>Muskwa P50</td>
<td>6.9</td>
<td>419</td>
<td>14.8</td>
<td>115.1</td>
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<tr>
<td>Muskwa P90–P10</td>
<td>4.1–10.5</td>
<td>289–527</td>
<td>6.0–26.3</td>
<td>74.8–159.9</td>
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<tr>
<td>Montney P50</td>
<td>17.7</td>
<td>2133</td>
<td>28.9</td>
<td>136.3</td>
</tr>
<tr>
<td>Montney P90–P10</td>
<td>10.8–26.0</td>
<td>1630–2828</td>
<td>11.7–54.4</td>
<td>78.6–220.5</td>
</tr>
<tr>
<td>Basal Banff/Exshaw P50</td>
<td>5.7</td>
<td>35</td>
<td>0.092</td>
<td>24.8</td>
</tr>
<tr>
<td>(preliminary data; see Section 5.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basal Banff/Exshaw P90–P10</td>
<td>3.2–10.0</td>
<td>16–70</td>
<td>0.034–0.217</td>
<td>9.0–44.9</td>
</tr>
<tr>
<td>North Nordegg P50</td>
<td>18.2</td>
<td>148</td>
<td>1.4</td>
<td>37.8</td>
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<tr>
<td>(preliminary data; see Section 5.1)</td>
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<td></td>
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</tr>
<tr>
<td>North Nordegg P90–P10</td>
<td>4.6–34.8</td>
<td>70–281</td>
<td>0.487–3.5</td>
<td>19.9–66.4</td>
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<tr>
<td>Wilrich P50 (preliminary data; see Section 5.1)</td>
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<tr>
<td>Wilrich P90–P10</td>
<td>33.7</td>
<td>246</td>
<td>2.1</td>
<td>47.9</td>
</tr>
<tr>
<td>Total P50 (medium estimate) resource endowment</td>
<td>n/a</td>
<td>3424</td>
<td>58.6</td>
<td>423.6</td>
</tr>
</tbody>
</table>

* The percentage of adsorbed gas represents the portion of natural gas that is stored as adsorbed gas.
Oil and Gas Regulatory Framework

- Assessment / Evaluation / Approval
- Monitoring / Research / Abatement / Enforcement
- Standards Objectives Guidelines Criteria

Air, Water, Land, Biodiversity

Dispute Resolution
Decommissioning / Reclamation
Regulatory Experience

• +70 years of regulatory experience
• Staff of +900
• Regulates
  – 176,000 oil and gas wells
  – 400,000 km of pipelines
  – 955 gas processing plants
  – 8 oil sands mines
  – 53 in situ oil sands projects
  – 5 upgraders
  – 12 coal mines

• Ongoing surveillance
  – About 100 inspections of oil sands mines in 2011, typically lasting several days
  – Conducted more than 3,000 inspections of in situ facility components in 2011

• Compliance with major AER regulations was 98.6% in 2009

• Penalties for non-compliance
  – Immediate shut down of facilities until operator shows problem can not occur again
Confluence of Priorities

License To Operate

Social
- Quality of life
- Population growth / interface with development

Environment
- Lower footprint
- Increased transparency
- Water

Economy
- Resource economy
- Value add
- Economic recovery

Energy
- Growing demand for oil and gas
- Desire for alternatives (clean gas)

Government of Alberta
The [Water] Policy Challenge

Figure 4.3

Paul Pross's diagram of the policy community

- Foreign governments
- Other federal agencies
- Individuals
- Major pressure groups
- Other pressure groups
- Other provincial governments
- Key provincial governments
- Cabinet and central policy structures
- Lead agency
- The attentive public
- Parliament

Integrated Resource Management

• The IRM System is the means by which Alberta will achieve **responsible resource stewardship**.

• The System is broadly defined, incorporating the management, conservation and wise use of all resources.

• It is founded upon principles of cumulative effects management:
  - Knowledge based
  - Outcomes driven
  - Future focused
  - Comprehensive implementation
  - Place based flexibility
  - Collaboration
  - Adaptation and Continuous Improvement
Integrated Resource Management

IRMS Functions

- Strategic Intent
- Knowledge & Informatics
- Setting Outcomes Policies / Plans
- Policy Assurance
- Performance Evaluation Reporting

Flow arrows indicate continuous improvement and adaptation.
Land-use Framework

• Blueprint for land-use, natural resource management, and decision-making to manage growth
• Seven regions based major provincial watersheds
• Sustains growing economy while balancing social and environmental goals
  − Considers the cumulative effects of all activities
  − Legally enforceable
  − Subject to regular reviews
  − Incorporates significant public feedback gathered through extensive consultation
Management Frameworks

- Key approach to manage the long term cumulative effects of development on the environment at a regional level
- Limits are clear boundaries in the system not to be exceeded, triggers are proactive warning signals
- Progressive action based on conditions found in the environment

**Indicators, Triggers and Limits**
- Indicators are chosen
- Triggers & limits are set

**Monitoring and Modelling**
- Ongoing monitoring and assessment of conditions relative to triggers & limits

**Management Response and Reporting**
- Management actions taken as needed at triggers & limits
- Results reported
<table>
<thead>
<tr>
<th>General Indicator</th>
<th>Water Quality Triggers</th>
<th>Water Quality Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Peak</td>
</tr>
<tr>
<td>Calcium (Ca(^{2+}))</td>
<td>34.7</td>
<td>48.8</td>
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<tr>
<td>Chloride (Cl(^-))</td>
<td>20.2</td>
<td>45.0</td>
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<tr>
<td>Magnesium (Mg(^+))</td>
<td>9.5</td>
<td>13.6</td>
</tr>
<tr>
<td>Potassium (K(^+))</td>
<td>1.4</td>
<td>2.1</td>
</tr>
<tr>
<td>Sodium (Na(^+))</td>
<td>21.4</td>
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<tr>
<td>Sulphate (SO(_4^{2-}))</td>
<td>26.7</td>
<td></td>
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<tr>
<td>Total Dissolved Phosphorus (TDP)</td>
<td>0.016</td>
<td></td>
</tr>
<tr>
<td>Total Phosphorus (TP)</td>
<td>0.073</td>
<td></td>
</tr>
<tr>
<td>Nitrate (NO(_3^-)-N)</td>
<td>0.092</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Management Intent</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Exceedance of water quality limits</td>
<td>Improve ambient water quality to below limits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Limit</strong></td>
</tr>
<tr>
<td>2</td>
<td>Exceedance of water quality triggers</td>
<td>Proactively maintain water quality below limits. Improve knowledge and understanding of trends.</td>
</tr>
<tr>
<td>1</td>
<td>Mean and peak water quality at or better than historical conditions</td>
<td>Apply standard regulatory and non-regulatory approaches to manage water quality.</td>
</tr>
</tbody>
</table>
Provincial Water Demand

Sectoral Water Allocations Index

Government of Alberta
Water Legislation and Strategy

Water Act and EPEA

• Regulates the use of water, and activities within and near waterbodies
• Provision for Water Management Planning--limits on the amount of water withdrawn from surface and groundwater sources
• EPEA dictates water quality limits for designated activities (point sources)

Water for Life Strategy

• Three goals: Safe, secure drinking water supply, Healthy aquatic ecosystems, Reliable, quality water supplies for a sustainable economy
• Three key directions: Knowledge and research, Partnerships, Water conservation
Hydraulic Fracturing in Alberta

- Decades of experience with development
  - 171,000+ wells drilled with hydraulic fracturing since 1950s
  - 6000+ horizontal wells to date (tight oil, shale gas and liquids)
- Measures in place to protect groundwater
  - Base of Groundwater Protection
- Deep well injection of waste
  - Not into surface water
Water Allocation in Alberta

2010 Total Water Allocation: 2.6 trillion gallons (US)

From State of the Environment (AESRD)
Water Use

• Access to water is typically temporary diversion licenses

• Must meet key criteria
  – availability, no significant impact to other users, or the environment

• Additional requirements depending on geographic location

• No return (disposal)
# Current Operating Requirements

<table>
<thead>
<tr>
<th>Management Areas</th>
<th>Current Legislation, Directive or Guideline relating to Fracturing</th>
<th>Regulatory Body</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site Characterization and Planning</strong></td>
<td>Oil and Gas Conservation Act and Regulations</td>
<td>Alberta Energy</td>
</tr>
<tr>
<td></td>
<td>Directive 056: Energy Development Applications</td>
<td>AER</td>
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<tr>
<td></td>
<td>Provincial Groundwater Inventory Program</td>
<td>ESRD</td>
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<tr>
<td><strong>Well Construction</strong></td>
<td>Directive 008: Surface Casing Depth Requirements</td>
<td>AER</td>
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<tr>
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<td>Directive 009: Casing Cementing Minimum Requirements</td>
<td>AER</td>
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<tr>
<td><strong>Operating &amp; Monitoring Requirements</strong></td>
<td>Directive 036: Drilling Blowout Prevention Requirements and Procedures</td>
<td>AER</td>
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<tr>
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<td>Directive 038: Noise Control</td>
<td>AER</td>
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<td>Directive 044: Requirements for the Surveillance of Water Production in Oil and Gas Wells</td>
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<tr>
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<td>Directive 050: Drilling Waste Management</td>
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<td>Directive 027: Shallow Fracturing Operations-Restricted Operations</td>
<td>AER</td>
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<td>Directive 035: Baseline Water Testing Requirements for Coalbed Methane Wells</td>
<td>AER</td>
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<tr>
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<td>Directive 051: Injection and Disposal Wells - Well Classifications, Completions, Logging, and Testing</td>
<td>AER</td>
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<tr>
<td></td>
<td>Directive 059: Well Drilling &amp; Completion Data Filing Requirements</td>
<td>AER</td>
</tr>
<tr>
<td></td>
<td>Collection and Reporting of Fracture Fluids</td>
<td>AER</td>
</tr>
<tr>
<td><strong>Water Use, Wastewater / Waste Handling</strong></td>
<td>Environmental Protection and Enhancement Act – water use, re-use and discharge (none)</td>
<td>ESRD</td>
</tr>
<tr>
<td></td>
<td>Water Act – water use (and water impacts)</td>
<td>ESRD</td>
</tr>
<tr>
<td></td>
<td>Directive 055: Storage Requirements for the Upstream Petroleum Industry</td>
<td>AER</td>
</tr>
<tr>
<td></td>
<td>Directive 058: Oilfield Waste Management Requirements for the Upstream Petroleum Industry</td>
<td>AER</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Directive 020: Well Abandonment</td>
<td>AER</td>
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<tr>
<td></td>
<td>Remediation Certificate Regulation</td>
<td>ESRD</td>
</tr>
<tr>
<td></td>
<td>Alberta Tier I and Tier II Soil and Groundwater Remediation Guidelines</td>
<td>ESRD</td>
</tr>
</tbody>
</table>
Groundwater Mapping

Total Wells: 215,816

Edmonton-Calgary Corridor Groundwater Inventory Airborne Resistivity Survey Coverage
Alberta Water Nexus

Prosperity: Then -- Rationalize

Communities (people)

Prosperity: Now -- Optimize

Healthy Ecosystems

Increasing Pressures, Risk → Water Ethic

Prosperity: Future -- Prioritize

Agriculture (food)

Energy (oil and gas)
The Water Conversation

Healthy Lakes, Hydraulic Fracturing, Drinking Water/wastewater, Water Management

To Do List
✓ CEP Part 1
✓ Reporting
☐ Water Allocation
☐ Storage
☐ Economic Tools
☐ Wetlands
☐ Etc

Water Act
EPEA
Water For Life
ENABLING RULES

BLUEPRINT
[Water Conversation]

WHAT

DIRECTION

Thinking for the next 50 Years

HOW

Doing for the next 50 Years

Increasing degree of relevance / connection to individuals

Government of Alberta
Longer Term Vision (5 years+)

- Healthy Lakes
  - Fully implement a provincial lakes framework including clarified roles, responsibilities, and a decision-making system

- Hydraulic Fracturing and Water
  - Adopt play-based and regional approaches to hydraulic fracturing providing assurance that water supply and quality is safe and secure

- Drinking Water and Wastewater
  - Develop options for provincial level governance and funding schemes that will continue to respect regional differences and allow for flexibility

- Water Management
  - Optimize the water management system by taking actions on the water demand and supply sides, clarifying governance, and providing overall system clarity
By the Numbers:

- 44 sessions
- 20 locations
- 11 Watersheds
- Attended by over 1,300 Albertans
- 650 Surveys submitted
- Over 200 alternative submissions
- Hundreds of pages of discussion summaries
- Thousands of stories
Hydraulic Fracturing and Water

- Need to **raise public awareness** and understanding about hydraulic fracturing and relationship to water
- Groundwater protection critical - **more mapping** needed
- Establish policies to **limit/prohibit use of fresh water**
- Enhance rules around **well bore integrity**
- Strict **controls for chemical storage**, use and disposal
- **Baseline water testing** before operations commence
- **Document data** and results of drilling using fracturing
- Consider **surface effects** of heavy equipment used in fracturing - impacts on soil, etc.
- **Play-based** and regional approaches should be used
- **Consistently enforce regulations**, capacity enhancements here might be needed
- **Resolve conflicts in policies** regarding natural resource development and water management
Hydraulic Fracturing – Initial Theme Analysis

- Fresh water conservation
- Need for more public education about hydraulic fracturing and current regulations in place to manage it
- Groundwater/water well protection
- Increased monitoring and reporting
- Increased compliance and enforcement

Stakeholder Support (0-10)

GOA Internal Capacity to Act (0-10)

Perceived Level of Public Knowledge/Understanding (0-10)
ST – Hydraulic Fracturing and Water

• Develop a policy guideline setting out water conservation practices expected from upstream oil and gas industry

• Develop and implement science-based standards for baseline water well testing near fracturing operations

• Provide balanced and credible information on how Alberta manages hydraulic fracturing
Unconventional Oil and Gas

• Dispersed on the landscape
  – No set ‘region’

• Multiple players
  – Includes service elements

• Range of impacts on the land
  – Some focused and accumulated (air, noise, footprint)
  – Others dispersed (source of water, waste management, truck traffic)

• Social dynamic
Responsible Development Challenges

• Water protection and management
  – Reporting, recycling, water well / aquifer distances

• Containment
  – Fluids, waste handling, casing

• Communication
  – Offset well management

• Surface infrastructure planning and cumulative effects

— AER Hydraulic Fracturing Directive
Additional Response Areas

Water Use and Source
  – Expanded Water Conservation for all Oil and Gas

Transparency and Assurance
  – Expanded Baseline Water Well Testing
  – Disclosure of fluids
  – Information portals (volume and source)

Cumulative Effects Management
  – Unconventional Regulatory Framework, play-based management approach)
Relative Proportion of Source Water Types Over Time
1973-2012*

Percent of Total Volume of Water Injected

- Blue: Non-Saline and Fresh
- Orange: Saline Groundwater

Year

*Data Source: Alberta Energy Resources Conservation Board (ERCB). Chart produced by Water Policy Branch, Alberta ESRD.
Oil Sands Information Portal
Sub-Regional Authorization

- Plays defined by geology, resource and technology
- Cumulative effects management within a play
- Collaboration amongst operators is key
- Initial focus on hot spots
Closing Comments

• Growing demand for energy must be reconciled with...
  – Move to unconventional resource base
  – Desire for cleaner alternatives
  – Social awareness and expectations

• Alberta experience demonstrates that...
  – Unconventional resources can be developed responsibly
  – Requires a robust regulatory regime including strong backstops

• Further development will require...
  – Transparency of experience (positive and negative)
  – Meaningful engagement with citizens
  – New management approaches to address intensity and scope of impacts
  – Collaboration across developers
  – Shared, independent, state of science, risks, etc.